



DLR Group

Architecture
Engineering
Planning
Interiors

**Aqua Waikiki Wave
Building Package
For Review – NOT FOR CONSTRUCTION
Specifications
Honolulu, Hawaii**

DLR Group Project No. 34-14102-00

January 9, 2015

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Project Manual

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DLR Group Project No. 34-14102-00

January 9, 2015

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Architecture Engineering Planning Interiors
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END OF SECTION 000100

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I hereby certify that this specification was prepared by me or under my direct supervision
and that I am a duly Licensed Architect under the laws of the State of Hawaii.

License No.

I hereby certify that this specification was prepared by me or under my direct supervision
and that I am a duly Licensed Professional Engineer under the laws of the State of Hawaii.

License No.

I hereby certify that this specification was prepared by me or under my direct supervision
and that I am a duly Licensed Professional Engineer under the laws of the State of Hawaii.

License No.

END OF SECTION 000105

PHILPOTTS						
INTERIORS						
ITEM	CODE	MFR	MATERIAL	COLOR	SIZE	FINISH
ENTRY DOOR (INTERIOR FINISH)	FOR SUITES 409/415	BY CONTRACTOR	FIRE RATED	BLEACHED WALNUT	BY ARCHITECT	SEMI-GLOSS FINISH
ENTRY DOOR (INTERIOR CASING FINISH)	KRISTIE	PAINT	PAINTED TO MATCH BLEACHED WALNUT	BY ARCHITECT	SEMI-GLOSS	BY CONTRACTOR
ENTRY DOOR (INTERIOR FINISH) OPTION	FOR 408	BY CONTRACTOR	FIRE RATED	PAINTED EXTRA WHITE	BY ARCHITECT	SEMI-GLOSS
ENTRY DOOR TRIM	PT-5	SHERWIN WILLIAMS	PAINT	EXTRA WHITE	BY ARCHITECT	SEMI-GLOSS
FLOORING	CT-1	TILE WAREHOUSE DEBBIE CARELLI 808-683-9323	SUGARCANE PORCELAIN PLANK - HAVANA	WHITE	6" X 24" x 3/8" THICK	NA
BASEBOARD	RB-1	JOHNSONITE	RESILIENT	MW-01-F 27-MIST	4 INCH	MILLWORK- REVEAL PROFILE
WALLS	PT-1	SHERWIN WILLIAMS	PAINT	EXTRA WHITE	NA	EGG SHELL
CEILING	PT-2	SHERWIN WILLIAMS	PAINT	EXTRA WHITE	NA	MATTE

PHILPOTTS						
INTERIORS						
ITEM	CODE	MFN	MATERIAL	COLOR	SIZE	FINISH
CLOSET						
CLOSET DOOR HARDWARE	HW-1	RECESSED CUP PULL	BRUSHED SS	SS	3X6	BRUSHED
REFRIGERATOR DOOR HARDWARE	SEE PFFE SPECS	NA	NA	NA	NA	OFCI
FLOORING	CT-1	TILE WAREHOUSE DEBBIE CARELLI 808-583-9323	SUGARCANE PORCELAIN PLANK- HAVANA	WHITE	6" X 24" X 3/8" THICK	NA
BASEBOARD	RB-1	JOHNSONITE RESILIENT	MW-01-F 27-MIST	4 INCH	MILLWORK- REVEAL PROFILE	BY CONTRACTOR
WALLS	PT-1	SHERWIN WILLIAMS PAINT	EXTRA WHITE	NA	EGG SHELL	BY CONTRACTOR
ROD/SHELF	AA-2	PA SUPPLIER	VINYL COATED METAL	WHITE	SEE DRAWINGS	NA
CEILING	PT-2	SHERWIN WILLIAMS PAINT	EXTRA WHITE	NA	MATTE	BY CONTRACTOR

PHILPOTTS						
INTERIORS						
ITEM	CODE	MFR	MATERIAL	COLOR	SIZE	FINISH
COUNTER FOR COFFEE APPLIANCE	ST-1	DAL-TILE Malia Moldanado 808-523-3660	VANITY ONE QUARTZ TOP NO9 WOVEN WOOL LEATHER FINISH	NA	NA	NA FFE-22 OCT 14 MEETING TRANSFER THIS ITEM FROM CONTRACTOR'S SCOPE TO FFE
COUNTER FOR COFFEE APPLIANCE	ST-1A OPTION KK ROOM	DAL-TILE Malia Moldanado 808-523-3660	VANITY ONE QUARTZ TOP NQ30 MORNING FROST POLISHED FINISH	NA	NA	BY CONTRACTOR
CABINETRY	WD-1	NA	BLEACHED WALNUT	NA	NA	BY CONTRACTOR NA
BATHROOM	CT-1	TILE WAREHOUSE DEBBIE CARELLI 808-683-9323	SUGARCANE PORCELAIN PLANK-HAVANA	WHITE THK	6" X 24" X 3/8"	NA BY CONTRACTOR, JOINT PER MANUFACTURER RECOMMENDATION, SLIP RESISTANT
BASEBOARD	CT-1	TILE WAREHOUSE DEBBIE CARELLI 808-683-9323	SUGARCANE PORCELAIN PLANK-HAVANA	WHITE	3" X 24" X 3/8" BULLNOSE TOP EDGE	NA BY CONTRACTOR, JOINT PER MANUFACTURER RECOMMENDATION, SLIP RESISTANT

PHILPOTTS							INTERIORS	
ITEM	CODE	MFR	MATERIAL	COLOR	SIZE	FINISH	NOTES	IMAGE
WALLS	PT-3	SHERWIN WILLIAMS	PAINT	EXTRA WHITE	NA	EGG SHELL	BY CONTRACTOR	
WALLCOVERING BEHIND TOILET	SEE PFFE SPECS	NA	NA	NA	NA	NA	NA	OFCL
CEILING	PT-4	SHERWIN WILLIAMS	PAINT	EXTRA WHITE	NA	MATTE	BY CONTRACTOR	
VANITY COUNTERTOP	SEE PFFE SPECS	NA	NA	NA	NA	NA	UNIT IS OFCL	
VANITY CABINETRY	SEE PFFE SPECS	NA	NA	NA	NA	NA	UNIT IS OFCL - CONTRACTOR SHALL CLEAT UNIT TO WALL FOR STABILITY	
SHOWER DOORS	GL-1	MINCEY MARBLE AREZZO SERIES ARZBP6075BAL 10M BYPASS	NA	NA	60"-2 DOOR BOTH MOVING FROSTED GLASS 3/8" THICK WITH TOWEL BAR HANDLE MOUNTS THRU GLASS	POLISHED SS- 315 BRUSHED ALUMINUM- 308 POLISHED ALUMINUM 309	BY CONTRACTOR	

PHILPOTTS						
INTERIORS						
ITEM	CODE	MFR	MATERIAL	COLOR	SIZE	FINISH
SHOWER PRE-FAB PAN AND DRAIN	PFP-1	MINCEY MARBLE PREFAB 36X60 SHOWER PAN	308-#2250 SOLID WHITE 309-#895 LINEN GRANITE 315-#410 WHITE SILK-TEXTURED ALL IN MATTE FINISH	NA	NA	308-SS GRATE 309-SOLID GRATE 315-SOLID GRATE
SHOWER WALL FIELD	CT-2	ARIZONA TILE ED AHRENS 562-89E-2832	TOUCH GLOW-TILE	NA	12"W X 24"L X 1/4" THK. WITH BULLNOSE EDGE ON LAST OUTSIDE COURSE	TOUCH, RECTIFIED GLAZED PORCELAIN
SOAP DISH	SS-1 FOR SUITE	NA	SILESTONE 3/4" THICK. MATCH VANITY ONE QUARTZ TOP NO09 WOVEN WOOL LEATHER FINISH 1/8" - 45 DEGREE BEVELED EDGE	NA	NA	BY CONTRACTOR

AQUA WAIKIKI WAVE
BUILDING PACKAGE

34-14102-00
FOR REVIEW - NOT FOR CONSTRUCTION

PHILPOTTS						
INTERIORS						
ITEM	CODE	MFR	MATERIAL	COLOR	SIZE	FINISH
SOAP DISH	SS-1A OPTION FOR 308	NA	SILESTONE ORANGE COOL 3/4" THICK. 1/8"-45 DEGREE BEVELED EDGE	NA	NA	NA
SHOWER WALL ACCENT	CT-3	BRIOT BLEND HIGHLAND GLASS MOSAIC TILE	MULTI-COLOR MOSAIC MIX	NA	NA	NA
BEDROOM						
FLOORING	CARPET- SEE PI FFE SPEC'S	NA	NA	NA	NA	NA
BASEBOARD	RB-1	JOHNSONITE	RESILIENT	M/W-01-F 27-MIST	4 INCH	MILLWORK- REVEAL PROFILE
WALLS	PT-1	SHERWIN WILLIAMS	PAINT	EXTRA WHITE	NA	EGG SHELL
CEILING	PT-2	SHERWIN WILLIAMS	PAINT	EXTRA WHITE	NA	MATTE
7.5X3/4 DRAPEY VALENCE	PT-1A	SHERWIN WILLIAMS	PAINT	EXTRA WHITE	NA	SEMI-GLOSS

PHILPOTTS						
INTERIORS						
ITEM	CODE	MFR	MATERIAL	COLOR	SIZE	FINISH
CROWN MOLDING 1/2X1/2 QUARTER ROUND	PT-1A	SHERWIN WILLIAMS	PAINT	EXTRA WHITE	NA	SEMI-GLOSS
WALL COVERING AT HEAD-BOARD WALL	SEE PI FFE SPECs	NA	NA	NA	NA	OFCL
LANAI						
FLOORING	DLR SPECs	NA	SEE DLR DRAWING	NA	NA	COLOR ONLY, BY CONTRACTOR
RAILING	DLR SPECs	NA	SEE DLR DRAWING	NA	NA	COLOR ONLY, BY CONTRACTOR
CEILING	DLR SPECs	NA	SEE DLR DRAWING	NA	NA	COLOR ONLY, BY CONTRACTOR
GUESTROOM/CORRIDOR						
FLOORING	SEE PI FFE SPECs	NA	NA	NA	NA	OFCL
BASEBOARD	RB-1	JOHNSONITE	RESILIENT	MW-01-F 27-MIST	4 INCH	MILLWORK- REVEAL PROFILE
WALLS	PT-100	SHERWIN WILLIAMS	PAINT	EXTRA WHITE	NA	EGG SHELL
ELEVATOR ACCENT WALL	RE: SHEET A-201	NA	SEE DLR DRAWING	NA	NA	BY CONTRACTOR

HEAVY COLORATION IS
ON THE ELEVATOR BANK
SIDE WALL SEE
RENDERING



PHILPOTTS INTERIORS						
ITEM	CODE	MFR	MATERIAL	COLOR	SIZE	FINISH
ELEVATOR HOISTWAY CASING	PT-101	SHERWIN WILLIAMS	PAINT-METAL PAINT	TURQUOISE		BY CONTRACTOR
CEILING	PT-200	SHERWIN WILLIAMS	PAINT	EXTRA WHITE	NA	MATTE BY CONTRACTOR
ELEVATOR ACCENT CEILING	PT-201	SHERWIN WILLIAMS	PAINT	EXTRA WHITE	NA	MATTE BY CONTRACTOR
DOOR NUMBER GRAPHIC	GR-100	NA	BY GRAPHIC DESIGNER	NA	NA	OFCI SEE DRAWING
DECORATIVE LIGHT FIXTURE	SEE PFFE SPECS	NA	AN	NA	NA	OFCI UPSE POWER POINT IMAGE PROVIDED; FINISH MATERIALS BY ROCKBRIDGE NA

AQUA WAIKIKI WAVE
BUILDING PACKAGE

34-14102-00
FOR REVIEW - NOT FOR CONSTRUCTION

END OF SECTION 001000

PROJECT: Waikiki Wave
SUBJECT: Public Area Interior Finish Schedule
PHASE: CD
ARCHITECT: DLR Group
INTERIORS: PHILPOTTS INTERIORS
DATE: 8-Dec-14

PHILPOTTS
INTERIORS

CODE	IMAGE	SIZE	MATERIAL	SPECIFICATIONS	NOTES	SOURCE	LOCATIONS
CC-1	EXISTING CONCRETE FLOOR		BY DLR				
CPT-1			CARPET	STYLE: NW985-2532 REPEAT: 24" X 18" COLOR: CUSTOM YARN - A: A3702/3710 B: A1069/A720		NORTHWEST 3399 CARPET CAPITAL DR. DALTON, GEORGIA 30720 (800) 367-2508 FAX: (706) 277-7485	
CPT-4			AREA RUG				
CPTT-1	TBS	18X18	CARPET TILES			JALENE	
CT-4		12X24X1/4	HAVANA - SUGARCANE -PORCELAIN PLANK	\$4 SQ. FT. ALLOWANCE	MEETS ADA SLIP RESISTANCE FOR FLOOR	TILE WAREHOUSE DEBBIE CARELLI (808) 683-9323	FLOORS AND WAINSCOT
CT-5		18X18X?	CERAMIC TILE/CONCRETE TILE	PATTERN: MAJORELLE		ANN SAKS	244
GL-2	TBS		BIZZAZA GLASS TILE				244 BOTTLE DISPLAY
GL-3	EXTERIOR RAILING		BY DLR				
GL-4	BAR BUBBLE GLASS TOP						
PLAM-1	TBS		PIONITE			ASI	
PLAS-1	TBS		ARMOUR COAT			GREG ENDO (808) 979-5555 1253 S. BERETANIA ST. #2425 HONOLULU, HI 96814 PACIFICSOURCING.COM	
PT-X		MATTE				CONTRACTOR	
PT-X		EGGSHELL				CONTRACTOR	
PT-X		SEMITLOSS				CONTRACTOR	

PROJECT: Waikiki Wave
SUBJECT: Public Area Interior Finish Schedule
PHASE: CD
ARCHITECT: DLR Group
INTERIORS: PHILPOTTS INTERIORS
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PHILPOTTS
INTERIORS

CODE	IMAGE	SIZE	MATERIAL	SPECIFICATIONS	NOTES	SOURCE	LOCATIONS
PT-X		HI GLOSS				CONTRACTOR	
RB-1		SAME AS GUESTROOM 4.25" H X .25" D	JOHNSONITE MILLWORK-REVEAL PROFILE MW-01-F SNOW WHITE			ASI	
RB-2		AT VCT	JOHNSONITE RECESSED WALL BASE 27-MIST			ASI	
SS-1			QUARTZ	ONE QUARTZ SURFACES NQ09: WOVEN WOOL - LEATHER		DALTILE 1200 NIMITZ HWY. HONOLULU, HI 96817 CONTACT: MALIA Maldonado (808) 523-3660	107,108
ST-1		24X24X3/8	MOONSOON BRUSHED TRAVERTINE		MEETS ADA SLIP RESISTANCE FOR FLOOR	TEXTURE INC CAMRON LEAO 808-294-8833	243
ST-2		24X24X3/8	MOONSOON LAPAZ HONED TRAVERTINE			TEXTURE INC CAMRON LEAO 808-294-8833	201,206,241,207,210,000,000
ST-3		12X12X3/4	SANDSTONE CARVED DECO TILE			TEXTURE INC CAMRON LEAO 808-294-8833	202
ST-4		24X24X3/4	PACIFIC BASALT FLAMED		MEETS ADA SLIP RESISTANCE FOR FLOOR	BELLA PIETRA 701 N. NIMITZ HWY. HONOLULU, HI 96817 (808) 587-7779 LAYLA DEDRICK LAYLA@BELLAPIETRA.CO M (808) 220-4119	
ST-5	TBS	VARIESX3CM	PUKA LAVA		VERIFY	BELLA PIETRA 701 N. NIMITZ HWY. HONOLULU, HI 96817 (808) 587-7779 LAYLA DEDRICK LAYLA@BELLAPIETRA.CO M (808) 220-4119	
DLR			STAMPED CONCRETE				DRIVEWAY
ST-6		3D-VERIFY SIZE	3D TRAVERTINE			TEXTURE INC CAMRON LEAO 808-294-8833	201,205
VCT-1	TBS	12X12	VINYL COMPOSITION TILE		MEETS ADA SLIP RESISTANCE FOR FLOOR	ASI	121,122,111,114,108,000,000
WC-3			DECOWALLCOVERING			ZAK + FOX 611 BROADWAY SUITE NEW YORK, NY 10012	
WD-2		VERIFY	EXTERIOR TEAK SOLIDS WITH PROTECTIVE COATING			INDO TEAK	L2 EXTERIOR
WD-3		VERIFY	EXTERIOR IPE PLANK DECKING		MEETS ADA SLIP RESISTANCE FOR FLOOR	KAHALA FLOORING	215,243 PORTION

PROJECT: Waikiki Wave
SUBJECT: Public Area Interior Finish Schedule
PHASE: CD
ARCHITECT: DLR Group
INTERIORS: PHILPOTTS INTERIORS
DATE: 8-Dec-14

PHILPOTTS
INTERIORS

CODE	IMAGE	SIZE	MATERIAL	SPECIFICATIONS	NOTES	SOURCE	LOCATIONS
WD-4		NOT USED					
WD-5			INTERIOR TEAK QUARTERSAWN WITH CLEARCOAT		MATTE FINISH	INDO TEAK	202,
WD-5A			INTERIOR TEAK PLAIN SAWN WITH CLEARCOAT 100% RECYCLED TEAK		MATTE FINISH	INDO TEAK	207
WD-5B		6" WIDE PLANK	INTERIOR TEAK ENGINEERED FLOORING 100% RECYCLED TEAK		MATTE FINISH	INDO TEAK	207,241
WD-6		2" THICK TRUNK SLAB	HAWAIIAN MONKEYPOD		MATTE FINISH	PAL	244
WD-7		NOT USED					

PHILPOTTS						
INTERIORS						
ITEM	CODE	MFR	DESCRIPTION	COLOR	SIZE	FINISH
BATHROOM SINK	PL-1	KOHLER	LADENA	WHITE	20-7/8" x 14-3/8" x 8-1/8"	NA
P-TRAP	PL-1A	KOHLER	ADJUSTABLE P-TRAP WITH TUBING OUTLET	BRUSHED CHROME	1-1/4" x 1-1/4"	POLISHED CHROME- 309/315 BRUSHED NICKEL- 308
LAVATORY FAUCET	PL-2	ROHL	Rohl Wave 3-Hole Deck Mounted Widespread Lavatory Faucet with Lever Handles #WA105L-WG Flow rate: 1.5 gpm	NA	10" SPREAD	POLISHED CHROME- 309/315 BRUSHED NICKEL- 308
LAVATORY FAUCET-KK ROOM OPTION	PL-2A	HANSGROHE	SINGLE HOLE METRIS S 31060001	NA	CENTER ON SINK	POLISHED CHROME- 309/315 BRUSHED NICKEL- 308
TOILET	PL-3	KOHLER	Kohler Persuade Circ K-3753-0 List: \$482.45	WHITE	NA	BRUSHED CHROME BUTTON

PHILPOTTS INTERIORS						
ITEM	CODE	MFR	DESCRIPTION	COLOR	SIZE	FINISH
HAND HELD SHOWER AND PIPE	PL-4	HANSGROHE	Hansgrohe Raindance E Wallbar Set, 36" Art. No. 27874001 List: 669.00 Flow rate: 2.5 GPM HOSE LENGTH 80 INCH	NA	NA	POLISHED CHROME-309/315 BRUSHED NICKEL 308
PRESSURE BALANCE CONTROL	PL-5	HANSGROHE	Hansgrohe Ecostat – S Pressure Balance Trim Art. No. 04233000 List: 174.00 Flow: 5.8 GPM	NA	NA	POLISHED CHROME-309/315 BRUSHED NICKEL 308
DIVERTER VALVE	PL-6	HANSGROHE	HANSGROHE WALL OUTLET W/ CHECK VALVES ART. NO. 27458003	NA	NA	POLISHED CHROME-309/315 BRUSHED NICKEL 308
UMBRELLA LAVATORY DRAIN	PL-7	NA	Fixed Umbrella Lavatory drain Finish to match faucet	NA	NA	POLISHED CHROME-309/315 BRUSHED NICKEL 308
VANITY MIRROR	SEE PI FINISHED SPECS					
MAKE UP MIRROR	SEE PI FINISHED SPECS					

PHILPOTTS INTERIORS						
ITEM	CODE	MFR	DESCRIPTION	COLOR	SIZE	FINISH
SOAP BASKET	SS-1 SEE FINISHED SPECS					
SOAP SHELF	SS-1A SEE FINISHED SPECS					
TOWEL BAR	PA-5	GATCO 18" MOUNT ON VANITY APRON PER DRAWING	ELEVATE 18 TOWEL BAR	NA	NA	POLISHED CHROME- 309/315 BRUSHED NICKEL 308
TOILET PAPER HOLDER	PA-6	GATCO	ELEVATE TPD	NA	NA	POLISHED CHROME- 309/315 BRUSHED NICKEL 308
ROBE HOOK	PA-7	GATCO	ELEVATE RH	NA	NA	POLISHED CHROME- 309/315 BRUSHED NICKEL 308
GRAB BAR	NOT FOR MODELS PER ROCKBRIDGE	NA	NA	NA	NA	12 INCH TYPE SET IN VERTICAL ORIENTATION ADJACENT TO THE WET WALL

PHILPOTTS						
INTERIORS						
ITEM	CODE	MFR	DESCRIPTION	COLOR	SIZE	FINISH
NOTES:						
1. Interior Designer specifications are subject to final review and confirmation by Owner and Contractor prior to integration into specifications.						
2. Pricing to be obtained by General Contractor or other construction estimators.						
3. Where in question, Contractor should check with Interior Designer on spatial relationships and requirements of materials and fixtures to meet codes.						
4. The Contractor is responsible to order all trims, drains, supply lines, p-traps, rough-in assemblies, siphons, internal parts, connections and recommended accessories for materials, finishes, plumbing fixtures, appliances, and decorative lighting.						
5. When substitutes are recommended, Contractor to submit samples, cut sheets, and specifications on all materials, fixtures, finishes, and appliances to Interior Designer/ Owner for approval.						
6. Contractor to have plumbing sub-contractors review and approve all plumbing specifications prior to ordering.						
7. Placement of plumbing fixtures, towel bars and other accessories shall be verified by Interior Designer.						

Code	Item	Description	Options	Room 308	Room 309	Room 315
PL-1	Undercounter sink	Kohler Ladena 20-7/8" x 14-3/8" x 8-1/8"	White	White	White	White
PL-1A	P-trap	Kohler adjustable p-trap with tubing outlet 1-1/4" x 1-1/4"	Polished Chrome confirming if other finishes available?	1st choice - brushed nickel, 2nd choice - brushed chrome, 3rd choice - polished chrome.	Polished Chrome	Polished Chrome
PL-2	Lav faucet - Rooms 309/	Rohl Wave 3-hole with lever handles WA105L-WG	Polished Chrome, Satin Nickel	X	Polished Chrome	Polished Chrome
PL-2A	Lav faucet - Room 308	Hansgrohe single-hole Metris S 31060001	Polished Chrome, Brushed Nickel	Brushed Nickel	X	X
PL-7	Lav drain	Umbrella lav drain - PHILPOTTS TO SUPPLY SPEC	TBD	TBD	TBD	TBD
PL-3	Toilet	Floor-mounted, two-piece Kohler Persuade Circ K-3753-0 White	Brushed Chrome, Brushed or Polished Nickel confirming if polished chrome available?	Brushed Nickel	1st choice - polished chrome, 2nd choice - brushed chrome	1st choice - polished chrome, 2nd choice - brushed chrome
	Toilet Seat	Open-front, Non-ADA Kohler K-4650	White	White	White	White
PL-4	Handshower	Hansgrohe Raindance E 36" Wallbar Set 27874001 with 80" hose	Polished Chrome, Brushed Nickel	Brushed Nickel	Polished Chrome	Polished Chrome
	Rough-in valve	Hansgrohe iBox Universal Plus Rough 01850-81				
PL-5	Pressure balance trim	Hansgrohe Ecostat S Pressure Balance Trim 04233000	Polished Chrome, Brushed Nickel	Brushed Nickel	Polished Chrome	Polished Chrome
PL-6	Divertor valve	Hansgrohe wall outlet w/check valves 27458003	Polished Chrome, Brushed or Polished Nickel	Brushed Nickel	Polished Chrome	Polished Chrome
PA-5	Towel Bar	Gatco Elevate 18" Towel Bar	Polished Chrome, Satin Nickel	Satin Nickel	Polished Chrome	Polished Chrome
PA-6	Toilet Paper Holder	Gatco Elevate Toilet Paper Holder	Polished Chrome, Satin Nickel	Satin Nickel	Polished Chrome	Polished Chrome
PA-7	Robe Hook	Gatco Elevate Robe Hook	Polished Chrome, Satin Nickel	Satin Nickel	Polished Chrome	Polished Chrome
GL-1	Shower Doors	Mincey Marble ARZBP6075BAL 10M Bypass	Brushed or Polished Aluminum, Brushed or Polished Stainless Steel	Brushed Aluminum	Polished Aluminum	Polished Stainless Steel
	Glassing			yes RU 27Oct2014	yes RU 27Oct 2014	yes RU 27Oct2014
Plumbing Fixtures						
Toilet Access.						

END OF SECTION 002000

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: Exterior Restaurant/Dining Extension.
 - 1. Description: Provide extension to Restaurant/Dining area as indicated on Drawings.
- B. Alternate No. 2: Re-Roofing.
 - 1. Description: Remove existing built-up asphalt roof membrane and parapet flashing on entire guestroom tower and elevator machine room penthouse per Section 070150.19 "Preparation for Reroofing" and install new roofing membrane and parapet flashing per Section 075423 "Thermal Polyolefin (TPO) Roofing". Remove all sheet metal parapet wall copings and roof edge gravel stop, and replace with new copings and gravel stop per Section 076200 "Sheet Metal Flashings and Trim".

END OF SECTION 012300

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.

- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect .
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 7. Proposal Request Form: Use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714 . Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.

4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 2. Arrange schedule of values consistent with format of AIA Document G703.
 3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
 7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
 8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by

- measured quantity. Use information indicated in the Contract Documents to determine quantities.
9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
- a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: Payment Applications shall be received in draft form no later than the 20th of each month, and shall be submitted in final form no later than the last day of the month. Payments shall be processed and issued by the end of the following month.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives executed before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.

2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit one signed and notarized original copy of each Application for Payment to Architect by a method ensuring receipt within 24 hours. Include waivers of lien and similar attachments if required.
1. Transmit with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Products list (preliminary if not final).
 6. Schedule of unit prices.
 7. Submittal schedule (preliminary if not final).
 8. List of Contractor's staff assignments.
 9. List of Contractor's principal consultants.
 10. Copies of building permits.
 11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 12. Initial progress report.
 13. Report of preconstruction conference.
 14. Certificates of insurance and insurance policies.

15. Performance and payment bonds.
 16. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

OFF-SITE STORAGE AGREEMENT

OFF-SITE STORAGE AGREEMENT

made _____ day of _____ in year two thousand and _____

Between the Owner:

Between the Contractor: _____
(Name and Address)

the Project: AQUA WAIKIKI WAVE HOTEL RENOVATION

The Owner and the Contractor understand and agree that a portion of the Total Completed Stored To Date Shown on Application for Payment No. ____ Represents an amount for material to be furnished and installed under their

Agreement dated _____, 20 ____, and that this material is to be stored at _____

(Storage Location)

a location other than the site, under the following conditions:

1. Materials stored at the above location shall be plainly tagged or marked by the Contractor as Property of _____
(Owner)
2. Such materials shall be stored separately located and segregated by the Contractor from other materials at the place of storage.
3. Such materials shall be kept free of any liens or encumbrances by the Contractor, and shall be kept adequately insured against loss to the Owner by theft, fire, or other casualty at the expense of the Contractor, and proof of such insurance will be furnished to the Owner.
4. Such materials shall be stored as herein provided and moved to the site without delaying the Work and without expense to the Owner.
5. Consent of Surety to enter the Off-Site Storage Agreement shall be furnished to the Owner.

Owner

(Sign same as Agreement)

Contractor

CONSENT OF SURETY COMPANY TO OFF-SITE STORAGE AGREEMENT

Owner	____
Architect	____
Contractor	____
Surety	____
Other	____

PROJECT: AQUA WAIKIKI WAVE RENOVATION

To: OWNER

ARCHITECT'S PROJECT NO. 34-14102-00
CONTRACT FOR: Combined Construction

CONTRACTOR: _____ CONTRACT DATE: _____

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above,

_____, SURETY COMPANY
(here insert name and address of Surety Company)

On bond of, _____, CONTRACTOR,
(here insert name and address of Contractor)

hereby approves the attached off-site agreement with the Contractor, and agrees that off-site storage agreement shall not relieve the Surety Company of any of its obligation to

_____, OWNER
(here insert name and address of Owner)

as set forth in the said Surety Company's bond.

IN WITNESS WHEREOF, the Surety Company has hereunto set its hand this _____ day of 20___.

Surety Company

Signature of Authorized Representative

Attest:
(Seal):

Title

TABULATION ON STORED MATERIALS

Page _____ of _____

Application for Payment No. _____

Project _____

Contractor _____
Application Date _____

Invoice No. (Materials Added)	Description of Material	(1) Materials Stored in Last Application		*(2) Material Added Since Last Application		(3) Materials Used Since Last Application		(4) Materials Stored in this Application	
		On-Site	Off-Site	On-Site	Off-Site	On-Site	Off-Site	On-Site	Off-Site
TOTALS									

*Attach Invoices

NOTE: All materials stored off-site must have proof of insurance and a supplementary agreement as required by the contract specifications.

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Requests for Information (RFIs).
 - 4. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.

- B. Key Personnel Names: Within seven days of receipt of Contract, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

- a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
- b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
- c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
- d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
- e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
- f. Indicate required installation sequences.
- g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.

6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.

1.7 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Electronic file in Adobe Acrobat PDF format with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be incorporated into the RFI Adobe Acrobat PDF electronic file so that the RFI is submitted as one electronic file. Multiple files submitted as one RFI will be rejected by the Architect. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
 2. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 3. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 4. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

- a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 7 days of receipt of the RFI response.
- D. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log at each construction progress meeting. Software log with not less than the following:
 1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
 1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.8 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 7 days after execution of the Agreement.
 1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect progress, including the following:

- a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.
 - k. Submittal procedures.
 - l. Preparation of record documents.
 - m. Use of the premises and existing building.
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for moisture and mold control.
 - s. Procedures for disruptions and shutdowns.
 - t. Construction waste management and recycling.
 - u. Parking availability.
 - v. Office, work, and storage areas.
 - w. Equipment deliveries and priorities.
 - x. First aid.
 - y. Security.
 - z. Progress cleaning.
4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.

- k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 60 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for completing documentation.
 - e. Requirements for preparing operations and maintenance data.
 - f. Requirements for delivery of material samples, attic stock, and spare parts.
 - g. Requirements for demonstration and training.
 - h. Preparation of Contractor's punch list.
 - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - j. Submittal procedures.
 - k. Coordination of separate contracts.

1. Owner's partial occupancy requirements.
 - m. Installation of Owner's furniture, fixtures, and equipment.
 - n. Responsibility for removing temporary facilities and controls.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at biweekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site utilization.
 - 9) Temporary facilities and controls.
 - 10) Progress cleaning.
 - 11) Quality and work standards.
 - 12) Status of correction of deficient items.
 - 13) Field observations.
 - 14) Status of RFIs.
 - 15) Status of proposal requests.
 - 16) Pending changes.
 - 17) Status of Change Orders.
 - 18) Pending claims and disputes.
 - 19) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Conduct Project coordination meetings at biweekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
 1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site utilization.
 - 9) Temporary facilities and controls.
 - 10) Work hours.
 - 11) Hazards and risks.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
 - 14) Change Orders.
 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 1. Contractor's construction schedule.
 2. Construction schedule updating reports.
 3. Daily construction reports.
 4. Material location reports.
 5. Site condition reports.
 6. Special reports.
- B. Related Requirements:
 1. Section 013300 "Submittal Procedures" for submitting schedules and reports.
 2. Section 014000 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 2. Predecessor Activity: An activity that precedes another activity in the network.
 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time belongs to Owner .
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF electronic file.
- B. Startup construction schedule.
 - 1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 - 3. Total Float Report: List of all activities sorted in ascending order of total float.

4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.
- G. Daily Construction Reports: Submit at weekly intervals.
- H. Material Location Reports: Submit at weekly intervals.
- I. Site Condition Reports: Submit at time of discovery of differing conditions.
- J. Special Reports: Submit at time of unusual event.

1.5 COORDINATION

- A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 1. Secure time commitments for performing critical elements of the Work from entities involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion and final completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.

4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.

8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
 1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and Contract Time.
- G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 STARTUP CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within seven days of date established for commencement of the Work .
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 30 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 14 days of date established for commencement of the Work . Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.4 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site.
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 - 7. Accidents.
 - 8. Meetings and significant decisions.
 - 9. Unusual events (see special reports).
 - 10. Stoppages, delays, shortages, and losses.
 - 11. Meter readings and similar recordings.
 - 12. Emergency procedures.
 - 13. Orders and requests of authorities having jurisdiction.
 - 14. Change Orders received and implemented.
 - 15. Construction Change Directives received and implemented.
 - 16. Services connected and disconnected.
 - 17. Equipment or system tests and startups.
 - 18. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
 - 1. Material stored prior to previous report and remaining in storage.
 - 2. Material stored prior to previous report and since removed from storage and installed.
 - 3. Material stored following previous report and remaining in storage.

- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner and Architect within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- C. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.

2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Final completion construction photographs.
4. Preconstruction video recordings.
5. Periodic construction video recordings.
6. Web-based construction photographic documentation.

- B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting photographic documentation.
2. Section 017700 "Closeout Procedures" for submitting photographic documentation as project record documents at Project closeout.
3. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
4. Section 024119 "Selective Structure Demolition" for photographic documentation before selective demolition operations commence.
5. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.3 INFORMATIONAL SUBMITTALS

- A. Digital Photographs: Submit image files within three days of taking photographs.

1. Digital Camera: Minimum sensor resolution of 8 megapixels.
2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
3. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.

- d. Name of Contractor.
- e. Date photograph was taken.
- f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
- g. Unique sequential identifier keyed to accompanying key plan.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.
- B. Digital Video Recordings: Provide high-resolution, digital video disc in format acceptable to Architect.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 - 1. Date and Time: Include date and time in file name for each image.
 - 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.
- C. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
 - 1. Flag excavation areas before taking construction photographs.
 - 2. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 - 3. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Periodic Construction Photographs: Take 20 photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

- E. Architect -Directed Construction Photographs: From time to time, Architect will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- F. Final Completion Construction Photographs: Take 20 color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.
 - 1. Do not include date stamp.
- G. Additional Photographs: Architect may request photographs in addition to periodic photographs specified.
 - 1. Three days' notice will be given, where feasible.
 - 2. In emergency situations, take additional photographs within 24 hours of request.
 - 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections include the following:
 1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
 2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
 3. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
 4. Division 01 Section "Photographic Documentation" for submitting construction photographs and construction videotapes.
 5. Division 01 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
 6. Division 01 Section "Closeout Procedures" for submitting warranties.
 7. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 8. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 9. Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.
 10. Divisions 02 through 49 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.
- C. PDF: Portable Data Format.

1.4 SUBMITTAL PROCEDURES

- A. All submittals must be transmitted electronically unless specifically authorized in advance by the Architect.
 - 1. The Architect will provide access to a dedicated FTP site for the project for the purpose of downloading electronic submittals and other project documentation.
- B. Electronic copies of CAD Drawings of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals. Comply with requirements of Section 013333 "Electronic Drawings."
- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- D. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- E. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 14 days for review of each resubmittal.
 - 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- F. Identification: Place a permanent label or title block on each submittal for identification.
 - 1. Indicate name of firm or entity that prepared each submittal on label or title block.
 - 2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 - 3. Include the following information on label for processing and recording action taken:
 - a. Project name.

- b. Date.
 - c. Name and address of Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Assign each submittal a unique identifier in the form "XXXXXX-YYY" where X and Y are defined as follows:
 - 1) XXXXXX: The 6 to 8-digit Section number that identifies the Section in which the product being submitted is specified.
 - 2) YYY: A sequential number, beginning with 001, that identifies the sequence of the submittal within each Section.
 - a) Resubmittals: Resubmittal numbers shall be the same as the original submittal, followed by the alphabetic suffix "R" and a unique sequential numeral, i.e. 033000-001R1 for the first resubmittal.
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.
- G. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
- H. Additional Copies: Additional copies submitted, unless specifically requested by the Architect, will be returned unmarked.
- I. Transmittal:
- 1. Package each submittal individually and appropriately for transmittal and handling.
 - 2. Transmittal Form: Transmit each submittal using the Architect's transmittal form found at the end of this Section. Transmittal form must be securely attached to the front of each submittal with a binder clip or rubber band; paper clips are not acceptable. Only one submittal may be listed on each transmittal form.
 - 3. Architect will discard submittals received from sources other than Contractor.
 - 4. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.
- J. Resubmittals: Make resubmittals in same form as initial submittal.
- 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked "**Reviewed**" or "**Furnish As Corrected**."

- K. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- L. Use for Construction: Use only final submittals with mark indicating "**Reviewed**", "**Reviewed - Additional Information Required**," or "**Furnish As Corrected**" taken by Architect.

1.5 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES

- A. General: At Contractor's written request, copies of Architect's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
 - 1. See Division 01 Section "Electronic Drawings" for requirements.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
 - 1. Submit electronic submittals directly via e-mail as directed by the Architect.
- B. File Size: Servers may not be able to accommodate attachments of indicated size. Verify that email recipients can receive files of this size before sending them. Verify that your own server storage can accommodate multiple email deliveries of this size.
- C. E-mail Addresses: Send submittals with PDF attachments directly to Architect at e-mail address indicated below. Send only submittals; general correspondence will not be processed.
- D. Submitting Shop Drawings and Product Data:
 - 1. Procedure Overview: Prepare electronic submittals as follows.
 - a. Fabricator produces CAD drawings and transfers them into a high-resolution PDF booklet of sheets.
 - 1) Use recent versions of AutoCad to create drawings, adhering to the following format requirements:
 - a) Resolution: Finest detail must be legible at full scale on a monitor without zooming in (1-inch width on 11 by 17-inch sheet is 1 inch on monitor).
 - b) Color: Black images on a white background.
 - c) Font: Use fonts no smaller than 1/16-inch.
 - 2) Prepare file for submittal by transferring it to PDF using Adobe Acrobat 6.0.2 Pro or a later version. Save resulting file, adhering to the following file format requirements:

- a) Follow naming convention as indicated in "Identification" Paragraph in "Submittal Procedures" Article followed by file type extension (pdf).
 - i) Scan product data to PDF in color.
 - j) File Security: Set no permissions on the file.
 - 3) Verify sheets readily print out to format specified for paper submittals in "Shop Drawings" Paragraph in "Action Submittals" Article with no additional formatting required by Architect, and with required information contained in title block.
 - a) Choose "Documents and Markups (Adobe 7.0) or "Documents and Comments" (Adobe 6.0) in the "Print What:" drop down list on the "Print" options window, before printing out shop drawing sets for Architect. With Adobe 5.0; check the "Comments" box. This will ensure that all stamps and corrections are printed.).
 - b) Electronic attachments to an e-mail must be unzipped and shall not exceed 5 MB in size. File size should accommodate as many as 60 to 70 sheets in Adobe® Acrobat®. Use recent versions of AutoCad® to create drawing sheets and then convert them to PDF using Adobe Acrobat 6.0.2 (or later) Pro to achieve these sheet-count file sizes. Send electronic attachments greater than 5 MB in 2 parts by separate emails, denoting "1 of 2" and "2 of 2" in subject lines after other required subject-line information.
 - b. Fabricator transmits e-mail with attachment. Send e-mail with attached, not-zipped PDF set to Architect. E-mail shall adhere to the following format requirements:
 - 1) Subject Line: Project name, and attachment file name, but without file type extension (without .pdf).
 - 2) Body: Include information in block format using "plain text" (not HTML).
2. Architect Reviews: Architect's review will be completed in red; review comments by Contractors shall use colors other than red.
- G. Product Data: All product data must be submitted electronically in accordance with requirements of this Section. Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.

- f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operation and maintenance manuals.
 - k. Compliance with specified referenced standards.
 - l. Testing by recognized testing agency.
 - m. Application of testing agency labels and seals.
 - n. Notation of coordination requirements.
4. Submit Product Data before or concurrent with Samples.
- H. Shop Drawings: All shop drawings must be submitted electronically in accordance with the requirements of this Section. Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Architect's CAD Drawings are otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.
 - l. Notation of dimensions established by field measurement.
 - m. Relationship to adjoining construction clearly indicated.
 - n. Seal and signature of professional engineer if specified.
 - o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 40 inches (750 by 1000 mm).
- I. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:

- a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of appropriate Specification Section.
3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit two sets of Samples. Architect will retain Sample set; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- J. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product.
 2. Number and name of room or space.
 3. Location within room or space.
 - a. Print and retain one copy as a Project Record Document.

- K. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation" for action.
- L. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- M. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- N. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- O. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
 - 4. Number of Copies: Submit one copy of subcontractor list, unless otherwise indicated.
 - a. Mark up and retain one copy as a Project Record Document.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 - 1. Number of Copies: Submit one copy of each submittal, unless otherwise indicated. Architect will not return copies.
 - 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - 3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure

Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

- F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- M. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- N. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- O. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

- P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- R. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- S. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
 - 1. Preparation of substrates.
 - 2. Required substrate tolerances.
 - 3. Sequence of installation or erection.
 - 4. Required installation tolerances.
 - 5. Required adjustments.
 - 6. Recommendations for cleaning and protection.
- T. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
 - 1. Name, address, and telephone number of factory-authorized service representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement whether conditions, products, and installation will affect warranty.
 - 7. Other required items indicated in individual Specification Sections.
- U. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- V. Construction Photographs and Videotapes: Comply with requirements specified in Division 01 Section "Photographic Documentation."

2.3 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
 - 1. Reviewed: Where submittals are marked "Reviewed," that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
 - 2. Reviewed Additional Information Required: Where submittals are marked "Reviewed Additional Information Required," the information submitted has been reviewed and approved as noted. However, additional information as noted and/or required by Contract Documents needs to be submitted.

3. Furnish As Corrected: When submittals are marked "Furnish As Corrected," that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
 4. Revise and Resubmit: When submittal is marked "Revise and Resubmit," do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
 - a. Do not permit submittals marked "Revise and Resubmit" to be used at the Project site, or elsewhere where Work is in progress.
 5. Rejected: When submittal is marked "Rejected," information submitted is not in compliance with Contract Documents. Resubmit submittal as required by Contract Documents.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

Shop Drawing Transmittal/Action Form



Architecture Engineering Planning Interiors

7290 West 133rd Street
Overland Park, KS 66213
tel 913/897-7811
fax 913/897-8333
kansascity@dlrgroup.com
www.dlrgroup.com

Date	
Project	Aqua Waikiki Wave Hotel Renovation
Project No.	39-14102-00
Contractor	
Address	
City, State Zip	

Copies	Specification Section No.	Specification Section Name	Product/ Manufacturer Name	Type (Product Data, Shop Drawing, Sample, Certificate, Report, Qualification)	Action (For Architect Only A, B, C,D,E)

Limit one Spec Section Number and Specification Section Name per form.

Architect/Engineer Comments

*Above Shop Drawings, Product Data, and/or Samples are returned with action as designated above in accordance with legend:

- (A)** - Reviewed
- (B)** - Reviewed – Additional Information Required
- (C)** – Furnished As Corrected (Reviewer does not authorize changes to Contract Sum unless stated in a separate Change Order)
- (D)** – Revise and Resubmit
- (E)** - Rejected
- (F)** – For Information ONLY

Reviewer's

Signature: _____ **Date:** _____

Printed Name _____

This review is only for general conformance with the design concept and the information given in the Construction Documents. Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with the requirements of the plans and specifications. Review of a specific item shall not include review of an assembly of which the item is a component. The Contractor is responsible for: quantities; dimensions to be confirmed and correlated at the job site; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of the work with that of all other trades and performing all Work in a safe and satisfactory manner.

SECTION 013333 – ELECTRONIC DRAWINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Architect-Engineer, if requested, will provide the Contractor with an electronic copy of Contract Document Drawings. The electronic copy will be provided in AutoCAD or REVIT, as requested.
- B. The requesting party shall provide the following to the Architect-Engineer prior to release of the electronic files.
 1. Payment of the Architect's service fee of \$150 per hour for time spent preparing the electronic files requested.
 2. A signed copy of AIA Document C106-2007 Digital Licensing Agreement.

1.3 REFERENCES

- A. A copy of AIA Document C106-2007 Digital Licensing Agreement, as amended, is included at the end of the Section.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013333



Digital Data Licensing Agreement

AGREEMENT made as of the day of in the year
(In words, indicate day, month and year.)

BETWEEN the Party transmitting Digital Data ("Transmitting Party"):
(Name, address and contact information, including electronic addresses)

and the Party receiving the Digital Data ("Receiving Party"):
(Name, address and contact information, including electronic addresses)

for the following Project:
(Name and location or address)

Aqua Waikiki Wave Hotel Renovation
2299 Huhio Avenue
Honolulu, Hawaii

The Transmitting Party and Receiving Party agree as follows.

TABLE OF ARTICLES

- 1 GENERAL PROVISIONS
- 2 TRANSMISSION OF DIGITAL DATA
- 3 LICENSE CONDITIONS
- 4 LICENSING FEE OR OTHER COMPENSATION
- 5 DIGITAL DATA

ARTICLE 1 GENERAL PROVISIONS

§ 1.1 The purpose of this Agreement is to grant a license from the Transmitting Party to the Receiving Party for the Receiving Party's use of Digital Data on the Project, and to set forth the license terms.

§ 1.2 This Agreement is the entire and integrated agreement between the parties. Except as specifically set forth herein, this Agreement does not create any other contractual relationship between the parties.

§ 1.3 For purposes of this Agreement, the term Digital Data is defined to include only those items identified in Article 5 below.

§ 1.3.1 Confidential Digital Data is defined as Digital Data containing confidential or business proprietary information that the Transmitting Party designates and clearly marks as "confidential."

ARTICLE 2 TRANSMISSION OF DIGITAL DATA

§ 2.1 The Transmitting Party grants to the Receiving Party a nonexclusive limited license to use the Digital Data identified in Article 5 solely and exclusively to perform services for, or construction of, the Project in accordance with the terms and conditions set forth in this Agreement.

§ 2.2 The transmission of Digital Data constitutes a warranty by the Transmitting Party to the Receiving Party that the Transmitting Party is the copyright owner of the Digital Data, or otherwise has permission to transmit the Digital Data to the Receiving Party for its use on the Project in accordance with the terms and conditions of this Agreement.

§ 2.3 If the Transmitting Party transmits Confidential Digital Data, the transmission of such Confidential Digital Data constitutes a warranty to the Receiving Party that the Transmitting Party is authorized to transmit the Confidential Digital Data. If the Receiving Party receives Confidential Digital Data, the Receiving Party shall keep the Confidential Digital Data strictly confidential and shall not disclose it to any other person or entity except as set forth in Section 2.3.1.

§ 2.3.1 The Receiving Party may disclose the Confidential Digital Data as required by law or court order, including a subpoena or other form of compulsory legal process issued by a court or governmental entity. The Receiving Party may also disclose the Confidential Digital Data to its employees, consultants or contractors in order to perform services or work solely and exclusively for the Project, provided those employees, consultants and contractors are subject to the restrictions on the disclosure and use of Confidential Digital Data as set forth in this Agreement.

§ 2.4 The Transmitting Party retains its rights in the Digital Data. By transmitting the Digital Data, the Transmitting Party does not grant to the Receiving Party an assignment of those rights; nor does the Transmitting Party convey to the Receiving Party any right in the software used to generate the Digital Data.

§ 2.5 To the fullest extent permitted by law, the Receiving Party shall indemnify and defend the Transmitting Party from and against all claims arising from or related to the Receiving Party's modification to, or unlicensed use of, the Digital Data.

ARTICLE 3 LICENSE CONDITIONS

The parties agree to the following conditions on the limited license granted in Section 2.1:

Architect-Engineer of Record (AER) makes no representation as to the compatibility of the Computer Aided Drafting/Building Information Model (CAD/BIM) files with any hardware or software.

AER makes no representation regarding the accuracy, completeness, or permanence of CAD/BIM files, nor for their merchantability or fitness for a particular purpose. Addenda information or revisions made after the date indicated on the CAD/BIM files may not have been incorporated. In the event of a conflict between the AER's sealed Contract Drawings and CAD/BIM files, the sealed Contract Drawings shall govern. It is the Owner, Contractor, or Third Party's (OCT) responsibility to determine if any conflicts exist. The CAD/BIM files shall not be considered to be Contract Documents as defined by the General Conditions of the Contract for Construction.

The use of CAD/BIM files prepared by the AER shall not in any way obviate the OCT's responsibility for the proper checking and coordination of dimensions, details, member sizes and gage, and quantities of materials as required to facilitate complete and accurate fabrication and erection.

This Agreement shall be governed by the laws of the principal place of business of the AER.

ARTICLE 4 LICENSING FEE OR OTHER COMPENSATION

§ 4.1 There is no charge to the Owner receiving Architect-Engineer generated Digital Data for its internal facility management use.

The Transmitting Party agrees to send the Digital Data upon receipt of the fee or other compensation as indicated in Specification Section 013333, Electronic Drawings, for the Receiving Party's use of the Digital Data:
(State the fee, in dollars, or other method by which the Receiving Party will compensate the Transmitting Party for the Receiving Party's use of the Digital Data.)

The Transmitting Party will provide the Digital Data, dated _____, for the following drawings:

Drawings were prepared on the following:

Computer Software: _____ / Version: _____.

ARTICLE 5 DIGITAL DATA

The Parties agree that the following items constitute the Digital Data subject to the license granted in Section 2.1:
(Identify below, in detail, the information created or stored in digital form the parties intend to be subject to this Agreement.)

This Agreement is entered into as of the day and year first written above and will terminate upon Substantial Completion of the Project, as that term is defined in AIA Document A201™–2007, General Conditions of the Contract for Construction, unless otherwise agreed by the parties and set forth below.

(Indicate when this Agreement will terminate, if other than the date of Substantial Completion.)

TRANSMITTING PARTY (Signature)

(Printed name and title)

RECEIVING PARTY (Signature)

(Printed name and title)

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified

installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.
 2. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
 3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
1. Indicate manufacturer and model number of individual components.
 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
 2. Entity responsible for performing tests and inspections.
 3. Description of test and inspection.
 4. Identification of applicable standards.
 5. Identification of test and inspection methods.
 6. Number of tests and inspections required.
 7. Time schedule or time span for tests and inspections.
 8. Requirements for obtaining samples.
 9. Unique characteristics of each quality-control service.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- C. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 - 3. Owner-performed tests and inspections indicated in the Contract Documents.
- D. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- E. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.

11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.9 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.

- e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.
2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed unless otherwise indicated.

1.10 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify

agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if

bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association (The) www.aluminum.org	(703) 358-2960
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists www.aatcc.org	(919) 549-8141
ABAA	Air Barrier Association of America www.airbarrier.org	(866) 956-5888
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 367-1155
ACI	American Concrete Institute www.concrete.org	(248) 848-3700

ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700
AGA	American Gas Association www.agas.org	(202) 824-7000
AHAM	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AHRI	Air-Conditioning, Heating, and Refrigeration Institute, The www.ahrinet.org	(703) 524-8800
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	Association of Official Seed Analysts, Inc. www-aosaseed.com	(405) 780-7372
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA	Architectural Precast Association	(239) 454-6989

	www.archprecast.org	
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association www.asphaltruofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	
ASHRAE	American Society of Heating, Refrigerating and Air- Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9500
ATIS	Alliance for Telecommunications Industry Solutions www.atis.org	(202) 628-6380
AWCMA	American Window Covering Manufacturers Association (Now WCMA)	
AWCI	Association of the Wall and Ceiling Industry www.awci.org	(703) 534-8300
AWI	Architectural Woodwork Institute www.awinnet.org	(571) 323-3636
AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association) www.awpa.com	(205) 733-4077
AWS	American Welding Society	(800) 443-9353

	www.aws.org	(305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
BICSI	BICSI, Inc. www.bicsi.org	(800) 242-7405 (813) 979-1991
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International) www.bifma.com	(616) 285-3963
BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(866) 342-4772
CCC	Carpet Cushion Council www.carpetcushion.org	(610) 527-3880
CDA	Copper Development Association www.copper.org	(800) 232-3282 (212) 251-7200
CEA	Canadian Electricity Association www.canelect.ca	(613) 230-9263
CEA	Consumer Electronics Association www.ce.org	(866) 858-1555 (703) 907-7600
CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute	(301) 596-2583

	www.chainlinkinfo.org	
CPA	Composite Panel Association www.pbmdf.com	(703) 724-1128
CRI	Carpet and Rug Institute (The) www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRRC	Cool Roof Rating Council www.coolroofs.org	(866) 465-2523 (510) 485-7175
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200 (800) 328-6306
CRRC	Cool Roof Rating Council www.coolroofs.org	(866) 465-2523 (510) 485-7175
CSA	Canadian Standards Association www.csa.ca	(800) 463-6727 (416) 747-4000
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(866) 797-4272 (416) 747-4000
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau www.cedarbureau.org	(604) 820-7700
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) www.cti.org	(281) 583-4087
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
ECA	Electrical Components Association www.ec-central.org	(703) 907-8024
EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (770) 968-7945
EJCDC	Engineers Joint Contract Documents Committee http://content.asce.org/ejcdc/	(703) 295-6000
EJMA	Expansion Joint Manufacturers Association, Inc.	(914) 332-0040

	www.ejma.org	
ESD	ESD Association (Electrostatic Discharge Association) www.esda.org	(315) 339-6937
ETL SEMCO	Intertek ETL SEMCO (Formerly: ITS - Intertek Testing Service NA) www.intertek-etlsemko.com	(800) 967-5352
FIBA	Federation Internationale de Basketball (The International Basketball Federation) www.fiba.com	41 22 545 00 00
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation) www.fivb.ch	41 21 345 35 35
FM Approvals	FM Approvals LLC www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG - FM Global) www.fmglobal.com	(401) 275-3000
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc. www.floridaroof.com	(407) 671-3772
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council www.fsc.org	49 228 367 66 0
GA	Gypsum Association www.gypsum.org	(301) 277-8686
GANNA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GRI	(Part of GSI)	
GS	Green Seal www.greenseal.org	(202) 872-6400
GSI	Geosynthetic Institute www.geosynthetic-institute.org	(610) 522-8440
HI	Hydronics Institute	(908) 464-8200

	www.gamanet.org	
HI/GAMA	Hydronics Institute/Gas Appliance Manufacturers Association Division of Air-Conditioning, Heating, and Refrigeration Institute (AHRI) www.ahrinet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IAPSC	International Association of Professional Security Consultants www.iapsc.org	(515) 282-8192
ICBO	International Conference of Building Officials www.iccsafe.org	(888) 422-7233
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
ICPA	International Cast Polymer Association www.icpa-hq.org	(703) 525-0320
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IES	Illuminating Engineering Society of North America www.iesna.org	(703) 525-0320
IESST	Institute of Environmental Sciences and Technology www.iest.org	(847) 255-1561
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426

ISA	Instrumentation, Systems, and Automation Society, The www.isa.org	(919) 549-8411
ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(877) 464-7732 (801) 341-7360
ITS	Intertek Testing Service NA (Now ETL SEMCO)	
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LGSEA	Light Gauge Steel Engineers Association www.arcat.com	(202) 263-4488
LMA	Laminating Materials Association (Now part of CPA)	
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MCA	Metal Construction Association www.metalconstruction.org	(847) 375-4718
MFMA	Maple Flooring Manufacturers Association, Inc. www.maplefloor.org	(888) 480-9138
MFMA	Metal Framing Manufacturers Association, Inc. www.metalframingmfg.org	(312) 644-6610
MH	Material Handling (Now MHIA)	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937 (604) 298-7578

MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(630) 942-6591
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(800) 797-6223 (281) 228-6200
NADCA	National Air Duct Cleaners Association www.nadca.com	(202) 737-2926
NAGWS	National Association for Girls and Women in Sport www.aahperd.org/nagws/	(800) 213-7193, ext. 453
NAIMA	North American Insulation Manufacturers Association www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCAA	National Collegiate Athletic Association (The) www.ncaa.org	(317) 917-6222
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 222-2300
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (269) 488-6382
NFHS	National Federation of State High School Associations	(317) 972-6900

	www.nfhs.org	
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NGA	National Glass Association www.glass.org	(866) 342-5642 (703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association) www.nofma.org	(901) 526-5016
NOMMA	National Ornamental & Miscellaneous Metals Association www.nomma.org	(888) 516-8585
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. (The) www.ntma.com	(800) 323-9736 (540) 751-0930
NWFA	National Wood Flooring Association www.nwfa.org	(800) 422-4556 (636) 519-9663
PCI	Precast/Prestressed Concrete Institute www pci org	(312) 786-0300
PDI	Plumbing & Drainage Institute www pdionline org	(800) 589-8956 (978) 557-0720

PGI	PVC Geomembrane Institute http://pgi-tp.cee.uiuc.edu	(217) 333-3929
PTI	Post-Tensioning Institute www.post-tensioning.org	(248) 848-3180
RCSC	Research Council on Structural Connections www.boltcouncil.org	
RFCI	Resilient Floor Covering Institute www.rfci.com	(706) 882-3833
RIS	Redwood Inspection Service www.redwoodinspection.com	(925) 935-1499
SAE	SAE International www.sae.org	(877) 606-7323 (724) 776-4841
SCAQMD	South Coast Air Quality Management District www.aqmd.com	(909) 396-2000
SCTE	Society of Cable Telecommunications Engineers www.scte.org	(800) 542-5040 (610) 363-6888
SDI	Steel Deck Institute www.sdi.org	(847) 458-4647
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(877) 294-5424 (516) 294-5424
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)	
SIA	Security Industry Association www.siaonline.org	(866) 817-8888 (703) 683-2075
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association www.smacentral.org	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980

SMPTE	Society of Motion Picture and Television Engineers www.smpste.org	(914) 761-1100
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPPD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division) www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau (The) www.spib.org	(850) 434-2611
SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www(sspc.org	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute www.steltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWPA	Submersible Wastewater Pump Association www.swpa.org	(847) 681-1868
TCA	Tilt-Up Concrete Association www.tilt-up.org	(319) 895-6911
TCNA	Tile Council of North America, Inc. www.tileusa.com	(864) 646-8453
TEMA	Tubular Exchanger Manufacturers Association www.tema.org	(914) 332-0040
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
TPI	Truss Plate Institute, Inc. www.tpinst.org	(703) 683-1010
TPI	Turfgrass Producers International	(800) 405-8873

	www.turfgrasssod.org	(847) 649-5555
TRI	Tile Roofing Institute www.tileroofing.org	(312) 670-4177
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USA V	USA Volleyball www.usavolleyball.org	(888) 786-5539 (719) 228-6800
USGBC	U.S. Green Building Council www.usgbc.org	(800) 795-1747
USITT	United States Institute for Theatre Technology, Inc. www.usitt.org	(800) 938-7488 (315) 463-6463
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association www.wcmamanet.org	(212) 297-2122
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (312) 321-6802
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California) www.wicnet.org	(916) 372-9943
WMMPA	Wood Moulding & Millwork Producers Association www.wmmpa.com	(800) 550-7889 (530) 661-9591
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 570-5441
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names,

telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

DIN	Deutsches Institut fur Normung e.V. www.din.de	49 30 2601-0
IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICC	International Code Council www.iccsafe.org	(888) 422-7233
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

COE	Army Corps of Engineers www.usace.army.mil	(202) 761-0011
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce www.commerce.gov	(202) 482-2000
DOD	Department of Defense http://dodssp.daps.dla.mil	(215) 697-6257
DOE	Department of Energy www.energy.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(866) 835-5322
FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
FDA	Food and Drug Administration www.fda.gov	(888) 463-6332
GSA	General Services Administration www.gsa.gov	(800) 488-3111

HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
LBL	Lawrence Berkeley National Laboratory www.lbl.gov	(510) 486-4000
NCHRP	National Cooperative Highway Research Program (See TRB)	
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
PBS	Public Buildings Service (See GSA)	
PHS	Office of Public Health and Science http://www.hhs.gov/ophs/	(202) 690-7694
RUS	Rural Utilities Service (See USDA)	(202) 720-9540
SD	State Department www.state.gov	(202) 647-4000
TRB	Transportation Research Board http://gulliver.trb.org	(202) 334-2934
USDA	Department of Agriculture www.usda.gov	(202) 720-2791
USP	U.S. Pharmacopeia www.usp.org	(800) 227-8772
USPS	Postal Service www.usps.com	(202) 268-2000

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from U.S. Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080
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CFR	Code of Federal Regulations Available from Government Printing Office www.gpoaccess.gov/cfr/index.html	(866) 512-1800 (202) 512-1800
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
DSCC	Defense Supply Center Columbus (See FS)	
FED-STD	Federal Standard (See FS)	
FS	Federal Specification Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil/ Available from Defense Standardization Program www.dsp.dla.mil	(215) 697-2664
	Available from General Services Administration www.gsa.gov	(202) 619-8925
	Available from National Institute of Building Sciences www.wbdg.org/ccb	(202) 289-7800
FTMS	Federal Test Method Standard (See FS)	
MIL	(See MILSPEC)	
MIL-STD	(See MILSPEC)	
MILSPEC	Military Specification and Standards Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
UFAS	Uniform Federal Accessibility Standards Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CBHF State of California, Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation (800) 952-5210

	www.dca.ca.gov/bhfti	(916) 574-2041
CCR	California Code of Regulations www.calregs.com	(916) 323-6815
CDHS	California Department of Health Services www.dhcs.ca.gov	(916) 445-4171
CDPH	California Department of Public Health, Indoor Air Quality Section www.cal-iaq.org	
CPUC	California Public Utilities Commission www.cpuc.ca.gov	(415) 703-2782
TFS	Texas Forest Service Forest Resource Development http://txforestservice.tamu.edu	(979) 458-6606

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
1. Locations of dust-control partitions at each phase of work.
 2. HVAC system isolation schematic drawing.
 3. Location of proposed air-filtration system discharge.
 4. Waste handling procedures.
 5. Other dust-control measures.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- D. Scaffolding shall be coordinated and in compliance with requirements by the Authority Having Jurisdiction.
- E. Pedestrian walkway enclosure requirements shall be coordinated with requirements of the Authority Having Jurisdiction.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide galvanized-steel bases for supporting posts.
- B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil (0.25-mm) minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- C. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches (914 by 1624 mm).
- D. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Provide a private office dedicated for use by the Owner's Representative, available during all construction hours. Keep office clean and orderly. Furnish and equip offices as follows:
 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- (1.2-m-) square tack and marker boards.
 3. Provide bottled water for use by project team.
 4. Coffee machine and supplies.
 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
 6. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures".
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

- C. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- H. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

- J. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
 2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- K. Electronic Communication Service: Provide a desktop computer in the primary field office adequate to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:
1. Processor: Intel Pentium D or Intel CoreDuo, 3.0 GHz processing speed.
 2. Memory: 4 gigabyte.
 3. Disk Storage: 300 gigabyte hard-disk drive and combination DVD-RW/CD-RW drive.
 4. Display: 22-inch (560-mm) LCD monitor with 256-Mb dedicated video RAM.
 5. Full-size keyboard and mouse.
 6. Network Connectivity: 10/100BaseT Ethernet.
 7. Operating System: Microsoft Windows XP Professional or Microsoft Windows Vista Business.
 8. Productivity Software:
 - a. Microsoft Office Professional, XP or higher, including Word, Excel, and Outlook.
 - b. Adobe Acrobat 8 Professional or higher.
 - c. WinZip 7.0 or higher.
 9. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
 10. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 384 Kbps upload and 1 Mbps download speeds at each computer.
 11. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
 12. Backup: External hard drive, minimum 40 gigabyte, with automated backup software providing daily backups.
- L. Provide copier/fax/scanner/high-speed internet connection dedicated for use by Owner's Representative in the Owner's Representative office.
- M. Coordinate with Owner on the installation of a temporary webcam, and maintenance of webcam throughout the duration of the project.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 321216 "Asphalt Paving."

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Temporary Project Sign: Provide Project identification sign as indicated at the end of this Section.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.
 4. Install and maintain a banner sign mounted to the elevator penthouse on the existing building. Owner shall provide the sign material. The sign shall be no larger than 15 feet by 30 feet.
- G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence: Before construction operations begin , furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations .
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- K. Covered Walkway: Comply with paragraph 1.5, Quality Assurance. Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.
 - 1. Construct covered walkways using scaffold or shoring framing.
 - 2. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
 - 3. Paint and maintain appearance of walkway for duration of the Work.
- L. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- M. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and occupants from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
 - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water-dampened foot mats in vestibule.
 2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 3. Insulate partitions to control noise transmission to occupied areas.
 4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 5. Protect air-handling equipment.
 6. Provide walk-off mats at each entrance through temporary partition.
- N. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.

2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
 1. Division 01 Section "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
- C. Storage:
1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Store cementitious products and materials on elevated platforms.
 5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 7. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
 3. Refer to Divisions 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
 7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
 3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
 6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
 7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
 8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions,

- and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
- a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

- A. No pre-bid substitutions will be considered.
- B. Timing: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
- C. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 1. Requested substitution is submitted on Form 016000A "Request for Substitution Form" and Form 016000B "Contractor's Statement of Conformance" found at the end of this Section.
 2. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 3. Requested substitution does not require extensive revisions to the Contract Documents.
 4. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 5. Substitution request is fully documented and properly submitted.
 6. Requested substitution will not adversely affect Contractor's Construction Schedule.
 7. Requested substitution has received necessary approvals of authorities having jurisdiction.
 8. Requested substitution is compatible with other portions of the Work.
 9. Requested substitution has been coordinated with other portions of the Work.
 10. Requested substitution provides specified warranty.
 11. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.3 COMPARABLE PRODUCTS

- A. Conditions: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

POST-BID REQUEST FOR SUBSTITUTION FORM

TO: **DLR Group**
7290 West 133rd Street
Overland Park, Kansas 66213
Phone: (913) 897-7811
Fax: (913) 897-8333

PROJECT: **Aqua Waikiki Wave Hotel**

CONTRACTOR'S REQUEST, WITH SUPPORTING DATA

A. Reason for Substitution Request: _____

B. Specifications to which this request applies: _____

Section _____ Page _____ Paragraph _____

- Product Data for proposed substitution attached (description of product, reference standards, performance and test data.)
- Sample is attached. Sample will be sent if requested by Architect/Engineer.

C. Itemized comparison of proposed substitution with product specified:

ORIGINAL PRODUCT

PROPOSED SUBSTITUTION

Name, brand: _____

Catalog No.: _____

Manufacturer: _____

Significant Variations: _____

D. Unit costs of original product and proposed substitution. State whether cost is for

- material only, material installed, or Life Cycle cost of installed product.

E. Proposed change in Contract Sum:

Credit to Owner: \$ _____ Additional Cost to Owner: \$ _____

F. Proposed Change in Contract Time: Reduce Increase by ____ days No change

G. Effect of proposed substitution on other parts of the Work, or on other Contracts:

CONTRACTOR'S STATEMENT OF CONFORMANCE
OF PROPOSED SUBSTITUTION TO CONTRACT DOCUMENTS

I / We have investigated the proposed substitution. I / We

1. believe that it is equal or superior in all respects to the originally specified product, except as stated in Paragraph C of the Post-Bid Request for Substitution Form;
2. will provide the same warranty as required in AIA A201 General Conditions 3.5.1;
3. will provide the same special warranty or guaranty as specified;
4. have included all cost data and cost implications of the proposed substitution;
5. will pay redesign and special inspection costs caused by the use of this product;
6. will pay additional costs to other contractors caused by the substitution;
7. will coordinate the incorporation of the proposed substitution in the Work;
8. will modify other parts of the Work as may be needed, to make all parts of the Work complete and functioning;
9. waive future claims for added cost to Contractor caused by the proposed substitution.

Contractor: _____
Signature _____ Date _____

Firm _____ Telephone _____

Address _____

City, State Zip _____

ARCHITECT/ENGINEER'S REVIEW AND ACTION

- Provide more information in the following categories. Resubmit.

- Sign Contractor's Statement of Conformance. Resubmit.

- The proposed substitution is approved with the following conditions:

- The proposed substitution request is rejected.

The following changes will be made by Change Order:

Addition to / deduction from the Contract Sum: \$ _____

Addition to / deduction from the Contract Time: _____ days.

DLR Group

By: _____ Date: _____
Architect

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

- B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
4. Section 024119 "Selective Structure Demolition" for demolition and removal of selected portions of the building.
5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor .
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 - 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
- D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- E. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

- a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Mechanical systems piping and ducts.
 - f. Control systems.
 - g. Communication systems.
 - h. Fire-detection and -alarm systems.
 - i. Conveying systems.
 - j. Electrical wiring systems.
 - k. Operating systems of special construction.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
- a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 1. Description of the Work.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility

appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
 - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 - 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.

3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Existing Precast Concrete Plank Roof Structure: Do not cut reinforcing tendons. Conduct X-ray surveys of areas to be core-drilled or cut to confirm locations of reinforcing.
 5. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 6. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 7. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

- B. Related Requirements:

1. Section 013233 "Photographic Documentation" for submitting final completion construction photographic documentation.
2. Section 017300 "Execution" for progress cleaning of Project site.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
4. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
5. Section 017900 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.3 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.
- D. Provide all record documents and training videos on three copies of DVD's and three printed copies.
- E. Coordinate organization of close-out documents with Owner.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
 5. Submit test/adjust/balance records.
 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 6. Advise Owner of changeover in heat and other utilities.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements, including touchup painting.
 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On

receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect will return annotated file.
 - b. PDF electronic file. Architect will return annotated file.
 - c. Three paper copies. Architect will return two copies.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.

2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

- c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
 - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - q. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

- B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
 2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
1. List of documents.
 2. List of systems.
 3. List of equipment.
 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to

ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Electronic Files: Submit 3 copies of manuals in the form of a multiple file composite electronic PDF file for each manual type required on DVDs.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so

that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, post-type binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.

9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.

2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.

4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."
- G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

- B. Related Requirements:

1. Section 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit three copies of record Drawings on DVDs as follows:

- a. Initial Submittal:

- 1) Submit PDF electronic files of scanned marked up record prints and one paper copy set of marked up record prints.
 - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

- b. Final Submittal:

- 1) Submit PDF electronic files of scanned record prints and one set of prints.
 - 2) Print each drawing, whether or not changes and additional information were recorded.

- B. Record Specifications: Submit one paper copy and annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy and annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.

- n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
 2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets. Record drawings to be half-size and in three copies.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 - 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as annotated PDF electronic file.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 1. Demonstration of operation of systems, subsystems, and equipment.
 2. Training in operation and maintenance of systems, subsystems, and equipment.
 3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
 2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet

- with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
3. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals .

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 1. Inspect and discuss locations and other facilities required for instruction.
 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 3. Review required content of instruction.
 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

- a. System, subsystem, and equipment descriptions.
- b. Performance and design criteria if Contractor is delegated design responsibility.
- c. Operating standards.
- d. Regulatory requirements.
- e. Equipment function.
- f. Operating characteristics.
- g. Limiting conditions.
- h. Performance curves.

2. Documentation: Review the following items in detail:

- a. Emergency manuals.
- b. Operations manuals.
- c. Maintenance manuals.
- d. Project record documents.
- e. Identification systems.
- f. Warranties and bonds.
- g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

- a. Instructions on meaning of warnings, trouble indications, and error messages.
- b. Instructions on stopping.
- c. Shutdown instructions for each type of emergency.
- d. Operating instructions for conditions outside of normal operating limits.
- e. Sequences for electric or electronic systems.
- f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

- a. Startup procedures.
- b. Equipment or system break-in procedures.
- c. Routine and normal operating instructions.
- d. Regulation and control procedures.
- e. Control sequences.
- f. Safety procedures.
- g. Instructions on stopping.
- h. Normal shutdown instructions.
- i. Operating procedures for emergencies.
- j. Operating procedures for system, subsystem, or equipment failure.
- k. Seasonal and weekend operating instructions.
- l. Required sequences for electric or electronic systems.
- m. Special operating instructions and procedures.

5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Owner will furnish Contractor with names and positions of participants.

- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least seven days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.
 - 1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
 - 2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. E-mail address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 - 1. Film training session(s) in segments not to exceed 15 minutes.

- a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 017900

SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstated.
- B. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstated.

1.3 INFORMATIONAL SUBMITTALS

- A. Predemolition Photographs or Video: Submit before Work begins.

1.4 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

- A. Items indicated to be removed and salvaged remain Owner's property. Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner. Include fasteners or brackets needed for reattachment elsewhere.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.
- D. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 2. Arrange to shut off indicated utilities with utility companies.
 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 5. Dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Construction Waste Management and Disposal."
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 4. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SCTION 030130.72 STRENGTHENING CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This specification is intended to define the minimum requirements of structural strengthening using externally bonded fiber reinforced polymer (FRP) composite systems.
- B. The work includes the furnishing of all materials, labor, equipment and services for the supply, installation and finish of all structural strengthening using externally bonded FRP systems.
- C. The general contractor or subcontractor shall furnish all materials, tools, equipment, transportation, necessary storage, access, labor and supervision required for the proper installation of the externally bonded FRP systems.

1.2 REFERENCE STANDARDS

- A. General: The publications listed below form a part of this specification to the extent referenced. Where a date is given for referenced standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available shall be used.
- B. International Code Council (ICC)
 - 1. ICC AC125, Acceptance Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Externally Bonded Fiber Reinforced Polymer (FRP) Composite Systems.
 - 2. ICC AC178, Interim Criteria for Inspection and Verification of Concrete and Reinforced and Unreinforced Masonry Strengthening Using Externally Bonded Fiber Reinforced (FRP) Composite Systems.
- C. American Standard for Testing and Materials (ASTM)
 - 1. ASTM D7565, Standard Test Method for Determining Tensile Properties of Fiber Reinforced Polymer Matrix Composites Used for Strengthening of Civil Structures.
 - 2. ASTM D3039, Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials.
 - 3. ASTM D7522, Standard Test Method for Pull-Off Strength for FRP Bonded to Concrete Substrate.
 - 4. ASTM D4541, Standard Test Method for Pull-off Strength of Coating Using Portable Adhesive-Testers.

5. Fire Protection: ASTM E84 (regarding flame spread and smoke development requirement) and ASTM E119 (regarding hourly fire-rated requirement).

D. American Concrete Institute (ACI)

1. ACI 440.2R-08, Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures.

E. International Concrete Repair Institute (ICRI)

1. ICRI Technical Guideline No. 310.2-1997 (formerly No. 03732), Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.

1.3 MATERIAL QUALIFICATIONS

A. Materials for the FRP system have been pre-qualified and shall be supplied by the following manufacturers:

1. Fyfe Co. LLC (8380 Miralani Drive, Suite E, San Diego, CA 92126. Tel: 858-642-0694, Fax: 858-444-2982, Email: info@fyfeco.com)
2. Alternate FRP system manufacturers must provide all items listed in Section 1.5 of this specification prior to the bid date; otherwise, such system shall be considered non-compliant.

1.4 SUBMITTALS

A. Quality Control and Quality Assurance:

1. Submit manufacturer specified QA/QC manual indicating product standards, physical and chemical characteristics, technical specifications, limitations, installation instructions, maintenance instructions and general recommendations regarding each individual material.
 - a. Only epoxy resins will be accepted for construction of FRP systems referenced in this specification. Other resins, such as polyesters/vinyl esters, are not allowed as substitutes. The manufacturer shall clearly define the epoxy resin working time. Any batch that exceeds the batch life shall not be used.
2. Durability Requirements: The proposed FRP systems shall be compliant with all testing requirements as per ICC AC125 and a current ICC Evaluation Service Report compliant with the 2009 International Building Code (IBC) shall be provided (see Section 1.5.8 of this specification).
3. Submit a list of completed surface bonded FRP composite strengthening projects completed with the manufacturer's FRP system in the past 3 years. The list should include at a minimum 25 projects with proposed FRP system, the dates of work, description and amount of work performed.
4. All FRP composite systems shall be installed by certified applicator with written consent from manufacturer that the contractor has been trained. The certified applicator shall prove a minimum of 5 years experience in performing retrofits using FRP systems and submit a list of no fewer than 15 successful installations.

- a. The Engineer of Record may suspend the work if the Contractor substitutes an unapproved FRP system or unapproved personnel during construction.
5. Identify a manufacturer approved testing laboratory that can perform the required ASTM D7565 and/or ASTM D3039 tests as per Section 3.3 of this specification, if required.

B. Design and working drawings:

1. Structural calculations and shop drawings performed by a Structural Engineer. Design shall follow criteria in Section 1.6 of this specification and be based on the clearly written performance criteria defined on the structural drawings.
2. Working drawings shall detail the type, locations, dimensions, numbers of layers, and orientation of all FRP materials and coatings to be installed.

C. Product Information:

1. Provide a current ICC Evaluation Service Report, compliant with the 2009 IBC, for the proposed products.
2. If fire protection is required, provide approved U.L. rated assembly data for any required fire-resistant finish (2 or 4 hour rated assembly per ASTM E119 or

Class A Building, Flame Spread & Smoke Development per ASTM E84) as proposed with the FRP system. Note: Due to the temperature sensitive nature of FRP systems, no fire resistance system shall be allowed without the aforementioned U.L. rated assembly testing verification.

3. Manufacturer's product data sheets indicating physical, mechanical and chemical characteristics of all materials used in the FRP system. Data sheets to also include properties of the cured FRP laminates as determined by laboratory testing in accordance with ASTM D7565 and/or ASTM D3039 (ultimate and design tensile modulus, stress and strain).
4. Manufacturer's Material Safety Data Sheets (MSDS) for all materials to be used.
5. Certification by the manufacturer that supplied products comply with local regulations controlling use of volatile organic compounds (VOC's). Products that require the use of respirators do not comply with local regulations controlling use of VOC's and shall not be allowed.

1.5 PERFORMANCE

- A. Design the composite system to achieve the structural performance shown on the structural drawings and shall be submitted for approval by the Engineer of Record, and shall be performed by a Structural Engineer.
- B. Calculations shall conform to the requirements set forth in ACI 440.2R-08, Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures and be based on the design modulus and associated area of the cured laminate for the FRP system to be installed. FRP laminate design values must be lower than the calculated mean determined

from the test results of the ASTM D7565 and/or ASTM D3039 field test specimens (See Section 3.3 of this specification).

1.6 PRODUCT DELIVERY, HANDLING AND STORAGE

- A. Deliver epoxy materials in factory-sealed containers with the manufacturer's labels intact and legible with verification of date of manufacture and shelf life.
- B. Store materials in a protected area at a temperature between 40°F and 100°F.
- C. Products shall be stored according to the manufacturer's requirements and shall avoid contact with soil and moisture. Products shall be stored to avoid UV exposure.

1.7 COORDINATE WITH OTHER TRADES

- A. Prior to construction, the trades shall be briefed on any new or unusual construction procedures to ensure that they are aware of special conditions (e.g. new penetrations, construction anomalies).

PART 2 - PRODUCTS

1.2 ACCEPTABLE MANUFACTURERS & COMPOSITE STRENGTHENING SYSTEM

- A. Approved FRP system: Tyfo® Fibrwrap® System(s) to be supplied by Fyfe Co. LLC (8380 Miralani Drive, Suite A, San Diego, CA 92126. Tel: 858-642-0694, Fax: 858-444-2982, Email: info@fyfeco.com). Products include:
 - 1. Composite fabric: SCH fiber – primary carbon fiber, unidirectional.
SEH fiber – primary glass fiber, unidirectional.
Alternate primary carbon or glass fiber systems available upon request.
 - 2. Epoxy saturant/primer: Tyfo® S epoxy is used as a primer and is also combined with the fiber to form the Tyfo® Fibrwrap® System.
 - 3. Epoxy saturant/primer for underwater application: Tyfo® SW-1 epoxy is used as a primer and is also combined with the fiber to form the Tyfo® Fibrwrap® System.
 - 4. Primer/Filler: Thickened Tyfo® S, WS, WP or TC thickened epoxy for protective seal coat, filling voids (up to 1.5" deep) and priming where needed.
 - 5. Anchorage: Fiber anchors (if required) shall consist of either SCH or SEH unidirectional fibers and shall be saturated with the Tyfo® S epoxy in the field. Anchors may not be field fabricated. They shall be manufactured and shipped directly from the manufacturer. Anchor labels shall have the date of manufacture, the lot number and the minimum weight per unit length for each size.

6. Finishes: Tyfo® A, Tyfo® U, Tyfo® HS. Alternate finishes must be approved by the owner.
7. Fire Resistant Finishes: Tyfo® RR, Tyfo® FC/F, Tyfo® 4HFL, Tyfo® Advanced Fire Protection (AFP) System for applicable fire resistant finish (if required). Alternate finishes must be approved by the owner.
8. All other alternate FRP system manufacturers must provide all items listed in Section 1.5 of this specification prior to the bid date; otherwise, such system shall be considered non-compliant.

1.3 CERTIFIED APPLICATORS

- A. Installations of FRP Systems shall be performed by certified applicators only. Certified applicators shall have the minimum experience and written consent by the FRP manufacturer (See Section 1.5.4 of this specification).
- B. The certified applicator regarding the installation of all Tyfo® Fibrwrap® Systems in the State of Minnesota is Fibrwrap Construction Services (Contact: Kevin Hooley; (414) 702-7665; Kevin@fcclp.com).

1.4 OTHER MATERIALS

- A. Contractor to provide compatible primer, filler and other materials recommended by the manufacturer as needed for the proper installation of the complete surface bonded FRP composite system.

PART 3 APPLICATION

1.1 SURFACE PREPARATION

- A. “Contact-Critical” Applications:

- .1 The surface to receive the composite shall be free from fins, sharp edges and protrusions that will cause voids behind the installed casing or that, in the opinion of the Engineer of Record, will damage the fibers. Existing uneven surfaces to receive composite shall be filled with the system epoxy filler or other material approved by the Engineer of Record. Filling of large voids in surfaces to receive composite shall be paid as an extra to the contract work of installing the composite system (small pinholes or micro-bubbles in the concrete surface or resin do not require special detailing). The contact surfaces shall have no free moisture on them at the time of application. If moisture is present, use the manufacturer suggested wet prime epoxy, if available.
- .2 Repair all damaged concrete, spalls, and irregular surfaces to create a flat, or slightly convex, surface. Fill surfaces with thickened epoxy to eliminate air surface voids greater than 0.5" diameter. Well-adhered paint and concrete do not require removal.
- .3 Round off sharp and chamfered corners to a minimum radius of 0.75" by means of grinding or forming with the system's thickened epoxy. Variations in the radius along the vertical edge shall not exceed 0.5" for each 12" of column height.

B. Beams/Slabs Or “Bond-Critical” Applications:

1. Surfaces shall be prepared for bonding by means of abrasive blasting or grinding to remove existing laitance and expose aggregate [minimum ICRI CSP-2 concrete surface profile]. All contact surfaces shall then be cleaned by hand or compressed air. Prior to the application of the saturated composite fabric, prime surfaces and fill any uneven surfaces with the manufacturer's thickened epoxy. Provide anchorage as detailed on construction drawings, if required.
2. Round off sharp and chamfered corners (to be wrapped around) to a minimum radius of 0.75" by means of grinding or forming with the system's thickened epoxy. Variations in the radius along the edge shall not exceed 0.5" for each 12" of length.

1.2 INSTALLATION

- A. Preparation work for project: Visit site to ensure that all patch work is complete and cured. Review project specifications in detail.
- B. Verify ambient and concrete temperatures. No work shall proceed if the temperature of the concrete surface is less than 40°F or greater than 100°F or as specified on the epoxy component labels. The ambient temperature and temperature of the components shall be between 40°F and 100°F, unless provisions have been made to ensure components' temperature is maintained within this range or the range specified by the manufacturer.
- C. Prepare the epoxy matrix by combining components at a weight (or volume) ratio specified by the manufacturer. The components of epoxy resin shall be mixed with a mechanical mixer until uniformly mixed, typically 5 minutes at 400-600 rpm.
- D. Components that have exceeded their shelf life shall not be used.
- E. Saturation of the fabric shall be performed and monitored according to the manufacturer's specified fiber-epoxy resin ratio. Fabric shall be completely saturated prior to application to contact surface in order to ensure complete impregnation. Saturation shall be supervised and checked by the certified installer. Both the epoxy resin and fabric shall be measured accurately, combined, and applied uniformly at the rates shown on the approved working drawings and per manufacturer's recommendations.
- F. All cutting of fabrics, mixing of epoxy and combination thereof shall take place in a protected area away from critical structure functions and any electrical equipment.
- G. Prepare surfaces as required, including corner preparation.
- H. Remove dust and debris by hand or with compressed air as per specification.
- I. Clean up and protect area adjacent to element where FRP system is being applied.
- J. Using a roller or trowel, apply one prime coat of epoxy resin to the substrate (2 mil min.). Allow primer to become tacky to the touch.
- K. Fill any uneven surfaces or recesses with thickened epoxy.

- L. Apply saturated fabric to substrate surface by hand lay-up, using methods that produce a uniform, constant tensile force that is distributed across the entire width of the fabric, and ensure proper orientation of the fabric. Under certain application conditions, the system may be placed entirely by hand methods assuring a uniform, even final appearance. Gaps between composite bands may not exceed 0.5" width in the fabric's transverse joint unless otherwise noted on project drawings. A lap length of at least 6" is required at all necessary overlaps in the primary fiber direction of the fabric.
- M. Apply subsequent layers, continuously or spliced, until designed number of layers is achieved, per project drawings.
- N. Using a roller or hand pressure, release or roll out entrapped air, and ensure that each individual layer is firmly embedded and adhered to the preceding layer or substrate.
- O. Detail all fabric edges, including termination points and edges, with thickened epoxy.
- P. Finish: All edges and seams must be feathered. Finish as specified between 24 and 72 hours after final application of epoxy. If finish is provided beyond 72 hours of the application of the epoxy, the surface must be roughened by hand sanding or brush blasting, prior to finishing.
- Q. System may incorporate structural fasteners but limitations and detailing must be verified with FRP system manufacturer.

1.3 INSPECTION AND TESTING

A. Field Inspection

- 1. The contractor shall monitor the mixing of all epoxy components for proper ratio and adherence to manufacturer's recommendations. Record batch numbers for fabric and epoxy used each day, and note locations of installation. Measure square footage of fabric and volume of epoxy used each day. Complete report and submit to Owner, engineer-of-record and FRP composite system manufacturer.
- 2. A Certified Special Inspector shall observe all aspects of preparation, mixing, and application. All FRP composite applied areas shall be inspected, in accordance with the manufacturer's specifications for voids, bubbles, and delaminations. All defective areas shall be repaired as per Section 3.4 in this specification.

B. ASTM D7522 and/or ASTM D4541 – Direct Tension Adhesion Tests

- 1. Direct tension adhesion testing shall be conducted using the method described by ASTM D7522 and/or ASTM D4541. A minimum of one such test shall be performed for each 1,000 ft² (45m²) of surface area to be covered by the FRP application. Pull-off tests shall be performed on a representative adjacent area to the area being strengthened whenever possible. Tests shall be performed on each type of substrate or for each surface preparation technique used.
- 2. The epoxy bonded to the prepared surface shall be allowed to cure as per manufacturer's requirements before execution of the direct tension pull-off test. The locations of the pull-off tests shall be representative and on flat surfaces. If no adjacent areas exist, the tests shall be

conducted on areas of the installed FRP system subjected to relatively low stress during service.

3. The minimum acceptable value for any pull-off test is 175 psi. The average of the tests shall not be less than 200 psi. Additional tests may be performed to qualify the work at each identified area. Each pull-off test is to exhibit a failure mode in the substrate and not the epoxy-to-substrate bond plane.
4. ASTM D7522/4541 testing is required for all “Bond-Critical” applications of the FRP system (i.e. bond of FRP-to-concrete is critical to strengthening performance of the system), unless otherwise required by the Engineer of Record.

C. Laboratory Testing

1. Record lot number of fabric and epoxy resin used, and location of installation. Measure square footage of fabric and volume of epoxy used each day. Label each sample from each day’s production.
2. A “sample batch” shall consist of two 12” by 12” samples of cured composite (note: one 12” by 12” sample creates 5 coupons for ASTM D7565 and/or ASTM D3039 Tension Tests, see 3.3.5 and 3.3.6 of this specification). A minimum of one “sample batch” shall be made daily. Each sample of the “sample batch” will be taken at appropriate times during the day as to ensure the maximum material deviance in the components of the FRP composite.

D. Preparation of Samples

1. Prepare sample on a smooth, flat, level surface covered with polyethylene sheeting, or 16 mil plastic film, prime with epoxy resin. Then place one layer of saturated fabric and apply additional topping of epoxy. Cover with plastic film and squeegee out all bubbles.
2. Samples shall be stored in a sample box and not moved for a minimum 48 hours after casting. The prepared, identified samples shall be given to a pre-approved and experienced testing laboratory. The laboratory shall then precondition samples for 48 hours at 140°F before testing.

E. ASTM D7565 and/or ASTM D3039 – Material Tension Tests

1. A minimum of fifteen-percent of all 12"x12" sample panels shall be tested. Testing specimens shall be cut from samples and tested for ultimate tensile strength, tensile modulus and percentage elongation as per ASTM D7565 and/or ASTM D3039 in the longitudinal fiber direction.
2. Tensile properties must meet or exceed FRP composite system properties as defined in project specifications. If one coupon does not achieve the design properties, additional coupons from the same sample shall be tested. If these coupons fail (on average), coupons from the other 12-inch-by-12-inch sample, from the same batch for that day, shall be tested. If all tested samples of the sample batch do not meet the conditions of acceptance, it is recommended that 25 percent of all samples be tested.

F. Acceptance Criteria

1. FRP design values must be lower than the calculated mean determined from the test results received from the ASTM D7565 and/or ASTM D3039 field test specimens. Acceptable minimum values for ultimate tensile strength, tensile modulus, and elongation shall not be below the submitted design values unless calculations are performed using the tested values that exhibit an acceptable capacity as per the original design demands and concept.

1.4 REQUIRED REMEDIATION

- A. Small voids and bubbles [on the order of 3" diameter] shall be injected or back filled with epoxy.
- B. Voids and delaminations on the order of 6" in diameter or an area of 5" x 5" shall be reported to the engineer of record and remediation shall be submitted by the contractor for approval.
- C. In the event that the FRP system does not meet the Acceptance Criteria as per laboratory testing and calculations (refer to Section 3.3.6 of this specification), remedial measures shall be taken. Any structural member where the installed FRP system does not meet the Acceptance Criteria, additional layers shall be installed until the FRP meets design requirements, or any other remediation directed by the Engineer of Record.
- D. At no cost to the Owner, repair any damage to the new or existing structures, property or services caused by the installation and testing of the FRP system.

1.5 CLEAN UP

- A. Remove all surplus material, equipment and debris from the site on completion of the work. Leave the site clean.

END OF SECTION 03 013072

SECTION 031230 – GEOFOAM CONCRETE FORMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. System Description:

- 1. Provide Geo-foam blocks to provide supporting formwork for concrete floor slabs.

- B. Related Sections include the following:

- 1. Section 03 30 00 "Cast-in-Place Concrete" for concrete reinforcing and slabs poured on top of permanent form system.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect plastic insulation as follows:

- 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to project site before installation time.
 - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the work include, but are not limited to, the following:

1. Stadium Savers, Ltd.; 550 3 Mile Road NW; Grand Rapids, MI 49544; telephone 616-785-5598; website www.StadiumSavers.com.
2. Insulfoam, a Carlisle Company.

2.2 MATERIALS

- A. Molded, Rigid Cellular Polystyrene Geo-foam Blocks: Comply with manufacturer's requirements, ASTM D6817 for Type EPS15, and the following:
1. Minimum Density: 0.90 pounds per cubic foot.
 2. Flame-Spread and Smoke-Developed Indexes: 25 and 450 or less, respectively, per ASTM E 84.
 3. Minimum Compressive Resistance: at 1% deformation = 3.6 pounds per square inch (518 pounds per square foot).
 4. Blocks shall contain no CFC's, HCFC's, HFC's, or formaldehyde.

2.3 FABRICATION

- A. Fabricate geo-foam blocks, square, and true to dimension.
- B. Factory cut individual blocks for delivery to site and installation without the need for subsequent field cutting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install system in compliance with Drawings and manufacturer's recommendations.

END OF SECTION

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes.
- B. Related Sections include the following:
 1. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.3 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
- D. Samples: Submit samples not less than 12 inches by 12 inches by 1 inch in size of abrasive blast concrete finish, indicating materials and methods used to produce finishes. Architect's review will be for color and texture only. Samples shall be provided under provisions of this Section.
- E. Welding Certificates: Copies of certificates for welding procedures and personnel.
- F. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
 1. Cementitious materials and aggregates.
 2. Form materials and form-release agents.
 3. Steel reinforcement and reinforcement accessories.
 4. Admixtures.
 5. Curing materials.
 6. Floor and slab treatments.
 7. Bonding agents.

8. Adhesives.
9. Joint-filler strips.
10. Repair materials.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- F. ACI Publications: Comply with the following, unless more stringent provisions are indicated:
 1. ACI 301, "Specification for Structural Concrete."
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 1. Plywood, metal, or other approved panel materials.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce smooth surfaces without joint or spiral indications. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Earth cuts may be used as form for footings, and grade beams below grade.
- E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- G. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of the exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes not larger than 1 inch (25 mm) in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive damp-proofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Wire: ASTM A 82, as drawn.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
- B. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60 (Grade 420). Cut bars true to length with ends square and free of burrs.

2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I/II.
 - 1. Fly Ash: ASTM C 618, Class C or F.
- B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
 - 1. Class: Severe weathering region, but not less than 4S.
 - 2. Nominal Maximum Aggregate Size at Interior Slab-On-Grade: 1 inch (25 mm).
 - 3. Nominal Maximum Aggregate Size at All Other Locations: 3/4 inch (19 mm).
- C. Water: Potable and complying with ASTM C 94/C 94M.

2.5 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
- B. Air-Entraining Admixture: ASTM C 260.
- C. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
- D. High-Range, Water-Reducing Admixture: ASTM C 494/C 494 M, Type F.
- E. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
- F. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
- G. Granular Fill: Granular fill for use under slab on grade shall be crushed rock, stone, or gravel reasonably free of clay, shale, and soft particles, or other deleterious matter. Sizes and gradation of granular fill shall be as follows:

<u>Sieve Size</u>	<u>Percent by Weight Passing</u>
3-4 inch	100
No. 100	0 to 15
No. 200	0 to 2

2.6 FLOOR AND SLAB TREATMENTS

- A. Polyurethane Sealer:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Durathane HS/VOC; L&M Construction Chemicals, Inc.
 - b. Sonothane; Sonneborn, Div. of ChemRex, Inc.

2.7 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- G. Evaporation Retarder:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BurkeFilm; Burke by Edoco.
 - b. Spray-Film; ChemMasters.
 - c. Aquafilm; Conspec Marketing and Manufacturing Co., Inc., a Dayton Superior Company.
 - d. Sure Film; Dayton Superior Corporation.
 - e. Eucobar; Euclid Chemical Co.
 - f. Vapor Aid; Kaufman Products, Inc.
 - g. Lambco Skin; Lambert Corporation.
 - h. E-Con; L&M Construction Chemicals, Inc.
 - i. Confilm; MBT Protection and Repair, Division of ChemRex.
 - j. Waterhold; Metalcrete Industries.
 - k. SikaFilm; Sika Corporation, Inc.
 - l. Finishing Aid; Symons Corporation, a Dayton Superior Company.
- H. Clear, Waterborne, Membrane-Forming Curing Compound:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AH Curing Compound #2 DR WB; Anti-Hydro International, Inc.
 - b. Aqua Resin Cure; Burke by Edoco.
 - c. Safe-Cure Clear; ChemMasters.
 - d. WB Resincure; Conspec Marketing and Manufacturing Co., Inc., a Dayton Superior Company.
 - e. Day Chem Rez Cure (J-11-W); Dayton Superior Corporation.
 - f. Kurez DR VOX; Euclid Chemical Co.
 - g. Thinfilm 420; Kaufman Products Inc.

- h. Aqua Kure-Clear; Lambert Corporation.
- i. L&M Cure R; L&M Construction Chemicals, Inc.
- j. 1100 Clear; WR Meadows, Inc.
- k. Metcure; Metalcrete Industries.
- l. Resin Cure E; Nox-Crete Products Group, Kinsman Corporation.
- m. Resin-Chem Clear Cure; Symons Corporation, a Dayton Superior Company.
- n. Horncure WB 30; Tamms Industries, Inc.
- o. Hydro Cure 309; Unitex.

I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound:

- 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cureseal 1315 WB; Burke by Edoco.
 - b. Polyseal WB; ChemMasters.
 - c. UV Safe Seal; Lambert Corporation.
 - d. Lumiseal WB Plus; L&M Construction Chemicals, Inc.
 - e. Vocomp-30; W. R. Meadows, Inc.
 - f. Metcure 30; Metalcrete Industries.
 - g. Super Diamond Clear VOX; Euclid Chemical Company.

2.8 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and grade to suit requirements, and as follows:
 - 1. Type: Class I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - 2. Type: Class IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- D. Reglets: Fabricate reglets of not less than 0.0217-inch- (0.55-mm-) thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- E. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 POST INSTALLED ANCHORS

- A. Install all code-compliant post-installed anchor products in accordance with manufacturer's written instructions. See Drawings for approved anchor products.

2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- B. Floor Leveling Compound: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3 mm), and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXES

- A. Prepare design mixes for each type and strength of concrete indicated on drawings, proportioned on the basis of laboratory trial mix or field test data, or both, according to ACI 301.

2.12 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch (3 mm), exposed concrete.
 - 2. Class C, 1/2 inch (13 mm), concrete not exposed.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required, and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated. Install in vertical position with horizontal spacing of 24 inches where concrete is veneered with masonry.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.
- B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved at least 70 percent of 28-day design compressive strength. Determine compressive strength of in-place concrete by testing representative field-cured test specimens according to ACI 301.
- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect-Engineer.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318 (ACI 318M), ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not disturb the compacted granular fill or cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging, or 24 inches on center maximum. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Support welded wire fabric in slabs-on-grade 2 inches from upper surface, unless noted otherwise. Hooking and pulling up fabric as concrete is poured is not acceptable.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect-Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
 - 2. Form keyed joints from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent or an epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 7. Use epoxy-bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete

when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

- D. Isolation Joints in Slabs-on-Grade: Install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface at unexposed slabs, unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch (12 mm) or more than 1 inch (25 mm) below finished concrete surface at exposed floors where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mix.
 2. Do not add water to concrete for interior slab-on-grade.
- C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Scree slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 degrees F (4.4 degrees C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- F. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.
1. Apply to concrete surfaces not exposed to view or concealed by other construction.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm) in height.
1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
 2. Do not apply rubbed finish to smooth-formed finish.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

- A. General: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce amplitude of 1/4-inch (6 mm) in one direction.
 - 1. Apply scratch finish to surfaces indicated and to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system
 - 2. Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and levelness, F(L) 15.
- E. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect-Engineer before application.

3.10 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.11 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching $0.2 \text{ lb/sq. ft.} \times h$ ($1 \text{ kg/sq. m} \times h$) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:
 - E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive bonded cementitious floor coverings or toppings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive liquid floor treatments or a sealer.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs to be left exposed and not receive subsequent floor coatings or treatments, in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period. Apply a second coat at completion of construction according to manufacturer's written instructions.

3.12 LIQUID FLOOR TREATMENTS

- A. Apply two coats of polyurethane sealer to exposed concrete floors indicated to be "Sealed Concrete", unless indicated otherwise, in accord with the manufacturer's recommendations. Prior to application, dampen surface and acid clean in accord with the manufacturer's recommendations for cleaning, etching, and application.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged as long as possible, but not less than one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect-Engineer. Remove and replace concrete that cannot be repaired and patched to Architect-Engineer's approval.

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.2-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect-Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch (19 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect-Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect-Engineer's approval.

3.15 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.
- B. Inspections:
 1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mix placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change. Perform one test for each truckload of concrete for interior slab-on-grade.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.

5. Compressive-Strength Tests: ASTM C 39/C 39M; test two laboratory-cured specimens at 7 days and two at 28 days.
 - a. Test two field-cured specimens at 7 days and two at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
6. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
7. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
8. Test results shall be reported in writing to Architect-Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect-Engineer but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect-Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect-Engineer.

END OF SECTION 033000

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Concrete unit masonry.
2. Reinforced unit masonry.
3. Masonry waste disposal.

- B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet-metal flashing installed in masonry.

- C. Products installed but not furnished under this Section include the following:

1. Steel and shelf angles lintels for unit masonry specified in Section 051200 "Structural Steel Framing."
2. Manufactured reglets in masonry joints for metal flashing specified in Section 076200 "Sheet Metal Flashing and Trim."

1.3 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product data for each different masonry unit, accessory, and other manufactured product specified.

C. Samples for initial selection of the following:

1. Unit masonry samples in small-scale form showing the full range of colors and textures available for each different exposed masonry unit required.

D. Samples for verification of the following:

1. Full-size units for each different exposed masonry unit required showing the full range of exposed textures, and dimensions to be expected in the completed construction.

E. Material certificates for the following, signed by manufacturer and Contractor, certifying that each material complies with requirements.

1. Each different cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
2. Each material and grade indicated for reinforcing bars.
3. Each type and size of joint reinforcement.
4. Each type and size of anchors, ties, and metal accessories.

F. Material test reports from a qualified independent testing agency, employed and paid by Contractor or manufacturer, indicating and interpreting test results relative to compliance of the following proposed masonry materials with requirements indicated:

1. Mortar complying with property requirements of ASTM C 270.
2. Grout mixes. Include description of type and proportions of grout ingredients.
3. Masonry units.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not install until they are in an air-dried condition.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

- A. Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.
 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt on completed masonry.
- D. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and above.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Comply with referenced unit masonry standard and other requirements specified in this Section applicable to each material indicated.

2.2 CONCRETE MASONRY UNITS

- A. General: Provide shapes indicated and as follows for each form of concrete masonry unit required.
1. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
- B. Concrete Masonry Units: ASTM C 90 and as follows:
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength indicated below:
 - a. 1900 psi (13.1 MPa).

2. Weight Classification: Normal weight.
3. Size: Manufactured to the actual dimensions listed below (within tolerances specified in the applicable referenced ASTM specification) for the corresponding nominal sizes indicated on Drawings:
 - a. 4 inch (100 mm) nominal: 3-5/8 inch (92 mm) actual.
 - b. 6 inch (150 mm) nominal: 5-5/8 inch (143 mm) actual.
 - c. 8 inch (200 mm) nominal: 7-5/8 inch (194 mm) actual.
 - d. 10 inch (250 mm) nominal: 9-5/8 inch (244 mm) actual.
 - e. 12 inch (300 mm) nominal: 11-5/8 inch (295 mm) actual.
4. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

2.3 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Aggregate for Mortar: ASTM C 144; except for joints less than 1/4 inch (6.5 mm), use aggregate graded with 100 percent passing the No. 16 (1.18 mm) sieve.
- D. Aggregate for Grout: ASTM C 404.
- E. Water: Potable.

2.4 REINFORCING STEEL

- A. Steel Reinforcing Bars: Material and grade as follows:
 1. Billet steel complying with ASTM A 615 (ASTM A 615M).
 - a. Grade 60 (Grade 400).

2.5 JOINT REINFORCEMENT

- A. General: Provide joint reinforcement formed from the following:
 1. Galvanized carbon-steel wire, coating class as follows:
 - a. ASTM A 153, Class B-2, for both interior and exterior walls.
- B. Description: Welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10 feet (3 m), with prefabricated corner and tee units, and complying with requirements indicated below:
 1. Wire Diameter for Side Rods: 0.1483 inch (9 gauge) (3.8 mm).

2. Wire Diameter for Cross Rods: 0.1483 inch (9 gauge) (3.8 mm).
- C. For single-wythe masonry, provide type as follows with single pair of side rods:
 1. Ladder design with perpendicular cross rods spaced not more than 16 inches (407 mm) o.c.
- D. For multiwythe composite masonry, provide type as follows:
 1. Ladder design with perpendicular cross rods spaced not more than 16 inches (407 mm) o.c.
 - a. Number of Side Rods for Multiwythe Concrete Masonry: One side rod for each face shell of hollow masonry units more than 4 inches (100 mm) in width, plus 1 side rod for each wythe of masonry 4 inches (100 mm) or less in width.
 2. For cavity walls, provide one of the types as follows:
 - a. Ladder design with perpendicular cross rods, with no drips, spaced at 16 inches o.c. and number of side rods as follows:
 - 1) Number of Side Rods: One side rod for each face shell of hollow masonry units and one side rod for outer 4-inch wythe.
 - b. Ladder design with perpendicular box ties flush welded at not more than 16 inches o.c. extending into the cavity. Provide a welded cross bar across the tie to restrain the transverse movement between the two wythes. Tie to the outer wythe shall be a hook type box tie. The maximum misalignment of the coursing between the inner and outer wythes shall be 1-1/4 inches.
 - 1) Number of Side Rods: One side rod for each face shell of hollow masonry back up units.
- E. Mesh Wall Tie: 16 gauge hot-dipped galvanized with wires spaced 1/2 inch on center forming square grid in widths and lengths indicated.

2.6 TIES AND ANCHORS, GENERAL

- A. General: Provide ties and anchors specified in subsequent articles that comply with requirements for metal and size of this Article, unless otherwise indicated.
- B. Wire: As follows:
 1. Galvanized Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.
 2. Wire Diameter: 0.1875 inch (4.8 mm).
- C. Steel Sheet: As follows:

1. Galvanized Steel Sheet: ASTM A 366 (ASTM A 366M) (commercial quality) cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153, Class B-2 or B-3, as applicable, for sheet-metal ties and anchors.
- D. Thickness of Steel Sheet Galvanized After Fabrication: Uncoated thickness of steel sheet for hot-dip galvanizing after fabrication:
 1. 0.0598 inch (16 gauge) (1.5 mm).
- E. Galvanized Heavy-Thickness Steel Sheet: ASTM A 635 (ASTM A 635M) (commercial quality) hot-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153, Class B-2 or B-3, as applicable, for rigid anchors fabricated from steel sheet or strip with a thickness of 0.180 inch (4.6 mm) and greater.
- F. Steel Plates and Bars: ASTM A 36 (ASTM A 36M), hot-dip galvanized to comply with ASTM A 153, Class B-1, B-2, or B-3, as applicable to size and form indicated.

2.7 RIGID ANCHORS

- A. Corrugated Metal Ties: Metal strips not less than 7/8 inch (22 mm) wide with corrugations having a wavelength of 7.6 to 12.7 mm, and an amplitude of 0.06 to 0.10 inch (1.5 to 2.5 mm) made from 0.060-inch (1.52-mm-) thick, steel sheet, galvanized after fabrication.

2.8 ADJUSTABLE MASONRY-VENEER ANCHORS

- A. General: Provide 2-piece assemblies allowing vertical or horizontal differential movement between wall and wall framing parallel to plane of wall but resisting tension and compression forces perpendicular to it, for attachment over sheathing to metal studs, and with the following structural performance characteristics:
 1. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in either tension or compression without deforming over, or developing play in excess of, 0.05 inch (1.3 mm).
- B. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie section and a metal anchor section complying with the following requirements:
 1. Wire Tie Shape: Triangular.
 2. Wire Tie Length: As required to extend 1-1/2 inches (38 mm) into masonry wythe of veneer face.
 3. Anchor Section: Gasketed sheet-metal plate with screw holes top and bottom; top and bottom ends bent to form pronged legs to bridge insulation or sheathing and abut studs; and raised, rib-stiffened strap stamped into center to provide a slot between strap and plate for connection of wire tie; of overall size indicated below:
 - a. Plate and Strap Size: 1-1/4 inches (32 mm) wide for plate by 6 inches (150 mm) long, 5/8 inch (16 mm) wide by 6 inches (150 mm) long for strap; slot clearance

- formed between face of plate and back of strap at maximum rib projection: 1/32 inch (0.8 mm) plus diameter of wire tie.
- b. Neoprene Gaskets: Screw-attached, masonry-veneer anchor manufacturer's standard closed-cell neoprene gaskets manufactured to fit behind anchor plate and to prevent moisture from penetrating through screw holes to steel studs behind sheathing.
- C. Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 (4.8-mm) diameter by length required to penetrate steel stud flange by not less than 3 exposed threads, and with the following corrosion protective coating:
1. Organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.
- D. Products: Subject to compliance with requirements, provide the following:
1. Screw-Attached, Adjustable Masonry-Veneer Anchors:
 - a. Type A: Hohmann & Barnard, Inc.; X-Seal Anchor.
 - b. Type B: Hohmann & Barnard, Inc.; 2-Seal Tie with Byna-Lok Wire Tie.
 2. Organic-Polymer-Coated, Steel Drill Screws for Steel Studs:
 - a. Dril-Flex; Elco Industries, Inc.
 - b. Traxx; ITW-Buildex.

2.9 MISCELLANEOUS ANCHORS

- A. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:

1. Headed bolts.

2.10 POSTINSTALLED ANCHORS

- A. Expansion Bolts:
1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Hilti Fastening Systems; Kwik-Bolt.
 - b. The Molly Company; Molly Parabolt.
 - c. ITW Ramset/Redhead; Trubolt Wedge.
- B. Expansion Flush Anchors:

1. Products: Subject to compliance with requirements, provide the following or approved equal:

- a. ITW Ramset/Redhead; Self-Drill Anchors.

C. Screw Anchors:

1. Products: Subject to compliance with requirements, provide one of the following or approved equal:

- a. Buildex; Tapcon.
- b. Hilti Fastening Systems; Kwik-Con.

D. Sleeve Anchors:

1. Products: Subject to compliance with requirements, provide one of the following or approved equal:

- a. Hilti Fastening Systems; Sleeve Anchor.
- b. ITW Ramset/Redhead; Dynabolt Sleeve.

E. Adhesive Anchors:

1. Products: Subject to compliance with requirements, provide one of the following or approved equal:

- a. ITW Ramset/Redhead; Epcon Ceramic 6 Epoxy Anchoring System.
- b. Hilti Fastening Systems; HIT HY-20 (Hollow), HY-150 (Solid).

F. Note: Use anchors with screens at hollow masonry only where indicated on plans.

2.11 EMBEDDED FLASHING MATERIALS

A. Flexible Flashing: Use the following unless otherwise indicated:

1. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637, 0.040 inch (1.0 mm) thick.

a. Products: Subject to compliance with requirements, provide one of the following:

- 1) Carlisle Coatings & Waterproofing; Pre-Kleened EPDM Thru-Wall Flashing.
- 2) Firestone Specialty Products; FlashGuard.
- 3) Heckmann Building Products Inc.; No. 81 EPDM Thru-Wall Flashing.
- 4) Hohmann & Barnard, Inc.; Epra-Max EPDM Thru-Wall Flashing.
- 5) Sandell Manufacturing Co., Inc.; EPDM Flashing.

B. Stainless Steel Drip Edge:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Illinois Products Corporation; 0.015-inch- (15-mil-) thick by 3-inch-wide stainless steel strip with a turned down hemmed drip edge or comparable product by one of the following:
 - a. Heckmann Building Products, Inc.
 - b. Hohmann & Barnard, Inc.
 - c. Sandell Manufacturing Co.

C. Stainless Steel Termination Bar:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Hohmann & Barnard; T2 Termination Bar.

2.12 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Type 2, Class A, Grade 1; compressible up to 35 percent; of width and thickness indicated; formulated from the following material:
 1. Neoprene.
 2. Urethane.
 3. Polyvinyl chloride.
- B. Preformed Control-Joint Gaskets: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
 1. Styrene-Butadiene Rubber Compound: ASTM D 2000, Designation M2AA-805.
 2. Polyvinyl Chloride: ASTM D 2287, General Purpose Grade, Type PVC-65406.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Use the following unless otherwise indicated:
 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Advanced Building Products Inc.; Mortar Maze weep vent.
 - 2) Blok-Lok Limited; Cell-Vent.
 - 3) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
 - 4) Heckmann Building Products Inc.; No. 85 Cell Vent.
 - 5) Hohmann & Barnard, Inc.; Quadro-Vent.
 - 6) Wire-Bond; Cell Vent.
- E. Mortar/Grout Screen: Monofilament screen fabricated from polypropylene polymer fibers in widths to completely cover cells in concrete masonry units.

F. Cavity Drainage Material: 1-inch- (25-mm-) thick, One or more thicknesses as required to fill cavity width, reticulated, nonabsorbent mesh, made from polyethylene strands and shaped to maintain drainage at weep holes without being clogged by mortar droppings.

1. Product: Subject to compliance with requirements, provide the following:

a. Mortar Net USA; Mortar Net.

G. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch (3.6-mm) steel wire, hot-dip galvanized after fabrication.

1. Provide units with either two loops or four loops as needed for number of bars indicated.

2.13 MASONRY CLEANERS

A. Acidic Cleaner: Standard-strength, general-purpose cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by manufacturer of masonry units being cleaned.

2.14 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification, for job-mixed mortar; and ASTM C 1142 for ready-mixed mortar, of types indicated below:

1. Limit cementitious materials in mortar to portland cement and lime.
2. For All Concrete Masonry:

a. Type N.

C. Grout for Unit Masonry:

1. Comply with ASTM C 476 using proportions as indicated.
2. Use grout of consistency indicated or, if not otherwise indicated, of consistency (fine or coarse) at time of placement that will completely fill spaces intended to receive grout.

a. Use fine grout in grout spaces less than 2 inches (50 mm) in horizontal dimension, unless otherwise indicated.
b. Use coarse grout in grout spaces 2 inches (50 mm) or more in least horizontal dimension, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of unit masonry. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of thickness indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections of the Specifications.
- C. Leave openings for equipment to be installed before completion of masonry. After installing equipment, complete masonry to match construction immediately adjacent to the opening.
- D. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting, where possible. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of columns, walls, and arrises, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), nor 3/8 inch in 20 feet (10 mm in 6 m), nor 1/2 inch in 40 feet (12 mm in 12 m) or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch in 40 feet (12 mm in 12 m) or more. For vertical alignment of head joints, do not exceed plus or minus 1/4 inch in 10 feet (6 mm in 3 m), nor 1/2 inch (12 mm) maximum.
- B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch in 40 feet (12 mm in 12 m) or more. For top surface of bearing walls, do not exceed 1/8 inch (3 mm) in 10 feet (3 m), nor 1/16 inch (1.5 mm) within width of a single unit.
- C. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls, and partitions, do not exceed 1/2 inch in 20 feet (12 mm in 6 m), nor 3/4 inch in 40 feet (19 mm in 12 m) or more.

- D. Variation in Cross-Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4 inch (6 mm) nor plus 1/2 inch (12 mm).
- E. Variation in Mortar-Joint Thickness: Do not vary from bed-joint thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm). Do not vary bed-joint thickness from bed-joint thickness of adjacent course by more than 1/8 inch (3 mm). Do not vary from head-joint thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary head-joint thickness from adjacent head-joint thickness by more than 1/8 inch (3 mm). Do not vary from collar-joint thickness indicated by more than minus 1/4 inch (6 mm) or plus 3/8 inch (10 mm).

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.
- B. Lay walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.
- C. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
 - 1. One-half running bond with vertical joint in each course centered on units in courses above and below.
- D. Lay concealed masonry with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- E. Stopping and Resuming Work: In each course, rack back 1/2-unit length for one-half running bond or 1/3-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar prior to laying fresh masonry.
- F. Built-in Work: As construction progresses, build-in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.
- G. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
- H. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.
- I. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

- J. Fill cores in hollow concrete masonry units with grout so there is a minimum of twice the embedment length of solid concrete all around expansion bolts, expansion flush anchors, and bolts installed in masonry.
- K. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above and as follows:
 - 1. Install compressible filler in joint between top of partition and underside of structure above.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow concrete masonry units as follows:
 - 1. With full mortar coverage on horizontal and vertical face shells.
 - 2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
 - 3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.
 - 4. Maintain joint widths indicated, except for minor variations required to maintain bond alignment. If not indicated, lay walls with 3/8-inch (10-mm) joints.
- B. Tooling: Joints shall be struck flush, and, after mortar has partially set but is still sufficiently plastic to bond, tool joints with a tool that compacts mortar and presses excess mortar out of joint rather than dragging it out. Joints shall be made with a straight, clean line. Joints shall be the following:
 - 1. Concave Joints: Joints shall be tooled concave at exposed masonry, concrete masonry, brick masonry, including kerfed joint at double half-standard masonry units.

3.6 STRUCTURAL BONDING OF MULTIWYTHE MASONRY

- A. Use continuous horizontal-joint reinforcement installed in horizontal mortar joints for bond tie between wythes.
- B. Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.
 - 1. Provide continuity with horizontal-joint reinforcement at corners by using prefabricated "L" units in addition to masonry bonding.
- C. Intersecting and Abutting Walls: Unless vertical expansion joints are shown at juncture, provide rigid anchors and control joints, space as follows:
 - 1. Provide rigid metal anchors not more than 24 inches (610 mm) o.c. If used with hollow masonry units, embed ends in mortar-filled cores.

3.7 CAVITIES

- A. Keep cavities clean of mortar droppings and other materials during construction. Strike joints facing cavities flush.
 - 1. Use wood strips temporarily placed in cavity to collect mortar droppings. As work progresses, remove strips, clean off mortar droppings, and replace in cavity.
- B. Tie exterior wythe to back-up with continuous horizontal-joint reinforcing or continuous joint reinforcement with individual metal ties.

3.8 HORIZONTAL-JOINT REINFORCEMENT

- A. General: Provide continuous horizontal-joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcing a minimum of 6 inches (150 mm).
- B. Install reinforcement in first and second bed joints, 8 inches apart, immediately above opening at masonry lintels, above lintels at steel lintels, and below sills at openings and in bed joints at 16-inch intervals elsewhere, unless noted otherwise. Extend reinforcement in second bed joint above or below openings 2 feet beyond jambs. Other reinforcement shall be continuous.
- C. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- D. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.9 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
 - 1. Provide an open space not less than 1 inch (25 mm) in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
 - 2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.10 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to metal studs with masonry-veneer anchors to comply with the following requirements:

1. Fasten each anchor section through sheathing to metal studs with 2 metal fasteners of type indicated.
2. Fasten anchors through sheathing to metal studs with metal fasteners of type indicated.
3. Insert anchor section in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
4. Embed tie section in masonry joints. Provide not less than 2-inch (50-mm) air space between back of masonry veneer and face of sheathing.
5. Locate anchor section relative to course where tie section is embedded to allow maximum vertical differential movement of tie up and down.
6. Space anchors as indicated, but not more than 16 inches (458 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally with not less than 1 anchor for each 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals around perimeter not exceeding 8 inches (203 mm).

3.11 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joints in unit masonry where indicated. Build-in related items as the masonry progresses.
- B. Form control joints in concrete masonry with one of the following:
 1. Fit bond-breaker strips into hollow contour in ends of block units on one side of control joint. Fill the resultant core with grout and rake joints in exposed faces.
 2. Install preformed control-joint gaskets designed to fit standard sash block.
- C. Form expansion joints in brick made from clay or shale as follows:
 1. Build-in joint fillers where indicated.
 2. Form open joint of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Section 079200 "Joint Sealants." Maintain joint free and clear of mortar.

3.12 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels where shown and where openings of more than 12 inches for brick size units and 24 inches for block size units are shown without structural steel or other supporting lintels.
 1. Provide prefabricated masonry lintels. Use specially formed bond beam units with reinforcement bars placed as indicated and filled with coarse grout unless noted otherwise on Drawings. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.
- C. Provide minimum bearing of 8 inches (200 mm) at each jamb, unless otherwise indicated.

3.13 FLASHING, WEEP HOLES, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated.
- B. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
- C. Install flashing as follows:
 - 1. Wall base flashing at composite masonry walls, including cavity walls: Extend flashing to flush with horizontal joint in the exterior face of the outer wythe of masonry, through the outer wythe, turned up a minimum of 8 inches (100 mm), and extend into reglet in the inner wythe.
 - 2. At lintels, shelf angles, ledges, heads and sills, install the flashing as described above and add a stainless steel drip edge at the exterior face immediately below the flashing.
 - 3. At lintels, shelf angles, heads and sills, extend flashing a minimum of 4 inches (100 mm) into masonry at each end and turn up not less than 2 inches (50 mm) to form a pan.
 - 4. Turn up flashing not less than 2 inches (50 mm) to form a pan each side of control and expansion joints.
- D. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing and as follows:
 - 1. Form weep holes with product specified in Part 2 of this Section.
 - 2. Space weep holes 16 inches (400 mm) o.c. at base flashing and 24 inches (600 mm) o.c. at drip edges.
 - 3. Place cavity drainage material immediately above flashing in cavities.
- E. Trim wicking material used in weep holes flush with outside face of wall after mortar has set.
- F. Install reglets and nailers for flashing and other related construction where shown to be built into masonry.

3.14 INSTALLATION OF REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.
 - 1. Construct formwork to conform to shape, line, and dimensions shown. Make sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.

1. Do not exceed the following pour heights for fine grout:
 - a. For minimum widths of grout spaces of 3/4 inch (19 mm) or for minimum grout space of hollow unit cells of 1-1/2 by 2 inches (38 by 51 mm), pour height of 12 inches (305 mm).
 - b. For minimum widths of grout spaces of 2 inches (51 mm) or for minimum grout space of hollow unit cells of 2 by 3 inches (51 by 76 mm), pour height of 60 inches (1524 mm).
 - c. For minimum widths of grout spaces of 2-1/2 inches (63 mm) or for minimum grout space of hollow unit cells of 2-1/2 by 3 inches (63 by 76 mm), pour height of 12 feet (3.6 m).
 - d. For minimum widths of grout spaces of 3 inches (76 mm) or for minimum grout space of hollow unit cells of 3 by 3 inches (76 by 76 mm), pour height of 24 feet (7.3 m).
2. Do not exceed the following pour heights for coarse grout:
 - a. For minimum widths of grout spaces of 1-1/2 inches (38 mm) or for minimum grout space of hollow unit cells of 1-1/2 by 3 inches (38 by 76 mm), pour height of 12 inches (305 mm).
 - b. For minimum widths of grout spaces of 2 inches (51 mm) or for minimum grout space of hollow unit cells of 2-1/2 by 3 inches (63 by 76 mm), pour height of 60 inches (1524 mm).
 - c. For minimum widths of grout spaces of 2-1/2 inches (63 mm) or for minimum grout space of hollow unit cells of 3 by 3 inches (76 by 76 mm), pour height of 12 feet (3.6 m).
 - d. For minimum widths of grout spaces of 3 inches (76 mm) or for minimum grout space of hollow unit cells of 3 by 4 inches (76 by 101 mm), pour height of 24 feet (7.3 m).
3. Provide cleanout holes at least 3 inches (76 mm) in least dimension for grout pours over 60 inches (1524 mm) in height.
 - a. Provide cleanout holes at each vertical reinforcing bar.
 - b. At solid grouted masonry, provide cleanout holes at not more than 32 inches (813 mm) o.c.
4. Grouting shall be done, wherever possible, from inside face of masonry. Use extreme care to prevent grout or mortar from staining face of masonry left exposed or painted. Immediately remove grout or mortar if contact is made with face of masonry. Protect sills, ledges, offsets, etc., from droppings of mortar and protect door jambs and corners from damage during construction.
5. Stop grout pour 1-1/2 inches below top of masonry course to form a key when grouting is stopped for one hour or longer.

3.15 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units. Install new units to match adjoining units; install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point-up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for application of sealants.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears prior to tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleared for comparison purposes. Obtain Architect-Engineer's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid stripable masking agent, polyethylene film, or waterproof masking tape.
 - 4. Wet wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
 - a. Proprietary acidic cleaner, applied in compliance with directions of acidic cleaner manufacturer.
 - 5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain present on exposed surfaces.
- E. Protection: Provide final protection and maintain conditions that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

3.16 MASONRY WASTE DISPOSAL

- A. Excess Masonry Waste: Remove excess, clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off the Owner's property.

END OF SECTION

SECTION 044313.13 - ANCHORED STONE MASONRY VENEER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Stone masonry anchored to concrete and metal framed backup.

1.3 ACTION SUBMITTALS

- A. Product Data: For each variety of stone, stone accessory, and manufactured product.
- B. Samples for Verification:
 - 1. For each stone type indicated. Include at least five Samples in each set and show the full range of color and other visual characteristics in completed Work.
 - 2. For each color of mortar required. Label Samples to indicate types and amounts of pigments used.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, supply sources, and other information as required to identify materials used. Include mix proportions for mortar and source of aggregates.
 - 1. Neither receipt of list nor approval of mockups constitutes approval of deviations from the Contract Documents contained in mockups unless Architect approves such deviations in writing.
- C. Material Test Reports:
 - 1. Stone Test Reports: For stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous three years.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters.
- B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Build mockups for each type of stone masonry in sizes approximately **60 inches (1500 mm)** long by **60 inches (1500 mm)** high by full thickness, including face and backup wythes and accessories.
 - a. Include a sealant-filled joint at least **16 inches (400 mm)** long in mockup.
 - b. Include through-wall flashing installed for a **24-inch (600-mm)** length in corner of mockup approximately **16 inches (400 mm)** down from top of mockup, with a **12-inch (300-mm)** length of flashing left exposed to view (omit stone masonry above half of flashing).
 - c. Include metal studs, sheathing, veneer anchors, flashing, and weep holes in exterior masonry-veneer wall mockup.
 - 3. Protect accepted mockups from the elements with weather-resistant membrane.
 - 4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- C. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, in a dry location, or in covered weatherproof dispensing silos.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS

- A. Protection of Stone Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed stone masonry when construction is not in progress.

1. Extend cover a minimum of **24 inches (600 mm)** down both sides and hold cover securely in place.
- B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining stone masonry face.
 1. Protect base of walls from rain-splashed mud and mortar splatter using coverings spread on the ground and over the wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at end of each day to prevent rain from splashing mortar and dirt on completed stone masonry.
- C. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1.8 COORDINATION

- A. Advise installers of other work about specific requirements for placement of reinforcement, veneer anchors, flashing, and similar items to be built into stone masonry.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Stone: Obtain stone, regardless of finish, from single quarry, whether specified in this Section or in another Section of the Specifications, with resources to provide materials of consistent quality in appearance and physical properties.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of uniform quality for each cementitious component from single manufacturer and each aggregate from single source or producer.
- C. Varieties and Sources: Subject to compliance with requirements, provide stone of varieties and from sources complying with Section 044200 "Exterior Stone Cladding."

2.2 CORAL STONE

- A. Material Standards:
 1. Maximum Absorption per ASTM C 97/C 97M: <Insert required value>.
 2. Minimum Compressive Strength per ASTM C 170/C 170M: <Insert required value>.
 3. Minimum Flexural Strength per ASTM C 880/C 880M: <Insert required value>.
- B. Varieties and Sources: Subject to compliance with requirements, provide the following:
 1. Locally available coral type stone.

- C. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.3 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II, except Type III may be used for cold-weather construction; natural color or white cement may be used as required to produce mortar color indicated.
1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in stone masonry mortar.
- E. Aggregate: ASTM C 144 and as follows:
1. For pointing mortar, use aggregate graded with 100 percent passing **No. 16 (1.18-mm)** sieve.
 2. White Aggregates: Natural white sand or ground white stone.
- F. Water: Potable.

2.4 VENEER ANCHORS

- A. Materials:
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2.
 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 316.
 3. Hot-Dip Galvanized-Steel Sheet: ASTM A 1008/A 1008M, cold-rolled, carbon-steel sheet, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M, Class B-2.
 4. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 316.
- B. Size: Sufficient to extend at least halfway, but not less than **1-1/2 inches (38 mm)**, through stone masonry and with at least a **5/8-inch (16-mm)** cover on exterior face.
- C. Wire Veneer Anchors: Wire ties formed from W1.7 or **0.148-inch- (3.8-mm-)** diameter, stainless-steel wire.
1. Ties are bent in the form of loops with legs not less than **15 inches (381 mm)** in length and with last **2 inches (50 mm)** bent at 90 degrees.

2. Ties are bent in the form of rectangular loops with ends bent downward for inserting into eyes projecting from masonry joint reinforcement specified in Section 042000 "Unit Masonry."
 3. Ties are bent in the form of triangular loops designed to be attached to masonry joint reinforcement specified in Section 042000 "Unit Masonry" with vertical wires passing through ties and through eyes projecting from masonry joint reinforcement.
- D. Seismic Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in stone masonry mortar joint, complying with the following requirements:
1. Structural Performance Characteristics: Capable of withstanding a **100-lbf (445-N)** load in both tension and compression without deforming or developing play in excess of **0.05 inch (1.3 mm)**.
 2. Anchor Section: Rib-stiffened, sheet metal plate with screw holes in top and bottom, **2-3/4 inches (70 mm)** wide by **3 inches (75 mm)** high; with projecting tabs having slotted holes for inserting vertical leg of connector section.
 3. Connector Section: Rib-stiffened, sheet metal bent plate with down-turned leg designed to fit in anchor section slot and with integral tabs designed to engage continuous wire. Size connector to extend at least halfway through stone masonry but with at least a **5/8-inch (16-mm)** cover on exterior face.
 4. Fabricate sheet metal anchor sections and other sheet metal parts from **0.109-inch- (2.8-mm-)** thick stainless-steel sheet.
 5. Fabricate wire connector sections from **0.188-inch- (4.8-mm-)** diameter, stainless-steel wire.
 6. Continuous Wire: **0.188-inch- (4.8-mm-)** diameter, stainless-steel wire.
- E. Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C 954, except manufactured with hex washer head and neoprene washer, **No. 10 (4.8-mm diameter)** by length required to penetrate steel-stud flange with not less than three exposed threads.

2.5 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Asphalt Damproofing: Cut-back asphalt complying with ASTM D 4479, Type I or asphalt emulsion complying with ASTM D 1227, Type III or Type IV.

2.6 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar and grout stains, efflorescence, and other new construction stains from stone masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by cleaner manufacturer and stone producer.

2.7 FABRICATION

- A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated.
- B. Select stone to produce pieces of thickness, size, and shape indicated, including details on Drawings and pattern specified in "Setting Stone Masonry" Article.
- C. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.
- D. Cut and drill sinkages and holes in stone for anchors and supports.
- E. Carefully inspect stone at quarry or fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units before shipment.
 - 1. Clean sawed backs of stone to remove rust stains and iron particles.
- F. Thickness of Stone: Provide thickness indicated, but not less than the following:
 - 1. Thickness: **4 inches (100 mm)** plus or minus **1/4 inch (6 mm)**.
- G. Finish exposed stone faces and edges to comply with requirements indicated for finish and to match approved samples and mockups.
 - 1. Finish: **[Split face] [Rock face (pitched face)] [Natural cleft] [Mixed split face and seam face] [Mixed split face, seam face, and rock face (pitched face)] [Smooth] [Sand rubbed] [As indicated]**.

2.8 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride.
 - 2. Use portland cement-lime mortar unless otherwise indicated.
 - 3. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches required consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Stone Masonry: Comply with ASTM C 270, Property Specification.

1. Mortar for Setting Stone: Type N.
 2. Mortar for Pointing Stone: Type N.
- D. Pigmented Mortar: Use colored cement product.
1. Pigments shall not exceed 10 percent of portland cement by weight.
 2. Mix to match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces indicated to receive stone masonry, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone masonry.
- B. Examine substrate to verify that dovetail slots, inserts, reinforcement, veneer anchors, flashing, and other items installed in substrates and required for or extending into stone masonry are correctly installed.
- C. Examine wall framing, sheathing, and weather-resistant sheathing paper to verify that stud locations are suitable for spacing of veneer anchors and that installation will result in a weatherproof covering.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Accurately mark stud centerlines on face of weather-resistant sheathing paper before beginning stone installation.
- B. Coat concrete and unit masonry backup with asphalt dampproofing.
- C. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.3 SETTING STONE MASONRY

- A. Perform necessary field cutting and trimming as stone is set.
 1. Use power saws to cut stone that is fabricated with saw-cut surfaces. Cut lines straight and true, with edges eased slightly to prevent snapping.
 2. Use hammer and chisel to split stone that is fabricated with split surfaces. Make edges straight and true, matching similar surfaces that were shop or quarry fabricated.
 3. Pitch face at field-split edges as needed to match stones that are not field split.

- B. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.
- C. Arrange stones in broken-range ashlar pattern with uniform course heights, random lengths, and uniform joint widths.
- D. Arrange stones with color and size variations uniformly dispersed for an evenly blended appearance.
- E. Set stone to comply with requirements indicated on Drawings. Install supports, fasteners, and other attachments indicated or necessary to secure stone masonry in place. Set stone accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
- F. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are required to maintain bond alignment if any. Lay walls with joints not less than **3/8 inch (10 mm)** at narrowest points or more than **5/8 inch (16 mm)** at widest points.
- G. Provide sealant joints of widths and at locations indicated.
 - 1. Keep sealant joints free of mortar and other rigid materials.
 - 2. Sealing joints is specified in Section 079200 "Joint Sealants."

3.4 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed **1/4 inch in 10 feet (6 mm in 3 m)**, **3/8 inch in 20 feet (10 mm in 6 m)**, or **1/2 inch in 40 feet (13 mm in 12 m)** or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed **1/4 inch in 20 feet (6 mm in 6 m)** or **1/2 inch in 40 feet (13 mm in 12 m)** or more.
- B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed **1/4 inch in 20 feet (6 mm in 6 m)** or **1/2 inch in 40 feet (13 mm in 12 m)** or more.
- C. Variation of Linear Building Line: For position shown in plan, do not exceed **1/2 inch in 20 feet (13 mm in 6 m)** or **3/4 inch in 40 feet (19 mm in 12 m)** or more.
- D. Measure variation from level, plumb, and position shown in plan as a variation of the average plane of each stone face from level, plumb, or dimensioned plane.
- E. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.
- F. Variation in Plane between Adjacent Stones: Do not exceed one-half of tolerance specified for thickness of stone.

3.5 INSTALLATION OF ANCHORED STONE MASONRY

- A. Anchor stone masonry to concrete with corrugated-metal veneer anchors unless otherwise indicated. Secure anchors by inserting dovetailed ends into dovetail slots in concrete.
- B. Anchor stone masonry to stud framing with adjustable, screw-attached seismic veneer anchors unless otherwise indicated. Fasten anchors through sheathing to framing with two screws.
- C. Embed veneer anchors in mortar joints of stone masonry at least halfway, but not less than **1-1/2 inches** (38 mm), through stone masonry and with at least a **5/8-inch** (16-mm) cover on exterior face.
 1. Install continuous wire reinforcement in horizontal joints and attach to seismic veneer anchors as stone is set.
- D. Space anchors to provide not less than one anchor per **2 sq. ft. (0.2 sq. m)** of wall area. Install additional anchors within **12 inches (300 mm)** of openings, sealant joints, and perimeter at intervals not exceeding **12 inches (300 mm)**.
- E. Set stone in full bed of mortar with full head joints unless otherwise indicated. Build anchors into mortar joints as stone is set.
- F. Fill space between back of stone masonry and weather-resistant sheathing paper with mortar as stone is set.
- G. Provide **1-inch (25-mm)** cavity between stone masonry and backup construction unless otherwise indicated. Keep cavity free of mortar droppings and debris.
 1. Slope beds toward cavity to minimize mortar protrusions into cavity.
 2. Do not attempt to trowel or remove mortar fins protruding into cavity.
- H. Rake out joints for pointing with mortar to depth of not less than **1/2 inch (13 mm)** before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

3.6 POINTING

- A. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than **3/8 inch (10 mm)** deep until a uniform depth is formed.
- B. Point stone joints by placing and compacting pointing mortar in layers of not more than **3/8 inch (10 mm)** deep. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- C. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint profile:
 1. Joint Profile: Concave.

3.7 ADJUSTING AND CLEANING

- A. Remove and replace stone masonry of the following description:
 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
 2. Defective joints.
 3. Stone masonry not matching approved samples and mockups.
 4. Stone masonry not complying with other requirements indicated.
- B. Replace in a manner that results in stone masonry matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:
 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 2. Test cleaning methods on mockup; leave one-half of panel uncleared for comparison purposes. Obtain Architect's approval of sample cleaning before cleaning stone masonry.
 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid stripable masking agent, polyethylene film, or waterproof masking tape.
 4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.
 5. Clean stone masonry by bucket and brush hand-cleaning method described in BIA Technical Note No. 20, Revised II, using job-mixed detergent solution.
 6. Clean stone masonry with proprietary acidic cleaner applied according to manufacturer's written instructions.

3.8 EXCESS MATERIALS AND WASTE

- A. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other waste, and legally dispose of off Owner's property.

END OF SECTION 044313.13

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes structural steel.
- B. This Section includes structural steel and architecturally exposed structural steel.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 1. Section 014500 "Quality Requirements" for independent testing agency procedures and administrative requirements.
 2. Section 042000 "Unit Masonry" for masonry anchors attached to steel.
 3. Section 055000 "Metal Fabrications" for loose steel bearing plates and miscellaneous steel framing.

1.3 DESIGN CRITERIA

- A. Members and connections not shown on the Drawings shall be designed by the Fabricator to meet requirements of the current issue of the Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings published by the American Institute of Steel Construction. Make proper provisions to prevent excessive stresses wherever piles of material, erection equipment, or other loads are carried during erection.
- B. Allowable Loads: When details or reactions are not shown, select connections to support maximum end reactions using Tables for Allowable Loads on Beams in the AISC Manual of Steel Construction for the given shape, span, and steel specified for the subject member.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of product specified.
- C. Shop Drawings detailing fabrication of structural steel components.
 1. Erection plans with dimensioned location and size of members.

2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.
 5. Include Shop Drawings signed and sealed by a qualified professional engineer responsible for their preparation.
- D. Qualification data, if requested, for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information requested.
- E. Connection Calculations: Submit with shop drawings all connection calculations signed and sealed by the engineer responsible for the design of the connections.
- F. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.
1. Structural steel, including chemical and physical properties.
 2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 3. Direct-tension indicators.
 4. Shop primers.
 5. Nonshrink grout.
 6. Concrete anchor studs.
 7. Deformed bar anchors.
 8. Twist-off tension control bolts.
 9. Shear stud connectors.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.
1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:
 - a. Category: Category I, conventional steel structures.
- C. Comply with applicable provisions of the following specifications and documents:
1. American Institute of Steel Construction (AISC) "Code of Standard Practice for Steel Buildings and Bridges."

- a. Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence:
 - 1) "This approval constitutes the owner's acceptance of all responsibility for the design adequacy of any detail configuration of connections developed by the fabricator as a part of his preparation of these shop drawings."
 - 2. AISC's "Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings."
 - 3. AISC's "Specification for Load and Resistance Factor Design of Single-Angle Members."
 - 4. AISC's "Seismic Provisions for Structural Steel Buildings."
 - 5. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.
- E. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."
- 1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 SEQUENCING

- A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel Wide Flange Shapes: As follows:
 - 1. ASTM A 992.
- B. Miscellaneous Structural Steel Shapes, Plates, and Bars: As follows:
 - 1. Carbon Steel: ASTM A 36 (ASTM A 36M).
- C. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B.
- D. Steel Pipe: ASTM A 53, Type E or S, Grade B.
- E. Deformed Bar Anchors: Cold drawn wire, conforming to ASTM A 496, minimum tensile strength of 80,000 psi, and straight and solid fluxed.
- F. Anchor Bolts: ASTM A 307 or A36 headed bolts with rolled threads. Bars with threads and a staked heavy hex nut at the bottom may be substituted for headed bolts. Hooked anchor bolts are not acceptable. Anchor bolts supporting column baseplates shall be double nutted to support members until grout is placed.
- G. Nonhigh-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers.
 - 1. Finish: Plain, uncoated.
- H. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Bolts shall be 3/4-inch diameter, unless shown otherwise on the Drawings.
 - 2. Connections shall be bearing type with threads included in shear plane, unless noted otherwise on the drawings.
 - 3. Finish: Plain, uncoated.
 - 4. Direct-Tension Indicators: ASTM F 959, Type 325, uncoated.
 - a. Finish: Plain, uncoated.
- I. Welding Electrodes: Comply with AWS requirements.

- J. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers.

2.2 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: Grout shall be prepackaged, non-metallic, non-gaseous. It shall be non-shrink when tested in accordance with CRD C 621 and ASTM C 1107 at a fluid (flow cone) consistency of 20-30 seconds. Grout shall be bleed free and attain 7,500 psi compressive strength in 28 days when tested at fluid consistency.

2.4 FABRICATION

- A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.
 - 1. Camber structural steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A 6 (ASTM A 6M) and maintain markings until steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
 - 5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
 - 6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded.
- C. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.
- D. Concrete Anchor Studs and Deformed Bar Anchors: Weld in accord with the manufacturer's recommendations. Test welds in accord with AWS D1.1.
- E. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.

1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
 2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.
- F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

2.5 SHOP CONNECTIONS

- A. Shop install and tighten high-strength bolts according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 1. Bolts: ASTM A 325 (ASTM A 325M) high-strength bolts, unless otherwise indicated.
 2. Bolts: ASTM A 490 (ASTM A 490M) high-strength bolts, unless otherwise indicated.
 3. Connection Type: Fully tightened using one of the four methods described in the RCSC Specification.
- B. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
 2. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.6 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed-on fireproofing.
 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications as follows:
 1. SSPC-SP 3 "Power Tool Cleaning."

2. SSPC-SP 6 "Commercial Blast Cleaning," Steel Exposed to Weather.
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 3.0 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.7 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated according to ASTM A 123:
 1. Exterior steel angle lintels.
 2. Bottom plate on exterior steel beam lintels.
 3. All exterior framing.

2.8 SOURCE QUALITY CONTROL

- A. When required by Paragraph 1.5.B.1.C., engage an independent testing and inspecting agency to perform shop inspections and tests and to prepare test reports.
 1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.
 2. Provide testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.
- C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- D. Shop-bolted connections will be tested and inspected according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 1. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.
- E. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.
 1. Liquid Penetrant Inspection: ASTM E 165.
 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
 4. Ultrasonic Inspection: ASTM E 164.

- F. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
- G. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.2 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.
- B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
 - 3. Fill volume between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
 - a. Comply with manufacturer's instructions for proprietary grout materials.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 1. Maintain erection tolerances of architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be

in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
- E. Splice members only where indicated.
- F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members that are not under stress, as acceptable to Architect-Engineer. Finish gas-cut sections equal to a sheared appearance when permitted.
- H. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.
- I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.3 FIELD CONNECTIONS

- A. Install and tighten non-high-strength bolts, except where high-strength bolts are indicated.
- B. Install and tighten high-strength bolts according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 1. Bolts: ASTM A 325 (ASTM A 325M) high-strength bolts, unless otherwise indicated.
 2. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.
 - a. Twist off tension control bolts may be used at the Contractor's option.
 3. Connection Type: Slip-critical, direct-tension, or tensioned shear/bearing connections as indicated shall be tightened using direct tension indicators.
- C. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
 1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
 3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface

bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.

3.4 FIELD QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform field inspections and tests and prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.
- C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- D. Field-bolted connections will be tested and inspected according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 1. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.
- E. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
 - 4. Ultrasonic Inspection: ASTM E 164.
- F. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

3.5 CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
 - 1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils (0.038 mm).

- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on structural steel are included in Division 9 Section "Painting."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.
- D. Brush apply two coats of bituminous paint to steel surfaces exposed to earth. Apply in accord with the manufacturer's recommendations.

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Roof deck.
2. Composite floor deck.

- B. Related Sections include the following:

1. Section 033000 "Cast-in-Place Concrete" for concrete fill on metal decks.
2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
- C. Product Certificates: For each type of steel deck, signed by product manufacturer.
- D. Welding certificates.
- E. Field quality-control test and inspection reports.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 1. Power-actuated mechanical fasteners.
- G. Research/Evaluation Reports: For steel deck.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- D. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Steel Deck:
 - a. ASC Profiles, Inc.
 - b. Canam Steel Corp.;The Canam Manac Group.
 - c. Consolidated Systems, Inc.
 - d. DACS, Inc.
 - e. D-Mac Industries Inc.
 - f. Epic Metals Corporation.
 - g. Marlyn Steel Decks, Inc.
 - h. Metal Dek Group; Unit of Csi.
 - i. New Millennium Building Systems, LLC.
 - j. Nucor Corp.; Vulcraft Division.
 - k. Roof Deck, Inc.
 - l. United Steel Deck, Inc.
 - m. Valley Joist; Division of EBSCO Industries, Inc.
 - n. Verco Manufacturing Co.
 - o. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
 - p. Pre-approved equal.

2.2 ROOF DECK

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 (230) minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 2. Deck Profile: As indicated.
 3. Profile Depth: As indicated.
 4. Design Uncoated-Steel Thickness: As indicated.
 5. Span Condition: Triple or more span.
 6. Side Laps: Overlapped.

2.3 COMPOSITE FLOOR DECK

- A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:
1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 40 (275), G60 (Z180) zinc coating.
 2. Profile Depth: As indicated.
 3. Design Uncoated-Steel Thickness: As indicated.
 4. Span Condition: Triple or more span.

2.4 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 30 for overhang and slab depth.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch (1.52 mm) thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.
- J. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.
- K. Galvanizing Repair Paint: ASTM A 780.
- L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.
- M. Sound-Absorbing Insulation: Manufacturer's standard pre-molded roll or strip of glass or mineral fiber.
 - 1. Installation of sound-absorbing insulation is specified in Section 075423.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck, except at perimeter edges of deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions. Mechanical fasteners must meet the same pull out and shear values as welds. Engineering calculations must be provided for Engineer's review.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:
 1. Weld Diameter: 5/8 inch (16 mm) nominal.
 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds As Indicated.
 3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 18 inches (450 mm), and as follows, unless otherwise noted:
 1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
 1. End Joints: Lapped 2 inches (51 mm) minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches (305 mm) apart with at least one weld at each corner.
 1. Install reinforcing channels or zees in ribs to span between supports and weld.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.
 1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 1. Weld Diameter: 5/8 inch (16 mm) nominal.
 2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches (305 mm) apart, but not more than 18 inches (457 mm) apart.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches (910 mm), and as follows:
 1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
 2. Mechanically clinch or button punch.
 3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds at deck perimeter edge.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm) with end joints as follows:
 1. End Joints: Butted.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.
- F. Install piercing hanger tabs at 14 inches (355 mm) apart in both directions, within 9 inches (228 mm) of walls at ends, and not more than 12 inches (305 mm) from walls at sides, unless otherwise indicated.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Exterior nonload-bearing steel-stud walls.
2. Soffit framing.

- B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Section 072100 "Thermal Insulation" for blanket insulation installed in exterior walls.
2. Section 061600 "Sheathing" for gypsum sheathing applied to exterior steel framing.
3. Section 092900 "Gypsum Board" for gypsum board and nonload-bearing metal-stud framing and ceiling-suspension assemblies.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

- B. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

- C. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated.
2. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).

1.4 SUBMITTALS

- A. Product data for each type of cold-formed metal framing, accessory, and product specified.

- B. Shop drawings signed and sealed by the engineer responsible for their preparation, showing layout, spacings, sizes, thicknesses, and types of cold-formed metal framing, fabrication, fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachments to other units of Work.
- C. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- D. Product test reports from a qualified independent testing agency evidencing compliance with requirements of the following based on comprehensive testing:
 - 1. Expansion anchors.
 - 2. Powder-actuated anchors.
 - 3. Mechanical fasteners.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed cold-formed metal framing similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Engineer responsible for design of all cold formed framing and shop drawings shall be licensed in the state which the project is located.
 - 1. All sizes shown on drawings are minimum requirements. Final sizes, thicknesses, and components are to be determined by the cold-formed framing engineer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated in the Work include, but are not limited to, the following:
1. Allied Studco.
 2. Consolidated Fabricators Corp., Building Products Division.
 3. Custom Stud, Inc.
 4. Dietrich Metal Framing, a Worthington Industries Company.
 5. MarinoWare.
 6. SCAFCO Steel Stud Manufacturing Co.
 7. Steel Network, Inc. (The).
 8. Telling Industries.

2.2 MATERIALS

- A. Galvanized-Steel Sheet: ASTM A 446 (ASTM A 446M), zinc coated according to ASTM A 525 (ASTM A 525M), and as follows:
1. Coating Designation: G 60 (Z 180).
 2. Coating Designation at Exterior Walls: G 90 (Z 275).
 3. Grade: Grade A, 33,000 psi (230 MPa) minimum yield strength, 20 percent elongation for 18 and 20 gauge materials.
 4. Grade: Grade D, 50,000 psi (345 MPa) minimum yield strength, 12 percent elongation for 16 gauge and heavier materials.

2.3 EXTERIOR NON-LOAD BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs of web depths indicated, with lipped flanges, and complying with the following:
1. Design Uncoated-Steel Thickness: 0.0598 inch (16 gauge) (1.52 mm).
 2. Flange Width: 1-5/8 inches (41 mm).
 3. Web: Unpunched.
- B. Steel Track: Manufacturer's standard U-shaped steel track, unpunched, of web depths indicated, with straight flanges, and complying with the following:
1. Design Uncoated-Steel Thickness: 0.0598 inch (16 gauge) (1.52 mm).
 2. Flange Width: Manufacturers standard deep flange where indicated, standard flange elsewhere.

- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AllSteel & Gypsum Products, Inc.
 - b. ClarkWestern Building Systems, Inc.
 - c. Dietrich Metal Framing; a Worthing Industries company.
 - d. MarinoWARE.
 - e. SCAFCO Corporation.
 - f. Steel Network, Inc. (The).
- D. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.4 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
 2. Flange Width: 1-5/8 inches (41 mm) minimum.

2.5 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi (230 MPa).
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Supplementary framing.
 2. Bracing, bridging, and solid blocking.
 3. Web stiffeners.
 4. Gusset plates.
 5. Stud kickers and girts.
 6. Reinforcement plates.

2.6 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36 (ASTM A 36M).

- B. Cast-in-Place Anchor Bolts and Studs: ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); carbon-steel hex-head bolts and studs; carbon-steel nuts; and flat, unhardened-steel washers.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times the design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- D. Powder-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times the design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- E. Mechanical Fasteners: Corrosion-resistant coated, self-drilling, self-threading steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and a 30-minute working time.

2.8 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, true to line, and with connections securely fastened, according to manufacturer's recommendations and the requirements of this Section.
 - 1. Fabricate framing assemblies in jig templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Locate mechanical fasteners and install according to cold-framed metal framing manufacturer's instructions with screw penetrating joined members by not less than 3 exposed screw threads.
 - 4. Fasten other materials to cold-formed metal framing by bolting, or screw fastening, according to manufacturer's recommendations.

- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or distortion.
- C. Fabrication Tolerances: Fabricate assemblies to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements, including installation tolerances and other conditions affecting performance of cold-formed metal framing. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Grout bearing surfaces uniform and level to ensure full contact of bearing flanges or track webs on supporting concrete or masonry construction.
- B. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing and accessories plumb, square, true to line, and with connections securely fastened, according to manufacturer's recommendations and the requirements of this Section.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

- b. Locate mechanical fasteners and install according to cold-framed metal framing manufacturer's instructions with screw penetrating joined members by not less than 3 exposed screw threads.
- C. Install framing members in one-piece lengths, unless splice connections are indicated for track or tension members.
- D. Provide temporary bracing and leave in place until framing is permanently stabilized.
- E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- F. Install insulation in built-up exterior framing members, such as headers, sills, boxed joists, and double studs, inaccessible upon completion of framing work.
- G. Fasten reinforcement plate over web penetrations that exceed size of manufacturer's standard punched openings.
- H. Erection Tolerances: Install cold-formed metal framing to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch (1:960) and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NONLOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Squarely seat studs against webs of top and bottom tracks. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: 16 inches (406 mm), unless noted otherwise.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate steel framing from building structure at locations indicated to prevent transfer of vertical loads while providing lateral support.
 - 1. Install deflection track and anchor to building structure.
 - 2. Connect studs with vertical slide clips to continuous angles or supplementary framing anchored to building structure.
- E. Install horizontal bridging in studs, spaced in rows not more than 48 inches (1219 mm) apart. Fasten at each stud intersection.

1. Install additional row of horizontal bridging in stud beneath deflection track when studs are not fastened to an additional top track.
 2. Bridging: Cold-rolled steel channel, clip angle fastened to webs of punched studs.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtainwall-framing system.

3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanizing repair paint according to ASTM A 780 and the manufacturer's instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer to ensure that cold-formed metal framing is without damage or deterioration at the time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Rough hardware.
2. Loose bearing and leveling plates.
3. Miscellaneous framing and supports for the following:
 - a. Applications where framing and supports are not specified in other Sections.
4. Pipe bollards.
5. Trash enclosure gate, framing, and hardware.
6. Miscellaneous metal items and shapes required for the completed work indicated.

- B. Related Sections include the following:

1. Section 051200 "Structural Steel" for structural-steel framing system components.
2. Section 061053 "Miscellaneous Rough Carpentry" for metal framing anchors and other rough hardware.

1.3 SUBMITTALS

- A. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
 1. Provide templates for anchors and bolts specified for installation under other Sections.
- B. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.
- C. Welding Certificates: Copies of certificates for welding procedures and personnel.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- C. Codes and Standards: Comply with provisions of following, except as otherwise indicated:
 - 1. AISC "Code of Standard Practice for Steel Buildings and Bridges.
 - a. Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence: "This approval constitutes the Owner's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these Shop Drawings."
 - 2. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings," including "Commentary" and Supplements thereto as issued.
 - 3. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
 - 4. AWS D1.1 "Structural Welding Code."
 - 5. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piping and Bars for Structural Use."

1.5 PROJECT CONDITIONS

- A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.2 METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Wire Rod for Grating Crossbars: ASTM A 510 (ASTM A 510M).
- C. Uncoated Steel Sheet: ASTM A 570/A 570M, Grade 33.
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating.
- E. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.
- F. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- G. Slotted Channel Framing: Cold-formed metal channels with flange edges returned toward web and with 9/16-inch- (14.3-mm-) wide slotted holes in webs at 2 inches (51 mm) o.c.
1. Width of Channels: 1-5/8 inches (41 mm).
 2. Depth of Channels: 1-5/8 inches (41 mm).
 3. Metal and Thickness: Galvanized steel complying with ASTM A 653/A 653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating; 0.108-inch (2.8-mm) nominal thickness.
 4. Metal and Thickness: Uncoated steel complying with ASTM A 570, Grade 33; 0.0966-inch (2.5-mm) minimum thickness.
 5. Finish: Hot-dip galvanized after fabrication.
- H. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
- I. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.3 PAINT

- A. Shop Primers: Provide primers that comply with Division 09 painting Sections.
- B. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- D. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FASTENERS

- A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36.
- D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- F. Wood Screws: Flat head, carbon steel, ASME B18.6.1.
- G. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).
- H. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).
- I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
- J. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

2.5 GROUT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- B. Products: Subject to compliance with requirements, provide one of the following:
 1. Nonshrink Nonmetallic Grouts:
 - a. Euclid Chemical Co.; Euco N-S Grout.
 - b. L&M Construction Chemicals, Inc.; Crystex.
 - c. Master Builders; Masterflow 713.
 - d. WR Meadows, Inc.; Sealtight 588 Grout.
 - e. Sonneborn Building Products Div., Rexnord Chemical Products, Inc.; Sonogrout.

2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Shear and punch metals cleanly and accurately. Remove burrs.
- C. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Weld corners and seams continuously to comply with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

- H. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- J. Remove sharp or rough areas on exposed traffic surfaces.
- K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.7 ROUGH HARDWARE

- A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete.
- B. Fabricate items to sizes, shapes, and dimensions required.

2.8 PIPE BOLLARDS

- A. Fabricate pipe bollards from Schedule 80 steel pipe.
 - 1. All vertical bollards to be filled with nonshrink grout or concrete.

2.9 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.
- B. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long at 24 inches (600 mm) o.c., unless otherwise indicated.
 - 2. Furnish inserts if units must be installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports.

2.10 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from structural-steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches (150 mm) from each end, 6 inches (150 mm) from corners, and 24 inches (600 mm) o.c., unless otherwise indicated.
- C. Galvanize miscellaneous steel trim in the following locations:
 - 1. Exterior.
 - 2. Interior, where indicated.

2.11 TRASH ENCLOSURE GATE, FRAMING AND HARDWARE

- A. Fabricated gate and framing from galvanized steel pipe (Schedule 40), conforming to ASTM F 1083, according to heavy industrial requirements of ASTM F 669, Group 1A, with minimum yield strength of 25,000 psi, with no less than 1.8 oz. of zinc per square foot.
- B. Fabricate framing and gate in sizes and configuration indicated on Drawings.
- C. Gate Hardware: Provide galvanized hardware and accessories, as indicated.

2.12 PIPE BOLLARDS

- A. Fabricate pipe bollards from Schedule 80 steel pipe.
 - 1. All vertical bollards to be filled with nonshrink grout or concrete.

2.13 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.14 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 - 1. ASTM A 123, for galvanizing steel and iron products.
 - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of racking; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

3.3 INSTALLING PIPE BOLLARDS

- A. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. After bollards have been inserted into sleeves, fill annular space between bollard and sleeve solidly with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 057300 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Stainless Steel Railings.

1.3 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas and for pedestrian guidance and support, visual separation, or wall protection.

1.4 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not meet structural performance requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:

- 1. Manufacturer's product lines of railings assembled from standard components.
 - 2. Grout, anchoring cement, and paint products.

- B. Shop Drawings: Include plans, elevations, sections, and attachment details.

- 1. For illuminated railings, include wiring diagrams and roughing-in details.

- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods, including structural analysis, preconstruction testing, field testing, and in-service performance.
 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Stainless Steel: 60 percent of minimum yield strength.
 - 2. Steel: 72 percent of minimum yield strength.
- C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of **50 lbf/ft. (0.73 kN/m)** applied in any direction.
 - b. Concentrated load of **200 lbf (0.89 kN)** applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of **50 lbf (0.22 kN)** applied horizontally on an area of **1 sq. ft. (0.093 sq. m)**.
 - b. Infill load and other loads need not be assumed to act concurrently.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.
 - 1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
 - 2. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
 - 3. Provide formed-steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.
 - 4. Provide extruded-aluminum brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.

2.4 STAINLESS STEEL

- A. Tubing: ASTM A 554 Grade MT 316.

- B. Pipe: ASTM A 312/A 312M Grade TP 316.
- C. Castings: ASTM A 743/A 743M, Grade CF 8M or CF 3M.
- D. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 316.
- E. Bars and Shapes: ASTM A 276, Type 316.

2.5 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Stainless-Steel Components: Type 316 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless exposed fasteners are the standard fastening method for railings indicated.
 - 1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately **1/32 inch (1 mm)** unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds; no evidence of a welded joint.
- I. Form changes in direction as follows:
 - 1. As detailed.
- J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.
- L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.9 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
- C. Directional Satin Finish: No. 4.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of **1/16 inch in 3 feet (2 mm in 1 m)**.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed **1/4 inch in 12 feet (5 mm in 3 m)**.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than **5 inches (125 mm)** deep and **3/4 inch (20 mm)** larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

3.5 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057300

SECTION 057313 - GLAZED DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Glass-supported guards.

1.3 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas and for pedestrian guidance and support, visual separation, or wall protection.

1.4 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of railings assembled from standard components.
 - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, and attachment details.
- C. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.

- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Products furnished indicated to comply with requirements.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- C. Preconstruction test reports.
- D. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods, including structural analysis, preconstruction testing, field testing, and in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
 2. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA's Aluminum Curtain Wall Series No. 12, "Structural Properties of Glass."
- C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
 - a. Uniform load of **50 lbf/ft.** (**0.73 kN/m**) applied in any direction.
 - b. Concentrated load of **200 lbf** (**0.89 kN**) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of **50 lbf** (**0.22 kN**) applied horizontally on an area of **1 sq. ft.** (**0.093 sq. m**).
 - b. Infill load and other loads need not be assumed to act concurrently.

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.4 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Die and Hand forgings: **ASTM B 247 (ASTM B 247M)**, Alloy 6061-T6.
- C. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.5 STAINLESS STEEL

- A. Sheet, Strip, Plate, and Flat Bar: ASTM A 666 or ASTM A 240/A 240M, Type 304.

2.6 GLASS AND GLAZING MATERIALS

- A. Safety Glazing: Glazing shall comply with 16 CFR 1201, Category II.

- B. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type 1 (transparent flat glass), Quality-Q3. Provide products that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to 16 CFR 1201 for Category II materials.
 - 1. Glass Color: Clear.
 - 2. Thickness for Structural Glass Balusters: As required by structural loads, but not less than 12.0 mm.
 - 3. Thickness for Glass Infill Panels: As required by structural loads, but not less than 10.0 mm.
 - 4. Thickness: As indicated on Drawings.
- C. Safety Glazing Labeling: Permanently mark glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- D. Glazing Cement and Accessories for Structural Glazing: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal subrails.
 - 1. Glazing Cement: Nonshrinking organic cement designed for curing by passing an electric current through metal subrail holding glass panel, as standard with manufacturer.
- E. Glazing Gaskets for Glass Infill Panels: Glazing gaskets and related accessories recommended or supplied by railing manufacturer for installing glass infill panels in post-supported railings.

2.7 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Aluminum Components: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or **ASTM F 1941 (ASTM F 1941M)**, Class Fe/Zn 5, unless otherwise indicated.

2.8 MISCELLANEOUS MATERIALS

- A. Wood Rails: Clear, straight-grained hardwood rails secured to recessed metal subrail.
 - 1. Species: Ipe hardwood.
 - 2. Finish: Penetrating oil.
 - 3. Staining: None.
 - 4. Profile: Round, **2-inch (50-mm)** diameter.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.9 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately **1/32 inch (1 mm)** unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- H. Form changes in direction as follows:
 - 1. As detailed.

- I. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- J. Close exposed ends of hollow railing members with prefabricated end fittings.
- K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work where indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.
- L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.10 GLAZING PANEL FABRICATION

- A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.
 - 1. Clean-cut or flat-grind edges at butt-glazed sealant joints to produce square edges with slight chamfers at junctions of edges and faces.
 - 2. Grind smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.
- B. Structural Glass Balusters: Factory-bond glass to aluminum base and top-rail channels in railing manufacturer's plant using glazing cement to comply with manufacturer's written specifications, unless field glazing is standard with manufacturer.
- C. Infill Panels: Provide tempered glass panels.

2.11 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.12 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
- C. Directional Satin Finish: No. 4.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of **1/16 inch in 3 feet (2 mm in 1 m)**.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed **1/4 inch in 12 feet (5 mm in 3 m)**.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

3.3 INSTALLING GLASS PANELS

- A. Glass-Supported Railings: Install assembly to comply with railing manufacturer's written instructions.
 - 1. Attach base channel to building structure, then insert and connect factory-fabricated and - assembled glass panels if glass was bonded to base and top-rail channels in factory.
 - 2. Attach base channel to building structure, then insert glass into base channel and bond with glazing cement unless glass was bonded to base and top-rail channels in factory.
 - a. Support glass panels in base channel at quarter points with channel-shaped setting blocks that also act as shims to maintain uniform space for glazing cement. Fill remaining space in base channel with glazing cement for uniform support of glass.
 - 3. Adjust spacing of glass panels so gaps between panels are equal before securing in position.
 - 4. Erect glass railings under direct supervision of manufacturer's authorized technical personnel.

3.4 CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with water and soap, rinsing with clean water, and wiping dry.
- B. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.
- C. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.
- D. Clean wood rails by wiping with a damp cloth and then wiping dry.

3.5 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057313

SECTION 057500 - DECORATIVE FORMED METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Perforated metal panels.

1.3 COORDINATION

- A. Coordinate installation of anchorages for decorative formed metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for decorative formed metal.
 - 1. Include plans, elevations, component details, and attachment details.
 - 2. Indicate materials and profiles of each decorative formed metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
 - 3. Provide layouts indicating cut and factory edges and fastener patterns.
- C. Samples for Verification: For each type of exposed finish required, prepared on 6-inch- (150-mm-) square Samples of metal of same thickness and material indicated for the Work.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For powder-coating applicator.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver decorative formed metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.
- B. Store products on elevated platforms in a dry location.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with decorative formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Decorative formed metal items, including supports, anchors and connections, shall withstand the effects of gravity loads and the following loads and stresses without exceeding the allowable design working stress of materials involved and without exhibiting permanent deformation in any components:
 - 1. Wind Loads on Exterior Items: As indicated on Drawings.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METAL

- A. General: Fabricate products from sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 316, stretcher-leveled standard of flatness.

2.3 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble decorative formed metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

- B. Coordinate dimensions and attachment methods of decorative formed metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
- C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch- (12-mm-) wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch (1 mm) and support with concealed stiffeners.
- D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.
 - 1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
- E. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce decorative formed metal items as needed to attach and support other construction.
- F. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install decorative formed metal items.
- G. Where welding or brazing is indicated, weld or braze joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.
 - 1. Use welding and brazing procedures that will blend with and not cause discoloration of metal being joined.

2.4 PERFORATED METAL PANELS

- A. Perforated Metal Panels: Stainless steel sheet, 3/16- inch thick, with 1/2- inch round holes on 11/16-inch staggered centers. Open area: 48 percent.
 - 1. Basis-of-Design Product: Provide product with perforations matching McNichols Company Perforated Metal Products.
 - 2. Orient perforated metal panels vertically on vertical sides.
 - 3. Panel joints on tops and bottoms of structures shall align with panel joints on vertical sides.

2.5 GENERAL FINISH REQUIREMENTS

- A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Apply finishes to formed metal after fabrication unless otherwise indicated.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
- C. Directional Satin Finish: No. 4.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative formed metal.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.
 - 1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- B. Fasten panels to structure at 16 inches minimum spacing on entire perimeter of each panel in a uniform pattern, panel-to-panel, except fasten aluminum panels and supports per delegated engineering design in uniform spacing.

- C. Form tight joints with exposed connections accurately fitted together.

3.3 ADJUSTING AND CLEANING

- A. Unless otherwise indicated, clean metals by washing thoroughly with water and soap, rinsing with clean water, and drying with soft cloths.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

- A. Protect finishes of decorative formed metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 057500

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Rooftop equipment bases and support curbs.
2. Wood blocking and nailers.
3. Plywood backing panels.

- B. Related Sections include the following:

1. Section 064023 "Interior Architectural Woodwork" for interior woodwork not specified in this Section.

1.3 DEFINITIONS

- A. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NELMA - Northeastern Lumber Manufacturers Association.
2. NLGA - National Lumber Grades Authority.
3. SPIB - Southern Pine Inspection Bureau.
4. WCLIB - West Coast Lumber Inspection Bureau.
5. WWPA - Western Wood Products Association.

1.4 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include

- physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
- B. For the following, showing compliance with building code in effect for Project:
1. Preservative-treated wood.
 2. Fire-retardant-treated wood.
 3. Power-driven fasteners.
 4. Powder-actuated fasteners.
 5. Expansion anchors.
 6. Metal framing anchors.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 3. Provide dressed lumber, S4S, unless otherwise indicated.
 4. Provide dry lumber with 15 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.
- B. Wood Structural Panels:
1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
 2. Thickness: As needed to comply with requirements specified but not less than thickness indicated.
 3. Factory mark panels according to indicated standard.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPA C2 (lumber) and AWPA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and one of the following:
 - a. Ammoniacal copper zinc arsenate (ACZA) may be used for Douglas fir.
- B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 3. Wood framing members less than 18 inches (460 mm) above grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.
 2. Use treatment that does not promote corrosion of metal fasteners.
 3. Use Exterior type for exterior locations and where indicated.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including the following:
 1. Rooftop equipment bases and support curbs.
 2. Blocking.
 3. Nailers.
 4. Furring.
 5. Grounds.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 15 percent maximum moisture content and any of the following species:

1. Mixed southern pine; SPIB.
 2. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWPA.
 3. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
1. Mixed southern pine, No. 2 grade; SPIB.
 2. Hem-fir or Hem-fir (north), Construction or 2 Common grade; NLGA, WCLIB, or WWPA.
 3. Spruce-pine-fir (south) or Spruce-pine-fir, Construction or 2 Common grade; NELMA, NLGA, WCLIB, or WWPA.

2.5 PANEL PRODUCTS

- A. Miscellaneous Concealed Plywood: Exposure 1 sheathing, span rating to suit framing in each location, and thickness as indicated but not less than 1/2 inch (13 mm).
- B. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch (12.7 mm) thick.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 1. Where carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Wire, Brads, and Staples: FS FF-N-105.
- C. Power-Driven Fasteners: CABO NER-272.
- D. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- E. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- F. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.
- D. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.
- E. Countersink fastener heads on exposed carpentry work and fill holes with wood filler.
- F. Use fasteners of appropriate type and length. Predrill members when necessary to avoid splitting wood.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

END OF SECTION 061053

SECTION 061063 - EXTERIOR ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Wood fences, lumber, and boards

1.3 DEFINITIONS

- A. Boards: Lumber of less than **2 inches nominal (38 mm actual)** in thickness and **2 inches nominal (38 mm actual)** or greater in width.
- B. Dimension Lumber: Lumber of **2 inches nominal (38 mm actual)** or greater but less than **5 inches nominal (114 mm actual)** in least dimension.
- C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. RIS: Redwood Inspection Service.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

- A. Product Data: For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.

1.5 INFORMATIONAL SUBMITTALS

- A. Certificates of Inspection: Issued by lumber grading agency for exposed wood products not marked with grade stamp.
- B. Evaluation Reports: For preservative-treated wood products, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Lumber Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Lumber Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials under cover and protected from weather and contact with damp or wet surfaces. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

- A. Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by ALSC's Board of Review.
 - 1. Factory mark each item with grade stamp of grading agency.
 - 2. For items that are exposed to view in the completed Work, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
 - 4. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content:
 - 1. Boards: 15 percent.
 - 2. Dimension Lumber: 15 percent for **2-inch nominal (38-mm actual)** thickness or less; 19 percent for more than **2-inch nominal (38-mm actual)** thickness.
 - 3. Timber. 19 percent.

2.2 LUMBER

- A. Hand select wood for freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot holes, shake, splits, torn grain, and wane.
- B. Dimension Lumber: Select Structural grade and the following species:
 - 1. Ipe hardwood.

C. Boards:

1. Ipe hardwood.

2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than **1-1/2 inches (38 mm)** into wood substrate.
1. Use stainless steel unless otherwise indicated.
- B. Nails: ASTM F 1667.
- C. Power-Driven Fasteners: ICC-ES AC70.
- D. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.
- E. Carbon-Steel Bolts: **ASTM A 307 (ASTM F 568M)** with **ASTM A 563 (ASTM A 563M)** hex nuts and, where indicated, flat washers all hot-dip zinc coated.
- F. Stainless-Steel Bolts: **ASTM F 593, Alloy Group 1 or 2 (ASTM F 738M, Grade A1 or Grade A4)**; with **ASTM F 594, Alloy Group 1 or 2 (ASTM F 836M, Grade A1 or Grade A4)** hex nuts and, where indicated, flat washers.
- G. Postinstalled Anchors: Stainless-steel, chemical or torque-controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E 488, conducted by a qualified independent testing and inspecting agency.
1. Stainless-steel bolts and nuts complying with **ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or Grade A4)**.

2.4 METAL ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. comparable products by one of the following:
1. [Cleveland Steel Specialty Co.](#)
 2. [KC Metals Products, Inc.](#)
 3. [Phoenix Metal Products, Inc.](#)
 4. [R. H. Tamlyn & Sons LP.](#)
 5. [Simpson Strong-Tie Company, Inc.](#)
 6. [USP Structural Connectors.](#)

- C. Stainless-Steel Sheet: ASTM A 666, Type 316.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.
- B. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.
- C. Install metal framing anchors to comply with manufacturer's written instructions.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of members or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- G. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. ICC-ES AC70 for power-driven fasteners.
 - 2. "Fastening Schedule" in ICC's International Building Code.
 - 3. "Fastener Schedule for Structural Members" and "Alternate Attachments" in ICC's International Residential Code for One- and Two-Family Dwellings.
- H. Use common wire nails unless otherwise indicated. Select fasteners of size that do not fully penetrate members where opposite side is exposed to view. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads unless otherwise indicated.

END OF SECTION 061063

SECTION 061323 - HEAVY TIMBER CONSTRUCTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes framing using timbers.
- B. Related Sections:
 - 1. Division 06 Section "Rough Carpentry" for dimension lumber items associated with heavy timber construction.

1.3 DEFINITIONS

- A. Timbers: Lumber of 5 inches nominal (114 mm actual) or greater in least dimension.
- B. Poles: Round wood members, called either "poles" or "posts" in the referenced standards.
- C. Inspection agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA - Northeastern Lumber Manufacturers Association.
 - 2. NHLA - National Hardwood Lumber Association.
 - 3. NLGA - National Lumber Grades Authority.
 - 4. SPIB - Southern Pine Inspection Bureau.
 - 5. WCLIB - West Coast Lumber Inspection Bureau.
 - 6. WWPA - Western Wood Products Association.

1.4 SUBMITTALS

- A. Product Data: For preservative-treated wood products and timber connectors.
 - 1. For preservative-treated wood products, include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
 - 2. For timber connectors, include installation instructions.
- B. Shop Drawings: For heavy timber construction. Show layout, dimensions of each member, and details of connections.
- C. Material Certificates:

1. For heavy timber construction specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by ALSC's Board of Review.
 2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
- D. Certificates of Inspection: Issued by lumber grading agency for exposed timber not marked with grade stamp.

1.5 QUALITY ASSURANCE

- A. Timber Standard: Comply with AITC 108, "Standard for Heavy Timber Construction."
- B. Forest Certification: Provide wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Schedule delivery of heavy timber construction to avoid extended on-site storage and to avoid delaying the Work.
- B. Store materials under cover and protected from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.1 TIMBER

- A. General: Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable.
 1. Factory mark each item of timber with grade stamp of grading agency.
 2. For exposed timber indicated to receive a stained or natural finish, apply grade stamps to surfaces that will not be exposed to view, or omit grade stamps and provide certificates of grade compliance issued by grading agency.
- B. Timber Species and Grade: Ipe hardwood.
- C. Moisture Content: Provide timber with 19 percent maximum moisture content at time of dressing or provide timber that is unseasoned at time of dressing but with 19 percent maximum moisture content at time of installation.
- D. Dressing: Provide dressed timber (S4S) timber that is rough sawn (Rgh) unless otherwise indicated.

- E. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- F. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.2 TIMBER CONNECTORS

- A. General: Unless otherwise indicated, fabricate from the following materials:
 - 1. Structural-steel shapes, plates, and flat bars complying with ASTM A 36/A 36M.
 - 2. Round steel bars complying with ASTM A 575, Grade M 1020.
 - 3. Hot-rolled steel sheet complying with ASTM A 1011/A 1011M, Structural Steel, Type SS, Grade 33.
 - 4. Stainless-steel plate and flat bars complying with ASTM A 666, Type 316.
 - 5. Stainless-steel bars and shapes complying with ASTM A 276, Type 316.
 - 6. Stainless-steel sheet complying with ASTM A 666, Type 316.
- B. Fabricate beam seats from stainless steel with [0.239-inch (6-mm)] [3/16-inch (8-mm)] [3/8-inch (9.5-mm)] bearing plates, 3/4-inch- (19-mm-) diameter-by-12-inch- (300-mm-) long deformed bar anchors, and 0.239-inch (6-mm) side plates.
- C. Provide bolts, 3/4 inch (19 mm) unless otherwise indicated, complying with **ASTM A 307, Grade A** (**ASTM F 568M, Property Class 4.6**); provide nuts complying with **ASTM A 563** (**ASTM A 563M**); and, where indicated, provide flat washers.
- D. Provide shear plates, [2-5/8 inches (66.7 mm)] [4 inches (102 mm)] in diameter, complying with ASTM D 5933.

2.3 FABRICATION

- A. Shop fabricate members by cutting and restoring exposed surfaces to match specified surfacing. Finish exposed surfaces to remove planing or surfacing marks, and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
- B. Predrill for fasteners and assembly of units.
- C. Coat crosscuts with end sealer.
- D. Seal Coat: After fabricating and surfacing each unit, apply a saturation coat of penetrating sealer on surfaces of each unit except for treated wood where the treatment included a water repellent.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Erect heavy timber construction true and plumb. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
 - 1. Install heavy timber construction to comply with Shop Drawings.
 - 2. Handle and temporarily support heavy timber construction to prevent surface damage, compression, and other effects that might interfere with indicated finish.
- B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.
- C. Fit members by cutting and restoring exposed surfaces to match specified surfacing. Predrill for fasteners and assembly of units.
 - 1. Finish exposed surfaces to remove planing or surfacing marks, and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
 - 2. Coat crosscuts with end sealer.
- D. Install timber connectors as indicated.
 - 1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
 - 2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3.2 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged heavy timber construction if repairs are not approved by Architect.

END OF SECTION 061323

SECTION 061600 – SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following applications of gypsum sheathing:
 1. Wall sheathing.
- B. Related Sections: The following sections contain requirements that relate to this section:
 1. Section 042000 “Unit Masonry” for masonry veneer anchors.
 2. Section 054000 “Cold-Formed Metal Framing” for steel framing of walls covered with sheathing.

1.3 DEFINITIONS

- A. Gypsum Board Construction Terminology Standard: Refer to ASTM C 11 and GA 505 for definitions of terms for gypsum board construction not otherwise defined in this Section or other referenced standards.

1.4 SUBMITTALS

- A. Submit the following information:
 1. Product data for gypsum sheathing indicated.
 2. Research reports or evaluation reports of model code organization acceptable to authority having jurisdiction which evidence compliance of air infiltration barrier with building code in effect for Project.
 3. Submit manufacturer's specifications and installation instructions for air infiltration barriers.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain gypsum sheathing from one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver gypsum sheathing board and related materials in original packages bearing brand name and identification of manufacturer.
- B. Store gypsum sheathing board so that it is protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum sheathing boards flat on leveled supports off the ground under protective covering.
- C. Handle gypsum sheathing board to prevent damage to edges, ends, and surfaces.

1.7 SEQUENCING AND SCHEDULING

- A. Sequence installation of gypsum sheathing board with installation of exterior cladding/finish system to comply with requirements indicated below:
 - 1. Do not leave gypsum sheathing board exposed to the weather after application for longer than one month.
 - a. Protect cutouts, corners and joints in the sheathing by filling them with a flexible sealant at the time sheathing is applied.
 - b. As an alternate to sealant application, cover exposed exterior surface of sheathing with building paper or air infiltration barrier. Anchor covering with metal lath securely fastened through sheathing to framing. Apply covering immediately after sheathing is installed.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS

- A. Plywood: Either DOC PS 1 or DOC PS 2.
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3b for exterior construction not in contact with the ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE-RETARDANT-TREATED (FRT) PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet (3.2 m)** beyond the centerline of the burners at any time during the test.
1. Use treatment that does not promote corrosion of metal fasteners.
 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 4. Design Value Adjustment Factors: Treated lumber plywood shall be tested according ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat plywood indicated on Drawings.

2.4 WALL SHEATHING

- A. Glass-Mat Gypsum Wall Sheathing: Gypsum sheathing board consisting of noncombustible gypsum core incorporating a water-resistant material, surfaced on face and back with inorganic glass fiber mats, and with unsurfaced square edges; complying with ASTM C 1177, and requirements indicated below:
1. Type: Regular, 1/2-inch thickness.
 2. Size: 48 by 96 inches.
 3. Products: Subject to compliance with requirements, provide the following:
 - a. G-P Gypsum Corporation; Dens-Glass Gold.
 - b. USG Company; Fiberock Aqua Tough.

B. Plywood Wall Sheathing: Exterior sheathing.

1. Span Rating: Not less than 42/0.
2. Nominal Thickness: Not less than $\frac{3}{4}$ inch unless otherwise indicated.

2.5 ACCESSORY MATERIALS

- A. Fasteners: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
1. For steel framing less than 0.0329 inch (0.835 mm) thick, attach sheathing with steel drill screws complying with ASTM C 1002.
 2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, attach sheathing with drill screws complying with ASTM C 954.

PART 3 - EXECUTION

3.1 GYPSUM SHEATHING INSTALLATION

- A. Except as otherwise indicated, comply with manufacturer's instructions, GA 252, and the following for the installation of gypsum sheathing.
1. Cut boards at penetrations, edges and other obstructions of the work; fit tight against abutting work, except provide 3/8 inch setback where non-loadbearing work abuts structural elements at head and jambs.
 2. Coordinate installation of sheathing with installation of flashing and joint sealers so that these combined materials are installed in the sequence and manner which prevents exterior moisture from passing through completed exterior wall assembly to the interior.
 3. Apply fasteners so that screw heads bear tightly against face of gypsum sheathing boards but do not cut into face paper.
 4. Do not bridge building expansion joints with gypsum sheathing; cut and space edges to match spacing of structural support elements.
- B. Vertical or Horizontal Installation: Install 4-feet wide gypsum sheathing boards vertically or horizontally with edges centered over flanges of steel studs. Abut ends and edges of each board with those of adjoining boards. Screw-attach boards at perimeter and within field of board to each steel stud as follows:
1. Fasteners spaced approximately 8 inches o.c. and set back 3/8-inch minimum from edges and ends of boards.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall Sheathing:

- a. Screw to cold-formed metal framing.
- b. Space panels 1/8 inch (3 mm) apart at edges and ends.

END OF SECTION 061600

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Interior trim, including non-fire-rated interior door frames.
2. Shelving and clothes rods.
3. Hardwood paneling.

- B. Related Requirements:

1. Section 099123 "Interior Painting" for priming and backpriming of interior finish carpentry.

1.3 DEFINITIONS

- A. MDF: Medium-density fiberboard.
- B. MDO: Plywood with a medium-density overlay on the face.

1.4 ACTION SUBMITTALS

- A. Samples for Verification:

1. For each species and cut of lumber and panel products with non-factory-applied finish, with 1/2 of exposed surface finished, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
- B. Deliver interior finish carpentry materials only when environmental conditions meet requirements specified for installation areas. If interior finish carpentry materials must be stored

in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Low-Emitting Materials: Composite wood products shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Lumber: DOC PS 20 and the following grading rules:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association, "Standard Grading Rules for Northeastern Lumber."
 - 2. NHLA: National Hardwood Lumber Association, "Rules for the Measurement and Inspection of Hardwood & Cypress."
 - 3. NLGA: National Lumber Grades Authority, "Standard Grading Rules for Canadian Lumber."
 - 4. SPIB: The Southern Pine Inspection Bureau, "Standard Grading Rules for Southern Pine Lumber."
 - 5. WCLIB: West Coast Lumber Inspection Bureau, Standard No. 17, "Grading Rules for West Coast Lumber."
 - 6. WWPA: Western Wood Products Association, "Western Lumber Grading Rules."
- C. Softwood Plywood: DOC PS 1.
- D. Hardboard: AHA A135.4.
- E. MDF: ANSI A208.2, Grade 130.

2.2 INTERIOR TRIM

- A. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):
 - 1. Species and Grade: Select Walnut; Clear; NHLA.
 - 2. Maximum Moisture Content: 13 percent.
 - 3. Finger Jointing: Not allowed.
 - 4. Veneered Material: Use for lumber trim wider than 6 inches (150 mm).
 - 5. Face Surface: Surfaced (smooth).
 - 6. Matching: Selected for compatible grain and color.
- B. Lumber Trim for Opaque Finish (Painted Finish):
 - 1. Species and Grade: Eastern white pine, Finish or 1 Common; NeLMA or NLGA.
 - 2. Species and Grade: Spruce-pine-fir, 1 Common; NeLMA, NLGA, WCLIB, or WWPA.
 - 3. Species and Grade: Alder, aspen, basswood, cottonwood, gum, magnolia, soft maple, sycamore, tupelo, or yellow poplar; A Finish; NHLA.
 - 4. Maximum Moisture Content: 13 percent.
 - 5. Finger Jointing: Not allowed.
 - 6. Face Surface: Surfaced (smooth).
 - 7. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.

2.3 SHELVING AND CLOTHES RODS

- A. Closet Shelving: Made from the following material, 3/4 inch (19 mm) thick.
 - 1. Melamine-faced particleboard with applied-PVC front edge.
- B. Shelf Cleats: 3/4-by-3-1/2-inch (19-by-89-mm) boards, as specified above for lumber trim for opaque finish.
- C. Shelf Brackets with Rod Support: BHMA A156.16, B04051; prime-painted formed steel.
- D. Clothes Rods: 1-5/16-inch- (33-mm-) diameter, chrome-plated-steel tubes.
- E. Rod Flanges: Chrome-plated steel.

2.4 FLUSH WOOD PANELING

- A. Wood Species and Cut: Ipe hardwood, and as indicated on Drawings.
- B. Matching of Adjacent Veneer Leaves: Book match.
- C. Matching within Panel Face: Center-balance match.
- D. Matching of Adjacent Veneer Leaves and within Panel Face: Slip, center, book match.

- E. Panel-Matching Method: No matching is required between panels. Select and arrange panels for similarity of grain pattern and color between adjacent panels.
- F. Vertical Panel-Matching Method: Continuous end match; veneer leaves of upper panels are continuations of veneer leaves of lower panels.
- G. Panel Core Construction: Medium-density fiberboard.
 - 1. Thickness: As indicated on Drawings.
- H. Exposed Panel Edges: Applied solid-wood banding 11/16 inch (18 mm) thick by depth of panels.
- I. Fire-Retardant-Treated Paneling: Panels shall consist of wood-veneer and fire-retardant particleboard or fire-retardant, medium-density fiberboard. Panels shall have a flame-spread index of 25 or less and a smoke-developed index of 450 or less per ASTM E 84 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
- J. Assemble panels by gluing and concealed fastening.

2.5 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Low-Emitting Materials: Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
 - 1. Wood glue shall have a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Paneling Adhesive: Comply with paneling manufacturer's written recommendations for adhesives.
 - 1. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.
 - 1. Adhesive shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FABRICATION

- A. Back out or kerf backs of the following members except those with ends exposed in finished work:
 - 1. Interior standing and running trim except shoe and crown molds.
 - 2. Wood-board paneling.
- B. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, too small to fabricate with proper jointing arrangements, or with defective surfaces, sizes, or patterns.
- B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
 - 1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
4. Install stairs with no more than 3/16-inch (4.7-mm) variation between adjacent treads and risers and with no more than 3/8-inch (9.5-mm) variation between largest and smallest treads and risers within each flight.
5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
1. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
 2. Install trim after gypsum-board joint finishing operations are completed.
 3. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 SHELVING AND CLOTHES ROD INSTALLATION

- A. Cut shelf cleats at ends of shelves about 1/2 inch (13 mm) less than width of shelves and sand exposed ends smooth.
- B. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled. Space fasteners not more than 16 inches (400 mm) o.c. Use 2 fasteners at each framing member or fastener location for cleats 4 inches nominal (89 mm actual) in width and wider.
1. Apply a bead of multipurpose construction adhesive to back of shelf cleats before installing. Remove adhesive that is squeezed out after fastening shelf cleats in place.
- C. Install shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches (900 mm) o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
- D. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches (900 mm) o.c. and within 6 inches (150 mm) of end of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

- E. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled. Install shelves, fully seated on cleats, brackets, and supports.
 - 1. Fasten shelves to cleats with finish nails or trim screws, set flush.
 - 2. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.
- F. Install rod flanges for rods as indicated. Fasten to shelf cleats, framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Install rods in rod flanges.

3.6 PANELING INSTALLATION

- A. Hardwood Paneling: Install according to manufacturer's written recommendations. Leave **1/4-inch (6-mm)** gap to be covered with trim at top, bottom, and openings. Butt adjacent panels with moderate contact. Use fasteners with prefinished heads matching paneling color.
 - 1. Wood Stud or Furring Substrate: Install with **1-inch (25-mm)** annular-ring shank hardboard nails.
 - 2. Plaster or Gypsum-Board Substrate: Install with **1-5/8-inch (41-mm)** annular-ring shank hardboard nails.
 - 3. Nailing: Space nails **4 inches (100 mm)** o.c. at panel perimeter and **8 inches (200 mm)** o.c. at intermediate supports unless otherwise required by manufacturer.

3.7 ADJUSTING

- A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.8 CLEANING

- A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.

3.9 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062023

SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.

- B. Related Requirements:

1. Section 061053 Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
2. Section 123623.13 "Plastic-Laminate-Clad Countertops."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, including panel products high-pressure decorative laminate adhesive for bonding plastic laminate and cabinet hardware and accessories.

- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.
4. Apply AWI Quality Certification Program label to Shop Drawings.

- C. Samples for Verification:

1. Plastic laminates, **8 by 10 inches (200 by 250 mm)**, for each type, color, pattern, and surface finish.
2. Wood-grain plastic laminates, **12 by 24 inches (300 by 600 mm)**, for each type, pattern and surface finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For the following:
 1. Composite wood and agrifiber products.
 2. Thermoset decorative panels.
 3. High-pressure decorative laminate.
 4. Glass.
 5. Adhesives.
- C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
- D. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between **60 and 90 deg F (16 and 32 deg C)** and relative humidity between 25 and 55 percent during the remainder of the construction period.
- C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
 1. Provide labels and certificates from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- B. Grade: Premium.
- C. Type of Construction: Frameless.
- D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
- F. Laminate Cladding for Exposed Surfaces:
 1. Horizontal Surfaces: Grade HGS.
 2. Postformed Surfaces: Grade HGP.
 3. Vertical Surfaces: Grade VGS.
 4. Edges: Grade HGS.
 5. Pattern Direction: Vertically for doors and fixed panels, horizontally for drawer fronts.
- G. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - a. Edges of Plastic-Laminate Shelves: PVC tape, **0.018-inch (0.460-mm)** minimum thickness, matching laminate in color, pattern, and finish.
 - b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
 - c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
 2. Drawer Sides and Backs: Solid-hardwood lumber.
 3. Drawer Bottoms: Hardwood plywood.
- H. Dust Panels: **1/4-inch (6.4-mm)** plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As indicated by laminate manufacturer's designations on Drawings.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
1. Wood Moisture Content: 8 to 13 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
1. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
 2. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087111 "Door Hardware (Descriptive Specification)."
- B. Butt Hinges: **2-3/4-inch (70-mm)**, five-knuckle steel hinges made from **0.095-inch- (2.4-mm-)** thick metal, and as follows:
 - 1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
 - 2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.
- C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening.
- D. Cabinet Pulls: Hafele Tab collections, polished chrome:
 - 1. CTC/Length: 50. Item No. 124.02.220 – door pull.
 - 2. CTC/Length: 2500. Item No. 126.14.901 – drawer pull.”
- E. Catches: Magnetic catches, BHMA A156.9, B03141.
- F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- G. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.
- H. Drawer Slides: BHMA A156.9.
 - 1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated steel with polymer rollers.
 - 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
 - 3. For drawers not more than **3 inches (75 mm)** high and not more than **24 inches (600 mm)** wide, provide Grade 2.
 - 4. For drawers more than **3 inches (75 mm)** high but not more than **6 inches (150 mm)** high and not more than **24 inches (600 mm)** wide, provide Grade 1.
 - 5. For drawers more than **6 inches (150 mm)** high or more than **24 inches (600 mm)** wide, provide Grade 1HD-100.
 - 6. For computer keyboard shelves, provide Grade 1.
 - 7. For trash bins not more than **20 inches (500 mm)** high and **16 inches (400 mm)** wide, provide Grade 1HD-100.
- I. Door Locks: BHMA A156.11, E07121.
- J. Drawer Locks: BHMA A156.11, E07041.
- K. Door and Drawer Silencers: BHMA A156.16, L03011.
- L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 2. Satin Stainless Steel: BHMA 630.
- M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde.
- D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.5 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate cabinets to dimensions, profiles, and details indicated.
- C. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- D. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of **1/8 inch in 96 inches (3 mm in 2400 mm)**.
- D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 1. Use filler matching finish of items being installed.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 1. Install cabinets with no more than **1/8 inch in 96-inch (3 mm in 2400-mm)** sag, bow, or other variation from a straight line.
 2. Fasten wall cabinets through back, near top and bottom, and at ends not more than **16 inches (400 mm)** o.c. with No. 10 wafer-head screws sized for not less than **1-1/2-inch (38-mm)** penetration into wood framing, blocking, or hanging strips.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

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34-14102-00
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END OF SECTION 064116

SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes glass-fiber reinforced plastic (FRP) wall paneling and trim accessories.

- B. Related Sections:

1. Division 06 Section "Miscellaneous Carpentry" for wood furring for installing plastic paneling.
2. Division 10 Section "Wall and Door Protection" for corner guards installed over plastic paneling.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For plastic paneling and trim accessories.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.
 3. Testing Agency: Acceptable to authorities having jurisdiction.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PLASTIC SHEET PANELING (FRP)

- A. General: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kemlite Company Inc.
 - b. Marlite.
 - c. Nudo Products, Inc.
 - 2. Nominal Thickness: Not less than 0.12 inch (3.0 mm).
 - 3. Surface Finish: Molded pebble texture.
 - 4. Color: As selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
 - 1. Color: Match panels.
- B. Adhesive: As recommended by plastic paneling manufacturer.
- C. Sealant: Single-component, mildew-resistant, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Division 07 Section "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

- B. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.
- C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- D. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.
 - 1. Mark plumb lines on substrate at trim accessory locations for accurate installation.
 - 2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install trim accessories with adhesive.
- D. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.
- E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

SECTION 070150.19 - PREPARATION FOR REROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes the following under Alternate No. 2:

1. Partial tear off of entire roof.
2. Re-cover preparation of entire roof.
3. Removal of base flashings.

- B. Related Requirements:

1. Section 011000 "Summary" for use of the premises and phasing requirements.
2. Section 015000 "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for reroofing preparation.
3. Section 012300 "Alternates" for reroofing to be done under Alternate bid.

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.
- B. Roof Re-Cover Preparation: Existing roofing system is to remain and be prepared for new roof installed over it.
- C. Partial Roof Tear-Off: Removal of selected components and accessories from existing roofing system.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, sections, and details.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1. Include certificate that Installer is approved by warrantor of existing roofing system.
2. Include certificate that Installer is licensed to perform asbestos abatement.

1.6 QUALITY ASSURANCE

1.7 FIELD CONDITIONS

- A. Existing Roofing System: EPDM roofing with ballast over lightweight concrete fill over rigid insulation on precast concrete plank deck.
- B. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
- C. Conditions existing at time of inspection for bidding are maintained by Owner as far as practical.
 1. Construction Drawings for existing roofing system are provided for Contractor's convenience and information, but are not a warranty of existing conditions. They are intended to supplement rather than serve in lieu of Contractor's own investigations. Contractor is responsible for conclusions derived from existing documents.
- D. Limit construction loads on roof to 20 lbs/s.f. for uniformly distributed loads.
- E. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.
 1. Remove only as much roofing in one day as can be made watertight in the same day.
- F. Hazardous Materials: It is not expected that hazardous materials, such as asbestos-containing materials, will be encountered in the Work.
 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

PART 2 - PRODUCTS

2.1 TEMPORARY PROTECTION MATERIALS

- A. Expanded Polystyrene (EPS) Insulation: ASTM C 578.
- B. Plywood: DOC PS1, Grade CD Exposure 1.
- C. OSB: DOC PS2, Exposure 1.

2.2 AUXILIARY REROOFING MATERIALS

- A. General: Use auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of existing and roofing system.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Shut off rooftop utilities and service piping before beginning the Work.
- B. Test existing roof drains to verify that they are not blocked or restricted. Immediately notify Architect of any blockages or restrictions.
- C. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.
- D. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
 - 1. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding. Do not permit water to enter into or under existing roofing system components that are to remain.

3.2 ROOF TEAR-OFF

- A. Remove aggregate ballast from roofing. Store aggregate ballast for reuse.
- B. Partial Roof Tear-Off: Remove existing single-ply roof membrane and immediately check for presence of moisture by visually observing substrate that is to remain.
 - 1. Inspect wood blocking, curbs, and nailers for deterioration and damage. If wood blocking, curbs, or nailers have deteriorated, immediately notify Architect.

3.3 DECK PREPARATION

- A. Inspect substrate after tear-off of roofing system.
- B. Verify that lightweight concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 or by pouring **1 pint (0.5 L)** of hot roofing asphalt on deck at start of each day's work and at start of each roof area or plane. Do not proceed with roofing work if moisture condenses under plastic sheet or if asphalt test sample foams or can be easily and cleanly stripped after cooling.

- C. If deck surface is unsuitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect. Do not proceed with installation until directed by Architect.

3.4 BASE FLASHING REMOVAL

- A. Remove existing base flashings. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.
- B. Do not damage metal counterflashings that are to remain. Replace metal counterflashings damaged during removal with counterflashing as specified in Section 076200 "Sheet Metal Flashing and Trim."
- C. Inspect parapet sheathing, wood blocking, curbs, and nailers for deterioration and damage. If parapet sheathing, wood blocking, curbs, or nailers have deteriorated, immediately notify Architect.
- D. When directed by Architect, replace parapet framing, wood blocking, curbs, and nailers to comply with Section 061053 Miscellaneous Rough Carpentry."

3.5 DISPOSAL

- A. Collect demolished materials and place in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
 1. Storage or sale of demolished items or materials on-site is not permitted.
- B. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION 070150.19

SECTION 071413 - HOT FLUID-APPLIED RUBBERIZED ASPHALT WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Rubberized-asphalt waterproofing membrane.
2. Molded-sheet drainage panels.
3. Insulation.
4. Plaza-deck concrete pavers and wood tiles supported on pedestals.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1. Review waterproofing requirements, including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins to adjoining waterproofing, and other termination conditions.
1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.
- C. Samples: For plaza-deck pavers and wood tiles, full sized in each color and texture required.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.

- B. Field quality-control reports.
- C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Mockups: Install waterproofing to **100 sq. ft. (9.3 sq. m)** Insert value of deck to demonstrate surface preparation, crack and joint treatment, corner treatment, thickness, texture, and execution quality. Install pavers and paver supports to demonstrate aesthetic effects, and set quality standards for materials and execution.
 - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is below **zero deg F (minus 18 deg C)**.
 - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace waterproofing and sheet flashings that do not comply with requirements or that fail to remain watertight within specified warranty period.
 - 1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pedestal-mounted pavers on plaza decks.
 - 2. Warranty insulation retains 80 percent of original published thermal value.

3. Warranty pavers do not dish or warp and do not crack, split, or disintegrate in freeze-thaw conditions.
 4. Warranty Period: Five years from date of Substantial Completion.
- B. Special Installer's Warranty: Specified form, on warranty form at end of this Section, signed by Installer, covering Work of this Section, for warranty period of two years.
1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pedestal-mounted pavers on plaza decks.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain waterproofing materials sheet flashings protection course molded-sheet drainage panels insulation from single source from single manufacturer.

2.2 WATERPROOFING MEMBRANE

- A. Hot Fluid-Applied, Rubberized-Asphalt Waterproofing Membrane: Single component; 100 percent solids; hot fluid-applied, rubberized asphalt.
1. Products: Subject to compliance with rents, provide one of the following:
 - a. American Hydrotech, Inc; Monolithic Membrane 6125.
 - b. Barrett Company; Ram-Tough 250.
 - c. Carlisle Coatings & Waterproofing Inc; CCW-500R.
 - d. Henry Company; 790-11.
 - e. Soprema, Inc.
 - f. Tremco Incorporated; Tremproof 150.

2.3 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with waterproofing.
- B. Primer: ASTM D 41/D 41M, asphaltic primer.
- C. Elastomeric Sheet: **50-mil- (1.3-mm-)** minimum, uncured sheet neoprene with manufacturer's recommended contact adhesives as follows:
1. Tensile Strength: **1400 psi (9.6 MPa)** minimum; ASTM D 412, Die C.
 2. Elongation: 300 percent minimum; ASTM D 412.
 3. Tear Resistance: **125 psi (860 kPa)** minimum; ASTM D 624, Die C.
 4. Brittleness: Does not break at minus **30 deg F (34 deg C)**; ASTM D 2137.
- D. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum termination bars; approximately **1 by 1/8 inch (25 by 3 mm)** thick; with stainless-steel anchors.

- E. Sealants and Accessories: Manufacturer's recommended sealants and accessories.
- F. Reinforcing Fabric: Manufacturer's recommended, spun-bonded polyester fabric.

2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding **No. 70 (0.21-mm)** sieve, laminated to one side with or without a polymeric film bonded to the other side of a studded, non-biodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of **9 to 15 gpm/ft. (112 to 188 L/min. per m)**.
- B. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a woven-geotextile facing with an apparent opening size not exceeding **No. 40 (0.43-mm)** sieve, laminated to one side with or without a polymeric film bonded to the other side of a studded, non-biodegradable, molded-plastic-sheet drainage core, with a horizontal flow rate not less than **2.8 gpm/ft. (35 L/min. per m)**.

2.5 INSULATION

- A. Board Insulation: Extruded-polystyrene complying with ASTM C 578, Type VII, **60-psi (414-kPa)** minimum compressive resistance, square or shiplap edged.
 - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [DiversiFoam Products](#).
 - b. [Dow Chemical Company \(The\)](#).
 - c. [Owens Corning](#).
 - d. [Pactiv Corporation](#).
 - e. [T. Clear Corporation](#).
 - 2. Thickness: As required to achieve an R-value of 15 for the insulation.
- B. Unfaced Plaza-Deck Insulation Drainage Panels: Extruded-polystyrene board insulation complying with, Type VII, **60-psi (414-kPa)** minimum compressive resistance; unfaced; fabricated with shiplapped or channel edges and with one side having ribbed drainage channels.
 - 1. **Products:** with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [DiversiFoam Products](#); CertiFoam Plaza Deck.
 - b. [Dow Chemical Company \(The\)](#); STYROFOAM ROOFMATE Ribbed Insulation.
 - c. [Owens Corning](#); Foamular 404 RB.
 - 2. Thickness: As required to achieve an R-value of 15 for the insulation.

C. Geotextile-Faced Plaza-Deck Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, Type VII, **60-psi (414-kPa)** minimum compressive resistance; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with a nonwoven, geotextile filter fabric.

1. **Products:**, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [T. Clear Corporation](#); Thermadry 1750.
2. Thickness: As required to achieve an R-value of 15 for the insulation.

2.6 PLAZA-DECK PAVERS

A. Plaza-Deck Pavers: Heavyweight, hydraulically pressed, concrete units, square edged, manufactured for use as plaza-deck pavers; minimum compressive strength **7500 psi (52 MPa)**, ASTM C 140; absorption not greater than 5 percent, ASTM C 140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67.

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Hanover Architectural Products](#).
 - b. [Hastings Pavement Company, LLC](#).
 - c. [Roofblok Limited](#).
 - d. [Sunny Brook Pressed Concrete Co.](#).
 - e. [Wausau Tile Inc.](#).
 - f. [Westile Roofing Products](#).
2. Thickness: **2 inches (51 mm)**.
3. Face Size: **18 inches (457 mm)** square.
4. Color: As indicated by manufacturer's designations.

B. Paver Supports: Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane paver support adjustable or stackable pedestals, shims, and spacer tabs for joint spacing of **1/8 to 3/16 inch (3 to 5 mm)**.

1. Concrete Fill: ACI 301, compressive strength of **5000 psi (34 MPa)** at 28 days, and air content of 6 percent.

2.7 WOOD TILES

A. Wood Tiles: Pre-manufactured system of tiles made of wood boards factory-mounted to wood framing in modular tiles over adjustable pedestals.

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Bison Innovative Products; Model WT-IPE-24SMOOTH, or approved equal product.
2. Thickness: **1.69"**.
3. Face Size: **23-7/8 inches by 23-7/8 inches**.

4. Wood Species: Ipe hardwood.
 5. Color: Brown/natural range.
 6. Weight per Tile: 24 lbs.
 7. Fire Rating: Class A per ASTM E108-07a.
- B. Tile Pedestal Supports: Manufacturer's standard adjustable pedestals suitable for applications indicated. Basis-of-Design Product: Bison Innovative Products; Versajust, or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
 2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.
- D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
 1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces according to ASTM D 4258.
- E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, and other voids.

3.3 JOINTS, CRACKS, AND TERMINATIONS

- A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.
 1. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.
 2. Adhere strip of elastomeric sheet to substrate in a layer of hot rubberized asphalt. Extend elastomeric sheet a minimum of **6 inches (150 mm)** on each side of moving joints and cracks or joints and cracks exceeding **1/8 inch (3 mm)** thick, and beyond deck drains and penetrations. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.
 3. Embed strip of reinforcing fabric into a layer of hot rubberized asphalt. Extend reinforcing fabric a minimum of **6 inches (150 mm)** on each side of nonmoving joints and cracks not exceeding **1/8 inch (3 mm)** thick, and beyond roof drains and penetrations.
 - a. Apply second layer of hot fluid-applied, rubberized asphalt over reinforcing fabric.
- B. At expansion joints and discontinuous deck-to-wall or deck-to-deck joints, bridge joints with elastomeric sheet extended a minimum of **6 inches (150 mm)** on each side of joints and adhere to substrates in a layer of hot rubberized asphalt. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.

3.4 FLASHING INSTALLATION

- A. Install elastomeric sheets at terminations of waterproofing membrane according to manufacturer's written instructions.
- B. Prime substrate with asphalt primer.
- C. Install elastomeric sheet and adhere to deck and wall substrates in a layer of hot rubberized asphalt.
- D. Extend elastomeric sheet up walls or parapets a minimum of **8 inches (200 mm)** above plaza-deck pavers and **6 inches (150 mm)** onto deck to be waterproofed.
- E. Install termination bars and mechanically fasten to top of elastomeric flashing sheet at terminations and perimeter of waterproofing.

3.5 MEMBRANE APPLICATION

- A. Apply primer, at manufacturer's recommended rate, over prepared substrate and allow it to dry.
- B. Heat and apply rubberized asphalt according to manufacturer's written instructions.
 1. Heat rubberized asphalt in an oil- or air-jacketed melter with mechanical agitator specifically designed for heating rubberized asphalt.
- C. Start application with manufacturer's authorized representative present.

- D. Unreinforced Membrane: Apply hot rubberized asphalt to substrates and adjoining surfaces indicated. Spread to form a uniform, unreinforced, seamless membrane, **180-mil (4.5-mm)** minimum thickness.
- E. Reinforced Membrane: Apply hot rubberized asphalt to substrates and adjoining surfaces indicated. Spread to a thickness of **90 mils (2.3 mm)**; embed reinforcing fabric, overlapping sheets **2 inches (50 mm)**; spread another **125-mil- (3.2-mm-)** thick layer to provide a uniform, reinforced, seamless membrane **215 mils (5.5 mm)** thick.
- F. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.

3.6 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate according to manufacturer's written instructions. Use methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.7 INSULATION INSTALLATION

- A. Install one or more layers of board insulation to achieve required thickness and insulation drainage panels over waterproofed surfaces. Cut and fit to within **3/4 inch (19 mm)** of projections and penetrations.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.8 PLAZA-DECK PAVER INSTALLATION

- A. Install concrete pavers according to manufacturer's written instructions.
- B. Accurately install adjustable-height paver pedestals and accessories to elevations required. Adjust for final level and slope with shims.
 1. Fill paver pedestal with concrete mix, strike smooth with top of pedestal, and cure according to ACI 301.
- C. Loosely lay pavers on pedestals, maintaining a uniform open joint width. Tightly seat pavers against spacers to eliminate lateral movement or drift of paving assembly. Align joint patterns parallel in each direction.
 1. Lay out pavers to avoid less-than-half-width pavers at perimeter or other terminations.
- D. Install pavers to not vary more than **1/16 inch (1.6 mm)** in elevation between adjacent pavers or more than **1/16 inch (1.6 mm)** from surface plane elevation of individual paver.

- E. Limit variation in paving installation to within **1/4 inch in 10 feet (6 mm in 3 m)** of surface plane in any direction; noncumulative.

3.9 WOOD TILE INSTALLATION

- A. Install wood tiles according to manufacturer's written instructions.
- B. Accurately install adjustable-height pedestal supports and accessories to elevations required. Adjust for final level and slope with shims.

3.10 FIELD QUALITY CONTROL

- A. Engage a full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions; surface preparation; and application of membrane, flashings, protection, and drainage components; furnish daily reports to Architect.
 - 1. Site representative shall measure membrane thickness with pin tester or other suitable device at least once for every **100 sq. ft. (10 sq. m)** and include measurements in reports.
- B. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, waterproofing application, protection, and drainage components, and to furnish reports to Architect.
 - 1. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing and protecting waterproofing but before overlaying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water. Testing agency shall observe flood testing.
 - a. Flood to an average depth of **2-1/2 inches (65 mm)** with a minimum depth of **1 inch (25 mm)** and not exceeding a depth of **4 inches (100 mm)**. Maintain **2 inches (50 mm)** of clearance from top of sheet flashings.
 - b. Flood each area for 72 hours.
 - c. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.
 - 2. Electric Field Vector Mapping (EFVM): Testing agency shall survey entire waterproofing area for potential leaks using EFVM.

3.11 CLEANING AND PROTECTION

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Protect installed board insulation from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071413

SECTION 071800 - TRAFFIC COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes traffic coatings for the following applications:
 1. Pedestrian traffic at exterior concrete slab guestroom balconies.

1.3 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples for Initial Selection: For each type of finish indicated.
 1. Provide stepped Samples on backing large enough to illustrate buildup of traffic coatings.
- C. Qualification Data: For Installer.
- D. Material Test Reports: For each traffic coating.
- E. Material Certificates: For each traffic coating, signed by manufacturers.
- F. Field quality-control test reports.
- G. Maintenance Data: For traffic coatings to include in maintenance manuals. Identify substrates and types of traffic coatings applied. Include recommendations for periodic inspections, cleaning, care, maintenance, and repair of traffic coatings.
- H. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of traffic coatings required for this Project.
- B. Source Limitations:
 1. Obtain traffic coatings from a single manufacturer.

2. Obtain primary traffic coating materials, including primers, from traffic coating manufacturer. Obtain secondary materials including aggregates, sheet flashings, joint sealants, and substrate repair materials of type and from source recommended in writing by primary material manufacturer.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
1. Before installing traffic coatings, meet with representatives of authorities having jurisdiction, manufacturer's technical representative, Owner, Architect, consultants, independent testing agency, and other concerned entities. Review requirements for traffic coatings. Notify participants at least seven days before conference.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers with seals unbroken and bearing manufacturer's labels showing the following information:
1. Manufacturer's brand name.
 2. Type of material.
 3. Directions for storage.
 4. Date of manufacture and shelf life.
 5. Lot or batch number.
 6. Mixing and application instructions.
 7. Color.
- B. Store materials in a clean, dry location protected from exposure to direct sunlight. In storage areas, maintain environmental conditions within range recommended in writing by manufacturer.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Apply traffic coatings within the range of ambient and substrate temperatures recommended in writing by manufacturer. Do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F (5 deg C), when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
1. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of substrate.
- B. Do not install traffic coating until items that will penetrate membrane have been installed.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which traffic coating manufacturer agrees to repair or replace traffic coatings that deteriorate during the specified warranty period. Warranty

does not include deterioration or failure of traffic coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new substrate cracks exceeding 1/16 inch (1.6 mm) in width, fire, vandalism, or abuse by snowplow, maintenance equipment, and truck traffic.

1. Deterioration of traffic coatings includes the following:
 - a. Adhesive or cohesive failures.
 - b. Abrasion or tearing failures.
 - c. Surface crazing or spalling.
 - d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Traffic Coatings: Complying with ASTM C 957.
- B. Material Compatibility: Provide primers; base, intermediate, and topcoats; and miscellaneous materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- C. VOC Content: Provide waterproofing materials that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 1. Opaque waterproofing treatments: 400 g/L.

2.2 TRAFFIC COATING

- A. Products: Subject to compliance with requirements, provide the following:
 1. Neogard, Division of Jones-Blair; Peda-Gard.
 2. Approved manufacturers capable of products complying with requirements of this Section.
- B. Primer: Manufacturer's standard factory-formulated primer recommended for substrate and conditions indicated. Apply 1/3 gallon per 100 square feet.
- C. Preparatory and Base Coats: Single- or multicomponent, aromatic liquid urethane elastomer.
- D. Intermediate Coat: Single- or multicomponent, aromatic liquid urethane elastomer.
- E. Topcoat: Single- or multicomponent, aliphatic liquid urethane elastomer.
 1. Color: As selected by Architect from manufacturer's full range.

- F. Component Coat Thicknesses: As recommended by manufacturer for substrate and service conditions indicated, but not less than the following (measured excluding aggregate):
1. Base Coat: 1-1/2 gallons per 100 square feet.
 2. Wearing surface coat: 1/2 gallon per 100 square feet.
 3. Topcoat: 2/3 gallon per 100 square feet.
 4. Total System, 32 minimum dry film thickness, exclusive of aggregate.
- G. Aggregate: Uniformly graded, washed silica sand of particle sizes, shape, and minimum hardness recommended in writing by traffic coating manufacturer.
1. Spreading Rate: As recommended by manufacturer for substrate and service conditions indicated, but not less than the following:
 - a. Intermediate Coat: 8 to 10 lb/100 sq. ft. (3.6 to 4.5 kg/10 sq. m).

2.3 MISCELLANEOUS MATERIALS

- A. Joint Sealants: As specified in Division 07 Section "Joint Sealants."
- B. Sheet Flashing: Nonstaining.
 1. Minimum Thickness: 50 mils (1.3 mm).
 2. Material: Sheet material recommended in writing by traffic coating manufacturer.
- C. Adhesive: Contact adhesive recommended in writing by traffic coating manufacturer.
- D. Reinforcing Strip: Fiberglass mesh recommended in writing by traffic coating manufacturer.

PART 3 - EXECUTION

3.1 LOCATION

- A. Apply traffic coating to all exterior concrete slab guestroom balconies.

3.2 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements and for other conditions affecting performance of traffic coatings.
 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
 2. Verify compatibility with and suitability of substrates.
 3. Begin coating application only after minimum concrete curing and drying period recommended by traffic coating manufacturer has passed, after unsatisfactory conditions have been corrected, and after surfaces are dry.
 4. Verify that substrates are visibly dry and free of moisture.

- a. Test for moisture vapor transmission by plastic sheet method according to ASTM D 4263.
 - b. Test for moisture content by method recommended in writing by manufacturer.
5. Application of coating indicates acceptance of surfaces and conditions.

3.3 PREPARATION

- A. Clean and prepare substrates according to ASTM C 1127 and manufacturer's written recommendations to produce clean, dust-free, dry substrate for traffic coating application.
- B. Mask adjoining surfaces not receiving traffic coatings, deck drains, and other deck substrate penetrations to prevent spillage, leaking, and migration of coatings.
- C. Concrete Substrates: Mechanically abrade concrete surfaces to a uniform profile according to ASTM D 4259. Do not acid etch.
 1. Remove grease, oil, paints, and other penetrating contaminants from concrete.
 2. Remove concrete fins, ridges, and other projections.
 3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
 4. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D 4258.

3.4 TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written recommendations.
- B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.
- C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.
- D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

3.5 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C 1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.
 1. Comply with recommendations in ASTM C 1193 for joint-sealant installation.

3.6 TRAFFIC COATING APPLICATION

- A. Apply traffic coating material according to ASTM C 1127 and manufacturer's written recommendations.
 1. Start traffic coating application in presence of manufacturer's technical representative.
 2. Verify that wet film thickness of each component coat complies with requirements every 100 sq. ft. (9 sq. m).
- B. Apply traffic coatings to prepared wall terminations and vertical surfaces to 4 inches high, unless otherwise noted, and omit aggregate on vertical surfaces.
- C. Cure traffic coatings according to manufacturer's written recommendations. Prevent contamination and damage during application and curing stages.

3.7 FIELD QUALITY CONTROL

- A. Testing: Engage a qualified testing agency to perform the following field tests and inspections and prepare test reports:
 1. Samples of material delivered to Project site shall be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency shall perform tests for characteristics specified, using applicable referenced testing procedures.
 3. Testing agency shall verify thickness of coatings during traffic coating application.
 4. If test results show traffic coating materials do not comply with requirements, remove noncomplying materials, prepare surfaces, and reapply traffic coatings.
- B. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after traffic coating has completely cured. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 1. Flood to an average depth of 2-1/2 inches (65 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm).
 2. Flood each area for 72 hours.
 3. After flood testing, repair leaks, repeat flood tests, and make further repairs until traffic coating installation is watertight.
 4. Engage an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.
- C. Final Traffic Coating Inspection: Arrange for traffic coating manufacturer's technical personnel to inspect membrane installation on completion.
 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 PROTECTING AND CLEANING

- A. Protect traffic coatings from damage and wear during remainder of construction period.
- B. Clean spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071800

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Glass-fiber blanket insulation.
2. Spray polyurethane foam insulation.

- B. Related Sections:

1. Division 09 Section "Gypsum Board" for sound attenuation blanket insulation.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements:
 - 1. CertainTeed Corporation.
 - 2. Johns Manville.
 - 3. Knauf Insulation.
 - 4. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- C. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
 - 1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
 - 2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.2 SPRAY POLYURETHANE FOAM INSULATION

- A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Dow Chemical Company (The).
 - c. Gaco Western, Inc.
 - d. Henry Company.
 - e. Johns Manville.
 - f. NCFI; Division of Barnhardt Mfg. Co.
 - 2. Minimum density of 1.5 lb/cu. Ft. (24 kg/cu. M), thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F (43 K x m/W at 24 deg C).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Glass-Fiber Insulation: Install in cavities formed by framing members according to the following requirements:
 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 3. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically.
- C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.4 PROTECTION

- A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072200 - ACOUSTICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Loose-fill insulation for drill-and-fill application.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 LOOSE-FILL INSULATION

- A. Glass-Fiber Loose-Fill Insulation: ASTM C 764, Type I for pneumatic application; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.

2. Certified to GREENGUARD standards.
3. GREENGUARD Gold Certification and verified to be formaldehyde free.
4. Does not support microbial growth per ASTM C1338.
5. Non-combustibility per ASTM E 136.

2.2 ACCESSORIES

- A. Plugs: Tapered wood plugs for plugging insulation access holes.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to fill entire area to be insulated. Fit tightly around obstructions and fill voids with insulation.

3.2 INSTALLATION

- A. Cut a 2-1/2" diameter hole in each metal stud cavity.
- B. Verify if any blocking, or other obstructions exist that would interfere with filling entire cavities, and if so, cut additional holes as required to allow full cavity filling.
- C. Fill entire wall cavities to refusal with pneumatic blowing equipment recommended by insulation manufacturer, to 1.8 to 2.2 lbs./cf. density.
- D. Plug holes with wood plugs recessed 1/16" – 1/8", surfaces to match existing.

END OF SECTION 072200

SECTION 072400 – CEMENT BOARD STUCCO SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Composite wall finish system consisting of waterproofing/air barrier, base coat, reinforcing mesh and finish coat applied to a cement board. The cement board is attached to framing over a code approved sheathing that is protected with the waterproofing/air barrier.
- B. Related Sections
 - 1. Section 061105: Sheathing
 - 2. Section 076200: Sheet Metal Flashing and Trim
 - 3. Section 079200: Sealants and Caulking

1.2 SUBMITTALS

- A. Manufacturer's specifications, details, installation instructions and product data.
- B. Manufacturer's standard warranty.
- C. Applicator's certificate of instruction and lists of project references
- D. Samples for approval as directed by architect or owner.

1.3 REFERENCES

- A. ASTM Standards:
 - 1. B 117 Method of Salt Spray (Fog) testing
 - 2. C 150 Specification for Portland Cement
 - 3. C 1177 Specification for Glass Mat Gypsum for Use as Sheathing
 - 4. C 1325 Specification for Non-Asbestos Fiber-Mat Reinforced Cement Substrate Sheets
 - 5. C 2430 Standard Specification For Expanded Polystyrene (EPS) Thermal Insulation Boards For Use In Exterior Insulation and Finish Systems (EIFS)
 - 6. C1396 Standard Specification for Gypsum Board
 - 7. D 226 Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
 - 8. D 968 Test for Abrasion Resistance of Organic Coatings by Falling Abrasive
 - 9. D 1037 Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
 - 10. D 1784 Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
 - 11. E 84 Test Method for Surface Burning Characteristics of Building Material
 - 12. E 119 Method for Fire Tests of Building Construction and Materials

13. E 228 Test Method for Linear Thermal Expansion of Solid Materials With a Push-Rod Dilatometer
 14. E 283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
 15. E 330 Test Method for Structural Performance of Windows, Curtain Walls, and Doors by Uniform Static air Pressure Difference
 16. E 331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
 17. E 2178 Standard Test Method for Air Permeance of Building Materials
 18. E 2430 Specification for Expanded Polystyrene (“EPS”) Thermal Insulation Boards for Use in Exterior Insulation and Finish Systems (“EIFS”)
 19. G 153 Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
 20. G 154 Practice for Operating Light and Water Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Non-metallic materials
- B. National Fire Protection Association:
1. NFPA 268 Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radian Heat Energy Source
 2. NFPA 285 Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior, Nonload-bearing Wall Assemblies Containing Combustible Components Using the Intermediate-scale, Multistory Test Apparatus
- C. International Code Council
1. International Building Code, Chapter 26
 2. ICC-ES AC 59 Acceptance Criteria for Direct-Applied Exterior Finish Systems (DEFS)
 3. ICC-ES ESR 2356, Evaluation Report for StoQuik™ Silver systems.

1.4 DESIGN REQUIREMENTS

- A. L/360 maximum allowable stud deflection. Space studs 16 inches (406 mm) on center maximum. Provide horizontal blocking where needed for continuous support and attachment of cement board perimeter. Provide only kiln dried wood studs.
- B. Verify conformance of wall assembly wind load resistance with project design pressure requirements.
- C. Provide expansion joints at floor lines, dissimilar materials, where framing material changes, changes in building height, shape or structural system, and at expansion joints in the framing or building. Provide control joints at intervals of 25 ft (7.6 m) maximum in each direction with length/width ratio not to exceed 2-1/2:1. Maximum allowable area without a control joint is 625 ft² (58 m²). When using dark color finishes (lightness value less than 50) the allowable control joint interval/area is reduced to 16 ft/256 ft² (4.68 m/23.5 m²).
- D. When adding foam trim features use foam plastic in compliance with the applicable code. Refer to IBC Chapter 26 and Sto ICC ES Evaluation Report No 1720. Reinforce all foam trim with

base coat and reinforcing mesh. Comply with thickness and slope limitations for foam trim. Refer to Sto Details.

1.5 QUALITY ASSURANCE

- A. Manufacturer requirements
 - 1. System manufacturer for a minimum of twenty five (25) years.
 - 2. Manufacturing facilities ISO 9001:2000 Certified Quality System.
- B. Contractor requirements
 - 1. Licensed, insured and engaged in application of portland cement stucco, EIFS or DEFS for a minimum of three (3) years.
 - 2. Knowledgeable in the proper use and handling of Sto materials and possessing a certificate of completion of the Sto on-line applicator test.
 - 3. Employ skilled mechanics who are experienced and knowledgeable in EIFS, DEFS or portland cement stucco application and familiar with the requirements of the specified work.
 - 4. Successful completion of minimum of three (3) projects of similar size and complexity to the specified project.
 - 5. Provide the proper equipment, manpower and supervision on the job site to install the system in compliance with Sto's published specifications and details and the project plans and specifications.
- C. Cement board manufacturer requirements
 - 1. Recognized by Sto as capable of producing ASTM C 1325 compliant cement board to meet system requirements.
 - 2. Cement board shall be listed in an ICC evaluation report.
- D. Mock-up Testing (for projects of sufficient size or complexity)
 - 1. Construct full-scale mock-up of typical stucco/window wall assembly with specified tools and materials and test air and water infiltration and structural performance in accordance with ASTM E 283, E 331 and E 330 respectively, through independent laboratory. Mock-up shall comply with requirements of project specifications. Where mock-up is tested at job site maintain approved mock-up at site as reference standard. If tested off-site accurately record construction detailing and sequencing of approved mock-up for replication during construction.
- E. Inspections
 - 1. Provide independent third party inspection where required by code or contract documents.
 - 2. Conduct inspections in accordance with code requirements and contract documents.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in their original sealed containers bearing manufacturer's name and identification of product.
- B. Protect coatings (pail products) from freezing and temperatures in excess of 90°F (32° C). Store away from direct sunlight.
- C. Protect portland cement based materials (bag products) from moisture and humidity. Store under cover and off the ground in a dry location.
- D. Store cement board materials inside and protected from damage by the elements. Protect ends, edges, and faces of cement boards from damage

1.7 PROJECT/SITE CONDITIONS

- A. Maintain ambient and surface temperatures above 40°F (4°C) during application and for 24 hours after set of base coat and finish materials.
- B. Provide supplementary heat for installation in temperatures less than 40°F (4°C) such that temperatures are maintained as in 1.07A. Prevent concentration of heat on the uncured waterproofing/air barrier, base coat and finish coat and vent fumes and other products of combustion to the outside to prevent contact with the waterproofing/air barrier, base coat and finish coat
- C. Provide protection of surrounding areas and adjacent surfaces from application of materials.

1.8 COORDINATION/SCHEDULING

- A. For load bearing stud wall assemblies, commence the cement board system installation after completion of all floor, roof construction and other construction that imposes dead loads on the walls to prevent excessive deflection (and potential cracking) of the cement board system.
- B. Sequence interior work such as drywall installation prior to cement board system installation to prevent stud distortion (and potential cracking) of the cement board system.
- C. Provide site grading such that the cement board stucco terminates above earth grade minimum 4 inches (102 mm) and above finished grade (pavers/sidewalk) minimum 2 inches (51 mm). Provide increased clearance above grade for snow regions.
- D. Provide protection of rough openings before installing windows, doors, and other penetrations through the wall and provide sill flashing. Coordinate installation of water-resistive barrier with window and door installation to provide weather proofing of the structure and to prevent moisture infiltration and excess air infiltration.
- E. Install window and door head flashing immediately after windows and doors are installed.
- F. Install diverter flashings wherever water can enter the wall assembly to direct water to the exterior.

- G. Install copings and sealant immediately after installation of the cement board stucco system and when finish coatings are dry.
- H. Attach penetrations through the cement board stucco system to structural support and provide watertight seal at penetrations.

1.9 WARRANTY

- A. Provide manufacturer's 10 year limited materials and moisture protection warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Sto Corp.— StoQuik Silver NExT: water-resistive barrier, primer (if used), meshes, base coat and finish coat as furnished by Sto Corp.
- B. Plastic Components, Inc.— Accessories as furnished by Plastic Components, Inc., 9051 NW 97th Terrace, Miami, Florida 33178 (800 327-7077).
- C. National Gypsum Company, Inc.-Permabase® Brand Cement Board as furnished by National Gypsum Company, Inc. 2001 Rexford Road, Charlotte, NC 28211 (704 365 7300)

2.2 WATER-RESISTIVE BARRIER

- A. StoGuard™
 - 1. Joint Treatment: Sto Gold Fill® -- ready mixed flexible joint treatment for rough opening protection and joint treatment of wall sheathings.
 - 2. Water-Resistive Coating: Sto EmeraldCoat® --ready mixed vapor permeable, waterproof coating for wall sheathing.

2.3 CEMENT BOARD

- A. Minimum ½ inch (13 mm) thick PermaBase® Brand Cement Board complying with ASTM C 1325

2.4 MECHANICAL FASTENERS

- A. Appropriate non-corroding fasteners, depending on the type framing or substrate:
 - 1. Wood Framing—minimum # 9, Type S wafer head fully threaded corrosion resistant screws with minimum 3/4 inch (19 mm) penetration into studs.
 - 2. Steel Framing—minimum # 8 Type S-12 wafer head fully threaded corrosion resistant screws with minimum 3/8 inch (10 mm) penetration into studs.

2.5 BASE COAT

A. Cementitious Base Coat

1. Sto Primer/Adhesive-B—one-component polymer modified cement based factory blend base coat with less than 33% portland cement content by weight.
2. Sto BTS® Plus—one-component, polymer-modified, cement based high build adhesive with less than 33 percent Portland cement content by weight.
3. Sto BTS Xtra—A lightweight, one component, polymer modified, cement based high build base coat.

B. Waterproof Base Coat

1. Sto Flexyl—two component fiber reinforced acrylic based waterproof base coat mixed with Portland cement (for use as a waterproof base coat to waterproof foundations, parapets, splash areas, trim and other projecting architectural features).

2.6 REINFORCING MESHES

A. Standard Mesh

1. Sto Mesh--nominal 4.5 oz./yd² (153 g/m²), symmetrical, interlaced open-weave glass fiber fabric made with alkaline resistant coating for compatibility with Sto materials (achieves Standard Impact Classification when used with foam trim).

B. Specialty Meshes

1. StoGuard™ Mesh- nominal 4.2 oz/sq. yd. (142 g/m²), self-adhesive, flexible, symmetrical, interlaced glass fiber fabric, with alkaline resistant coating for compatibility with Sto materials (used to reinforce cement board joints, corners of openings and accessory flanges).
2. Sto Detail Mesh--nominal 4.2 oz/yd² (143 g/m²), flexible, symmetrical, interlaced glass fiber fabric, with alkaline resistant coating for compatibility with Sto materials (used for foam shape backwrapping, aesthetic detailing, and as an alternative to Sto Guard™ Mesh reinforcement).
3. Sto Corner Mat--nominal 7.7 oz./yd² (261 g/m²), pre-creased, heavy-duty, open-weave woven glass fiber fabric with alkaline resistant coating for compatibility with Sto materials (used for maximum impact protection at inside and outside corners).

2.7 PRIMER

A. Sto Primer—any Sto acrylic based tintable primer.

2.8 FINISH COAT

A. Sto Finish—any Sto acrylic or silicone enhanced acrylic based textured wall coating.

2.9 ACCESSORIES

- A. Starter Track—Vent Screen TRAC®, a rigid PVC (polyvinyl chloride) plastic track with double row of drainage holes, Part No. VST-75 as furnished by Plastic Components, Inc.
- B. Surface Mounted “L” Bead—a rigid PVC (polyvinyl chloride) surface mounted “L” shaped bead for terminations, openings, etc, Part No. 2221-50 as furnished by Plastic Components, Inc.
- C. Casing Bead—CB Casing Bead, a rigid PVC (polyvinyl chloride) plastic accessory for sheathing termination points Part No. CB-75-16 as furnished by Plastic Components, Inc.
- D. Corner Bead—Corner Bead a rigid PVC (polyvinyl chloride) plastic accessory for smooth transitions at exterior corners, Part No. 2209 as furnished by Plastic Components, Inc.
- E. Control Joint—Control Joint a rigid PVC (polyvinyl chloride) plastic accessory for designed control joints, Part No. 220027-16 as furnished by Plastic Components, Inc.
- F. Furring Strips—Strip-Lath®, a rust proof, self-furring, damage-resistant, ULTRA-LATH® strips of plastic lath for allowing drainage of incidental moisture to the exterior. Part Nos. PDM3 or PDM4 as furnished by Plastic Components, Inc.

2.10 JOB MIXED INGREDIENTS

- A. Water—clean and potable.
- B. Portland cement – ASTM C150, Type I, Type II, or Type I-II

2.11 FOAM BUILD-OUTS

- A. Adhesive
 - 1. Sto Primer Adhesive-B
- B. Insulation Board
 - 1. Sto EPS Insulation Board--nominal 1.0 lb/ft³ (16 kg/m³) Expanded Polystyrene (EPS) Insulation Board in compliance with ASTM C 2430.
- C. Reinforcing Mesh
 - 1. Sto Mesh
- D. Base Coats
 - 1. Sto Primer Adhesive-B
 - 2. Sto BTS® Plus
 - 3. Sto BTS Xtra
 - 4. Sto Flexyl (for use as a waterproof base coat on splash areas, trim and other projecting architectural features).

2.12 MIXING

- A. Sto Primer Adhesive-B—Mix automatically using Sto's continuous mixer, or mix manually by adding one 50 lbs. (23 kg) bag of Sto Primer/Adhesive-B to 5-6.5 quarts (4.7-6.2 L) of clean, potable water in a clean mixing pail. Mix with a clean, rust-free electric drill and paddle. Allow to set approximately five minutes, adjust mix if necessary by adding up to 12 fl. oz. (0.35 L) of water per bag, and remix to a uniform consistency. Avoid retempering after mixing of product. Do not exceed maximum amount of water in mix ratio.
- B. Sto BTS® PLUS—mix ratio with water: 6-8 quarts (5.7-7.6 L) of water per 60 pound (27.3 kg) bag of Sto BTS® PLUS. Pour water into a clean mixing pail. Add Sto BTS® PLUS, mix to a uniform consistency with clean, rust-free electric drill and paddle. Allow to set for approximately 5 minutes, then remix. Adjust mix if necessary with additional Sto BTS® PLUS or water and remix to a uniform trowel consistency. Avoid retempering. Keep mix ratio consistent.
- C. Sto BTS® Xtra—mix ratio with water: 4.75-5 quarts (4.5-4.7 L) of clean water per 38 pound (17.2 kg) bag of Sto BTS® Xtra. Mix automatically using StoSilo, Sto's Continuous Mixer or mix manually by pouring water into a clean mixing pail. Add Sto BTS® Xtra, mix to a uniform consistency, using a low speed electric drill mixer, and allow to set for approximately 5 minutes. Adjust mix if necessary with additional Sto BTS® Xtra or water (maximum 16 fl. oz./0.5 L) and remix to a uniform consistency.
- D. Sto Flexyl—mix ratio with portland cement: 1:1 ratio by weight. Pour Sto Flexyl into a clean mixing pail. Add portland cement, mix to a uniform consistency and allow to set for approximately five minutes. Adjust mix if necessary with additional Sto Flexyl and remix to a uniform trowel consistency. Avoid retempering. Do not add water. Keep mix ratio consistent.
- E. Sto Primer—mix with a clean, rust-free high speed mixer to a uniform consistency.
- F. Sto Finish—mix with a clean, rust-free high speed mixer to a uniform consistency. A small amount of water may be added to adjust workability. Limit addition of water to amount needed to achieve the finish texture.
- G. Sto EmeraldCoat®— mix with a clean, rust-free high speed mixer to a uniform consistency. Product must not be thinned or diluted.
- H. Sto Gold Fill®— mix with a clean, rust-free high speed mixer to a uniform consistency. Product must not be thinned or diluted.
- I. Mix only as much material as can readily be used.
- J. Do not use anti-freeze compounds or other additives.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS

- A. Pre-qualify under Quality Assurance requirements of this specification (section 1.06.B).

3.2 SHEATHING INSTALLATION

- A. Comply with applicable code for installation of wood and gypsum-based sheathings.

3.3 EXAMINATION

- A. Inspect framed wall assembly for:

1. Attachment and installation of sheathing in compliance with the applicable code.
 2. Damage or deterioration of sheathing; damage to the water-resistive barrier.
 3. Presence of flashing at decks, sills, roof/wall intersections and other areas requiring flashing.
 4. Straightness and trueness of wall assembly to receive the waterproofing/air barrier and cement board stucco system.
- B. Report deviations from the requirements of project specifications or other conditions that might adversely affect the waterproofing/air barrier or cement board stucco installation to the General Contractor.

3.4 INSTALLATION OF WATERPROOFING/AIR BARRIER AND CEMENT BOARD STUCCO SYSTEM

A. StoGuard™ Waterproofing/Air Barrier Installation

1. Sto Gold Fill®--Place minimum 4 inch (101 mm) wide mesh at sheathing joints and minimum 9 inch (152 mm) wide mesh at rough openings and inside and outside corners (refer to Sto detail 11.20). Immediately apply Sto Gold Fill® by spray or trowel over the mesh and trowel smooth. Protect from rain and freezing until dry. Spot overdriven fasteners, knots, or other voids in sheathing surface with Sto Gold Fill®.
2. Sto EmeraldCoat®--Apply Sto EmeraldCoat® to the prepared substrate using spray equipment such as Sto's M-8 spray Pump, or Graco airless spray equipment, 595 with a 25 mil tip or, 695 with a 27 mil tip, or with the appropriate size nap roller in a single, uniform coating at a wet thickness of 10 mils.
 - a. Application over Glass Mat Faced Gypsum sheathing: use 3/4" (19 mm) nap roller.
 - b. Application over plywood and exterior gypsum sheathing: Use a 1/2" (13 mm) nap roller.
 - c. Application over Oriented Strand Board (OSB): Use a 3/4" (19 mm) nap roller in a single, uniform coating at a wet thickness of 10 mils and allow to dry. Inspect surface for discontinuities that may be caused by swelling of individual wood strands in the OSB and touch up locations as necessary to provide a continuous void-free coating of Sto EmeraldCoat®.

B. Starter Track and Back Mount Casing Beads

1. Strike a level line at the base of the wall to mark where the top of the starter track terminates.

2. Attach the starter track even with the line onto the structure a maximum of 16 inches (406 mm) on center with the proper fastener: Type S-12 corrosion resistant screws for steel framing with minimum 3/8 inch (9 mm) penetration, and galvanized or zinc coated nails for wood framing with minimum 3/4 inch (19 mm) penetration. Blocking installed between the studs may be necessary to secure the track flat against the wall surface. For solid sheathing attach directly into sheathing at 12 inches (305 mm) on center maximum.
3. Butt sections of starter track together. Miter cut outside corners and abut. Snip front flange of one inside corner piece (to allow the cement board to be seated inside of track) and abut.
4. Install Starter Track at other cement board system terminations as designated on detail drawings: above windows and doors, at floor lines, above roof along dormers or gable end walls, and beneath window sills with concealed flashing.
5. Install casing beads similarly at cement board termination points—window and door jambs and other through wall penetrations, unless using surface mount accessories for these areas (see section 3.05D).

C. Installation of Cement Board

1. Install cement board horizontally or vertically but perpendicular to the direction of the supporting sheathing. Insert bottom edge of board into the starter track, and then attach the board through the sheathing to the studs with approved fasteners spaced 8 inches (203mm) on center at the perimeter and in the field of the board.
2. Install cement board with end and edges closely butted but not forced together. “L” cut boards around openings such as windows, doors, etc.
3. Stagger cement board joints by 16 inches (406mm) minimum from sheathing joints. Do not create planes of weakness by allowing cement board joints to coincide and overlap the substrate joints.
4. Provide for expansion joints and control joints in cement board layout (see Design Requirements, Section 1.04).

D. Surface Mounted Accessories

1. Install casing beads at stucco terminations—doors, windows, and other through wall penetrations. Use only casing bead/accessory with weeps at head of doors, windows, etc.
2. Install two piece expansion joints (or back to back “L” beads) at floor lines, dissimilar materials, where framing material changes, changes in building height, shape or structural system, and expansion joints in the framing or building. Abut horizontal into vertical joint accessories.
3. Install one piece control joints at intervals of 25 ft (7.6 m) maximum in each direction with length/width ratio not to exceed 2-1/2:1. Maximum allowable area without a control joint is 625 ft² (58 m²). When using dark color finishes (lightness value less than 50) the allowable control joint interval/area is reduced to 16 ft/256ft² (4.8 m/23.5m²). Abut horizontal into vertical joint accessories.
4. Install corner bead at outside corners.
5. Install full accessory pieces where possible and avoid small pieces.

E. Joint Reinforcement, Diagonal Reinforcement of Openings, and Reinforcement of Surface Mount Accessories

1. Center minimum 4 inch (102 mm) wide self-adhesive mesh over cement board joints. Overlap mesh seams minimum 2-1/2 inches (64mm).
2. Apply minimum 9 inch x 12 inch (225 x 300 mm) diagonal strips of self-adhesive mesh at corners of windows, doors, and all penetrations through the system.
3. Apply minimum 4 inch (103 mm) wide self-adhesive mesh over perforated flange of surface mount accessories. Overlap mesh seams minimum 2-1/2 inches (64 mm).
4. Skim coat self-adhesive mesh with base coat, feather along edges, and allow to dry.
5. Note: as an alternative to self-adhesive mesh detail mesh may be used. Embed the detail mesh in base coat, trowel smooth, feather along edges, and allow to dry.

F. Foam Trim and Build-Outs

1. Where foam build-outs terminate at a dissimilar material such as a window, door or other non-cement board stucco system surfaces, backwrap the foam build-out by installing detail mesh onto the terminating edge of the cement board. Embed the mesh in the foam adhesive. Allow the mesh to dangle until the backwrapping procedure is completed (see section 3.05 F.4).
2. Install foam build-outs directly over cement board with foam adhesive. Apply adhesive with the appropriate size notched trowel to the back of the insulation board and immediately place build-out in the proper location on the wall. Press firmly into place.
3. As soon as the foam build-out is firmly attached rasp the entire surface smooth.
4. Complete the backwrapping procedure by applying the foam base coat to the exposed edges of the foam build-out and minimum 2-1/2 inches (64 mm) onto the face. Pull the backwrap mesh around the foam build-out and fully embed it into the foam base coat. Use a corner trowel for neat straight corners.
5. Apply the foam base coat to the foam build-out and approximately 3 inches (76 mm) onto the adjacent cement board surfaces to an approximate thickness of 1/8 inch (3 mm). Immediately embed the reinforcing mesh in the wet base coat. Trowel from the center to the edges of the mesh to avoid wrinkles and remove excess base coat. Overlap mesh seams minimum 2-1/2 inches (64 mm). Overlap mesh onto adjacent cement board wall surfaces minimum 2-1/2 inches (64 mm) at terminations of the foam build-out and feather onto the cement board wall surface.

G. Base Coat and Reinforcing Mesh Application

1. Apply base coat over the cement board, including areas with self-adhesive or detail mesh and areas of unreinforced foam trim/build-outs, with a stainless steel trowel to a uniform thickness of approximately 1/8 inch (3 mm). Work horizontally or vertically in strips of 40 inches (1016mm), and immediately embed the mesh into the wet base coat by troweling from the center to the edge of the mesh. Overlap mesh not less than 2-1/2 inches (64 mm) at mesh seams and fully overlap self-adhesive or detail mesh (and backwrap reinforcing mesh along foam trim/build-outs if these surfaces have not yet been reinforced with base coat/mesh). Feather seams and edges. Double wrap all inside and outside corners with minimum 2-1/2 inch (64 mm) overlap in each direction where mesh is used in lieu of an accessory. (Alternate corner treatment with mesh: embed corner mat in base coat, allow to dry, and then overlap up to corner with standard reinforcing mesh embedded in base coat). Avoid wrinkles in the mesh. The mesh must be fully embedded so that no mesh color shows through the base coat when it is dry. Re-skim with additional

- base coat if mesh color is visible or if necessary to correct planar irregularities in the wall surface. Allow base coat to thoroughly dry before applying primer or finish.
2. Sloped Surfaces: for foam trim, reveals, aesthetic bands, cornice profiles, sills or other architectural features that project beyond the vertical wall plane more than 2 inches (51 mm) apply waterproof base coat with a stainless steel trowel to the weather exposed sloped surface and minimum four inches (100 mm) above and below it. Embed standard mesh or detail mesh in the waterproof base coat and overlap mesh seams a minimum of 2-½ inches (65 mm).Allow base coat to thoroughly dry before applying primer.

H. Primer Application

1. Apply primer evenly with brush, roller or proper spray equipment over the clean, dry base coat and allow to dry thoroughly before applying finish.

I. Finish Coat Application

1. Apply finish directly over the base coat (or primed base coat) when dry. Apply finish by spraying or troweling with a stainless steel trowel, depending on the finish specified. Follow these general rules for application of finish:
 - a. Avoid application in direct sunlight.
 - b. Apply finish in a continuous application, and work to an architectural break in the wall.
 - c. Weather conditions affect application and drying time. Hot or dry conditions limit working time and accelerate drying. Adjustments in the scheduling of work may be required to achieve desired results; cool or damp conditions extend working time and retard drying and may require added measures of protection against wind, dust, dirt, rain and freezing. Adjust work schedule and provide protection.
 - d. Float "R" (rilled texture) finishes with a plastic trowel to achieve their rilled texture.
 - e. Do not install separate batches of finish side-by-side.
 - f. Do not apply finish into or over sealant joints. Apply finish to outside face of wall only.
 - g. Do not apply finish over irregular or unprepared surfaces, or surfaces not in compliance with the requirements of the project specifications.

3.5 PROTECTION

- A. Provide protection of installed materials from water infiltration into or behind them.
- B. Provide protection of installed materials from dust, dirt, precipitation, freezing and continuous high humidity until they are fully dry.

END OF SECTION 072400

SECTION 075423 - THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes the following under Alternate No. 2:

1. Adhered TPO membrane roofing system.
2. Roof insulation.

- B. Related Sections:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 070150.19 "Preparation for Reroofing" for removal of existing roofing.
3. Section 076200 "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings and roof expansion joints.
4. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
5. Division 22 Sections for roof drains.
6. Division 01 Section "Alternates" for reroofing to be done under Alternate bid.

1.3 DEFINITIONS

- A. TPO: Thermoplastic polyolefin.
- B. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a

membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.

1. Fire/Windstorm Classification: Class 1A-120.
2. Hail Resistance: MH.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
 1. Base flashings and membrane terminations.
 2. Tapered insulation, including slopes.
 3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing for fully adhered membrane roofing.
 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Qualification Data: For qualified Installer and manufacturer.
- D. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 1. Submit evidence of compliance with performance requirements.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
- F. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.
- G. Field quality-control reports.
- H. Maintenance Data: For roofing system to include in maintenance manuals.
- I. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- B. Source Limitations: Obtain components including roof insulation fasteners adhesives for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.
- C. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

D. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 **WARRANTY**

- A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, roofing accessories, and other components of membrane roofing system.
 - 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 **TPO MEMBRANE ROOFING**

- A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle SynTec Incorporated.
 - b. Firestone Building Products Company.
 - c. GAF Materials Corporation.
 - d. Johns Manville.
 - e. Versico Incorporated.
 - 2. Thickness: 80 mils, nominal.
 - 3. Exposed Face Color: White.

2.2 **AUXILIARY MEMBRANE ROOFING MATERIALS**

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 55 mils (1.4 mm) thick, minimum, of same color as sheet membrane.

- C. Bonding Adhesive: Manufacturer's standard, low rise solvent based.
- D. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- F. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.3 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by TPO membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 - 1. Provide base layer (excluding tapered insulation) in thickness to achieve an R-value of 15, unless otherwise indicated.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.4 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch (12.7 mm) thick, factory primed.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Georgia-Pacific Corporation; Dens Deck and Dens Deck Prime.
- D. Cover Board (Contractor's Option): ASTM C 1278/C 1278M, cellulosic-fiber-reinforced, water-resistant gypsum substrate, 1/2 inch (12.7 mm) thick.

1. Products: Subject to compliance with requirements, provide the following:
 - a. USG Corporation; Securock.
- E. Bead-Applied Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multi-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

2.5 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick, and acceptable to membrane roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
 4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
 5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- G. Mechanically Fastened Insulation at Elevator Penthouse: Install layers of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 1. Fasten insulation according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
- H. Adhered Insulation: Install each layer of insulation and adhere to concrete substrate as follows:
 1. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place over concrete deck.
- I. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together.
 1. Fasten cover boards according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.

3.4 ADHERED MEMBRANE ROOFING INSTALLATION

- A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.
- B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.
- C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.
- E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.
- F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- G. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
- H. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

3.5 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

3.6 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- B. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.9 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS **<Insert name>** of **<Insert address>**, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 1. Owner: **<Insert name of Owner>**.
 2. Address: **<Insert address>**.
 3. Building Name/Type: **<Insert information>**.
 4. Address: **<Insert address>**.
 5. Area of Work: **<Insert information>**.
 6. Acceptance Date: **<Insert date>**.
 7. Warranty Period: **<Insert time>**.
 8. Expiration Date: **<Insert date>**.

- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. Lightning;
 - b. Peak gust wind speed exceeding <Insert wind speed> mph (m/sec);
 - c. Fire;
 - d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. Vapor condensation on bottom of roofing; and
 - g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
 2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
 6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.

7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.
- E. IN WITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.
1. Authorized Signature: <Insert signature>.
 2. Name: <Insert name>.
 3. Title: <Insert title>.

END OF SECTION 075423

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following sheet metal flashing and trim:

1. Formed low-slope roof flashing and trim.
2. Flashing not specified in other sections.
3. Copings and gravelstops provided under Alternate No. 2.

- B. Related Sections include the following:

1. Section 042000 "Unit Masonry" for installing through-wall flashing, reglets, and other sheet metal flashing and trim.
2. Section 061000 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
3. Section 079200 "Joint Sealants" for field-applied sheet metal flashing and trim sealants.
4. Section 012300 "Alternates" for coping and gravelstop replacement.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
- C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

- D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:
 1. Identify material, thickness, weight, and finish for each item and location in Project.
 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.

1.5 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.7 COORDINATION

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. Prepainted, Metallic-Coated Steel Sheet: Provide aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation, Grade 40 (Grade 275); prepainted by coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Exposed Finishes: Apply the following coil coating:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Coating shall contain suspended metallic flakes as required to provide finish indicated. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1) Colors: As selected by Architect from manufacturer's full range.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 - 1. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, dead soft, fully annealed; with smooth, flat surface.

2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
 - 1. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
 - 2. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
- C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- B. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with elastomeric sealant concealed within joints.
- F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
 - 1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" and FMG Loss Prevention Data Sheet 1-49 for application but not less than thickness of metal being secured.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. General: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
 - 1. Joint Style: Butt, with 12-inch- (300-mm-) wide concealed backup plate.
- B. Counterflashing: Fabricate from the following material:
 - 1. Preprinted, Metallic-Coated Steel: 0.0217 inch (0.55 mm) thick.
- C. Flashing Receivers: Fabricate from the following material:
 - 1. Preprinted, Metallic-Coated Steel: 0.0217 inch (0.55 mm) thick.
- D. Roof Edge Flashing (Gravel Stop): Fabricate in minimum **96-inch- (2400-mm-)** long, but not exceeding **12-foot- (3.6-m-)** long sections. Furnish with **6-inch- (150-mm-)** wide, joint cover plates. Shop fabricate interior and exterior corners.
 - 1. Joint Style: Butted with expansion space and **6-inch- (150-mm-)** wide, concealed backup plate.
 - 2. Fabricate with scuppers spaced 10 feet (3 m) apart, to dimensions required with **4-inch- (100-mm-)** wide flanges and base extending **4 inches (100 mm)** beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
 - 3. Fabricate from the Following Materials:
 - a. Galvanized Steel: 0.028 inch (0.71 mm) thick, coil-coated.
- E. Copings: Fabricate in minimum **96-inch- (2400-mm-)** long, but not exceeding **12-foot- (3.6-m-)** long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.
 - 1. Coping Profile: Match existing, and according to SMACNA's "Architectural Sheet Metal Manual."
 - 2. Joint Style: Butted with expansion space and **6-inch- (150-mm-)** wide, concealed backup plate.
 - 3. Fabricate from the Following Materials:
 - a. Galvanized Steel: **0.040 inch (1.02 mm)** thick, coil coated.

2.6 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing and Flashing not Specified in Other Sections: Fabricate from the following material:
 - 1. Preprinted, Metallic-Coated Steel: 0.0276 inch (0.7 mm) thick.

- B. Aluminum storefront and window sill flashing: Aluminum.

2.7 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 1. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
 1. Coat side of lead sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.

3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.
- C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 1. Secure continuous cleats not more than 24 inches (600 mm) apart.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with elastomeric sealant concealed within joints.
- G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
 1. Preprinted, Metallic-Coated Steel: Use stainless-steel fasteners.
- H. Seal joints with elastomeric sealant as required for watertight construction.
 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
 2. Prepare joints and apply sealants to comply with requirements in Section 072900 "Joint Sealants."

3.3 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

- B. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with elastomeric sealant.
 - 1. Secure in a waterproof manner by means of snap-in installation and sealant or lead wedges and sealant.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

3.4 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.5 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 078400 - FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Firestop devices and systems tested in accordance with ASTM E814 (ANSI/UL 1479) and listed in UL Fire Resistance Directory.
2. Fire resistant construction joints.
3. Dynamic partition head details.
4. Penetrations through fire-rated floors, walls, and shafts.
5. Duct and damper firestops.
6. Intumescent wraps and pads at receptacle boxes and recessed items within fire rated walls.

1.2 SYSTEM DESCRIPTION

A. General: Make firestop and smoke seal assembly selections that comply with UL Fire Resistance Directory, authority having jurisdiction, and applicable codes for:

1. Materials, fabrication, and installation of firestops and smoke seals.
2. Fire containment.
3. Fire resistant construction joints.
4. Dynamic partition head details.
5. Penetrations through fire-rated floors, walls, and shafts.
6. Duct and damper firestops.
7. Intumescent wraps and pads at receptacle boxes and recessed items within fire rated walls.
8. Coordinate with mechanical and electrical to provide single manufacturer for all firestopping materials.

B. Firestop Voids and Openings in Following Locations:

1. Duct, cable, cable tray, conduit, piping, and other penetrations through floor slabs (except on-grade slabs) and through fire rated walls and partitions.
2. Penetrations of vertical shafts, pipe chases, elevator shafts, and utility shafts.

3. Openings, gaps, and cracks at abutting fire rated assemblies and components, such as wall-to-wall and wall-to-floor including overhead floor and roof decks.
4. Blank openings into or through fire rated floors and walls.
5. Other locations indicated or scheduled.

C. Design Requirements:

1. Firestop materials used to fill floor openings in which smallest dimension is 4 inches shall support same loads that floor was designed to support. If equal floor loading capacity cannot be obtained with firestop material, provide fire rated permanent covering to support loads and traffic, capable of being removed to allow access.
2. Insulated Piping and Duct Penetrations: Install firestop systems intended for use with type of insulation on penetrating item.
 - a. Install firestop systems intended for use with type of insulation on penetrating item.
 - b. If compatible firestop system is unavailable, remove insulation at contact area with firestop material.
 - c. Coordinate with trades who installed insulation to ensure proper re-sealing of cut edges of insulation.
3. Provide Products that Do Not Deteriorate when Exposed to Following Conditions:
 - a. Plumbing and Wet-Pipe Sprinkler Systems: Moisture-resistant through-penetration firestop.
 - b. Exposed to View:
 - 1) Flame-spread value of less than 25 and smoke-developed value of less than 450, ASTM E84.
 - 2) Compatible with applied finishes.

D. F and T Rating Requirements: Conform to F and T ratings, ASTM E 814 (ANSI/UL 1479).

1. Comply with applicable codes and authority having jurisdiction.
2. F Ratings: Equal to fire resistance rating of assembly being penetrated but not less than one hour.
3. T Ratings: Equal to F ratings or as required by authority having jurisdiction.

E. Testing Requirements:

1. Utilize systems and materials tested and approved by UL or other nationally recognized independent testing agency acceptable to authorities having jurisdiction.

2. Determine fire ratings in accordance with ASTM E814 (ANSI/UL 1479) for through penetration firestops, ASTM E119 (UL263) for fire rated assemblies, and as required by applicable codes and authority having jurisdiction.
- F. Large openings may be closed with same type construction as adjacent floor, roof, and wall assembly.
- G. Sealing around penetrations fire rated assemblies without approved firestop system is not permitted. Methods and materials not permitted include but are not limited to:
 1. Joint compound at gypsum board assemblies.
 2. Mortar at masonry and concrete assemblies.
 3. Use of joint sealants.
- H. Whenever finished firestop materials are scheduled to receive finish paint or other coatings, test compatibility of firestop materials with coatings to be applied.

1.3 SUBMITTALS

- A. General: Submit in accordance with Section 013323.
- B. Submit deferred submittal to authorities having jurisdiction for each firestopping system and condition for this project. Obtain approval from authority having jurisdiction.
- C. Submit manufacturer's certification stating:
 1. Each penetration of fire rated walls and floor, partition heads, and edge of slabs will be firestopped with a firestopping system tested by UL or other recognized testing agency for substrate and penetrating item.
 2. Authorities having jurisdiction have approved firestopping systems for this project.
 3. Products and Classifications Schedule:
 - a. Provide tabular form schedule for firestops, fire containment, and fire resistant construction joints.
 - b. Schedule to identify:
 - 1) Construction penetrated including fire resistance rating.
 - 2) Penetrating item.
 - 3) Products and manufacturers included in each system.
 - 4) Form material used.
 - 5) Firestop classification and description from UL or other nationally recognized independent testing agency acceptable to authority having jurisdiction.

- 6) Fire containment and fire resistant construction joint description.
 - 7) F and T ratings.
- c. Update schedule periodically to include addition and changes.
- D. Informational Submittals: Submit following:
1. Test Reports: Copy of UL or other acceptable testing agency report illustrating each system and device as tested and approved.
 2. List of generic descriptions and product names and manufacturers included in each system including form material, containment system, gang assemblies, means of controlling size of annular space, and sealer, topcoat, or intumescent materials.
 3. Certifications specified in this section.
 4. Qualification Data: Manufacturer's and installer's qualification data.
 5. Manufacturer's field reports.
- 1.4 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum five years experience.
- B. Installer Qualifications:
1. Company specializing in installation of firestopping specified with experience on at least five projects of similar nature in past three years.
 2. Licensed, trained, and approved by manufacturer of firestop materials.
- C. Installer Responsibility: Select firestop, fire containment, and fire resistant construction joint products from those indicated for each penetration.
1. Obtain approval of authorities having jurisdiction for selected methods.
 2. Submit proposed methods along with proof of acceptance by authority having jurisdiction.
- D. Regulatory Requirements: Ensure firestop, fire containment, and construction joint components comply with applicable portions of local, state, and federal codes, laws, and ordinances for flame spread and smoke developed indices.
- E. Certifications:
1. Manufacturer's certification that products furnished for Project meet or exceed specified requirements.
 2. Contractor's and installer's certification that products are installed in accordance with Contract Documents, based on inspection and testing specified as part of Field Quality Control.

3. Certificates of compliance from authority having jurisdiction indicating approval of firestops, fire containments, and construction joints.
4. Certificate of inspection and acceptance by authority having jurisdiction of firestops, fire containments, and construction joints.

1.5 PRE-INSTALLATION CONFERENCE

- A. Conduct pre-installation conference in accordance with Section 013119.
- B. Agenda: Include discussion and agreement upon acceptable:
 1. Product and classification schedule.
 2. Test firestop materials to confirm compatibility with adjacent materials and chemicals and solvents with which they may come into contact during construction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 016600.
 1. Packing, Shipping, Handling, and Unloading: Deliver materials in manufacturer's unopened containers with manufacturers name, product identification, lot number, UL labels or labels of other nationally recognized independent testing agency, and mixing and installation instructions.
 2. Storage and Protection: Store materials to prevent deterioration and damage due to moisture, temperature change, and contamination.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements:
 1. Comply with manufacturer's temperature and humidity limitations before, during, and after installation.
 2. Comply with ventilation requirements specified in Section 015000.

1.8 SEQUENCING

- A. Sequence Work properly with adjacent work to allow unobstructed access to all areas needing firestops and smokeseals..
 1. Identify penetrations and openings requiring firestops, smoke seals, fire containments, and construction joints.
 2. Schedule installation of firestopping after completion of work involving penetrating items, but prior to covering, concealing, and eliminating access to penetrations.
 3. Coordinate with work of other trades

- B. Inspection: Request inspection of firestops by authority having jurisdiction and testing consultant before concealment.
 1. Sequence work to permit installation to be inspected and approved prior to being concealed.
 2. Ensure that subsequent openings and penetrations are reported, properly firestopped, and inspected.

PART 2 - PRODUCTS

2.1 FIRESTOPPING DEVICE AND SYSTEM MANUFACTURERS

- A. Acceptable Manufacturers:

1. Hilti, Corp., Tulsa, OK.
2. The Rectorseal Corp., Houston, TX.
3. 3M Fire Protection Products, St. Paul, MN.
4. Nelson Firestop Products, Tulsa, OK.
5. Specified Technologies Inc., Sommerville, NJ.

2.2 SYSTEMS

- A. Description:

1. Sealant, putty, intumescent materials, or mortar material.
2. Non-corrosive and compatible with synthetic cable jackets.
3. Flame spread less than 25 when tested according to ASTM E84.
4. Mixes: If mixing is required, mix components as instructed by manufacturer.
5. Top of partition assemblies: Combination of safing insulation and flexible fire rated smoke seal tested and approved for dynamic movement complying with ANSI/UL2079 Test for Fire Resistance of Building Joint Systems (cyclic test).
6. Provide typical dynamic assemblies complying with ASTM E1399 and UL 2079 for fire rated assemblies exposed to movement such as: head of wall joints; floor to floor joints; floor to wall joints; wall to wall joints; undersides of metal decks; tops of walls; undersides of composite decks; and fire-rated control, construction, and expansion joints.

- B. Systems: Comply with code for firestopping systems for each condition encountered.

- C. Safing Insulation, Foil Faced:

1. General: Mineral fiber composition, foil faced.
2. Classification:

- a. ASTM C612, Class 1 or 2.
- b. ASTM C665: Type III, Class A.
3. Density and Thickness: Manufacturers recommended to achieve indicated fire rating.
4. Combustion Characteristics: ASTM E136, noncombustible.
5. Fire rating: ASTM E84, flame spread 25 or less and smoke development 10 or less.
6. Acceptable Products:
 - a. Thermafiber Inc, Wabash, IN: Thermafiber Safing Insulation.
 - b. Fibrex Insulation Inc., FBX Safing Insulation.
- D. Accessories Provide accessories required by manufacturer, UL or other testing agency, and classification for specific application.
 1. Retaining Collars: Manufacturer's standard.
 2. Intumescent wrap strips and collars.
 3. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
 4. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
 5. Steel wire, wire mesh, clips, sleeves, anchoring devices, primers, and other materials.
 6. Metal Sheets and Shapes: Size and thickness as required by fire resistant system.
 7. Fibrous Fire Safing Adhesive: As instructed by manufacturer.
 8. Fibrous Fire Safing Clips/Fasteners: As instructed by manufacturer.
 9. Sealant Primers: As instructed by manufacturer.
 10. Sealant Damming Materials:
 - a. Non-combustible.
 - b. Chemically compatible with sealant.
 - c. Mineral fiberboard, mineral fiber matting, or fibrous fire safing.
 11. Cleaning Solvents: As instructed by manufacturer.
 12. Labels:
 - a. Provide label for each firestop condition.

- b. Type information in non-fading ink on 20 pound (minimum) paper.
- c. Include following information on each label:
 - 1) Manufacturer's name.
 - 2) Product name.
 - 3) Product type (sealant, putty, mortar, or other generic material description).
 - 4) F-Rating.
 - 5) T-Rating. State when not required for condition.
 - 6) Testing and listing agency filing number, such as UL System number.
- E. Adhesives & Sealants: Only use adhesives and sealants in the interior of the building that meet or do not exceed the VOC limits of the CURRENT requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168 on the interior of the building.
 - 1. Current requirement refers to the date on which the materials are installed in the building.
 - 2. Comply with SCAQMD Rule #1168 current as of the date of this specification. Refer to <http://www.aqmd.gov/rules> for the actual current version of the rule that will be applicable at the date of installation during construction.
 - 3. Interior refers to all building construction that is inside of the exterior weatherproofing material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and proceed with work in accordance with Section 017300.
- B. Verify that permanent penetration items have been installed and that temporary penetrating items have been removed.
- C. Verify that supports have been installed on both sides of penetrated construction as required by UL classifications.
- D. Inspect and verify that surfaces and condition of openings have no defects that could interfere with installation and performance of firestop materials.
- E. Verify sleeves installed under plumbing, mechanical, and electrical work are properly installed.

3.2 PREPARATION

- A. Clean surfaces of opening substrates free of dirt, oil, grease, loose and harmful materials which may adversely affect bond of materials to surfaces in accordance with manufacturers recommendations.

- B. Test surfaces which have been previously painted, sealed, and treated with other coatings and compounds to ensure compatibility with materials and proper bond capability.
- C. Remove incompatible coatings and materials which may affect firestop bond with surrounding surfaces.
- D. Mask and protect adjacent surfaces from damage.
- E. Prime surfaces as instructed by manufacturer.

3.3 FIRESTOPPING INSTALLATION

- A. General: Install in accordance with Section 01 7300, manufacturer's details, applicable codes, UL or other testing agency classification requirements, and approved schedule and shop drawings.
 - 1. Fire resistant systems without UL or other testing agency classification requirements shall be approved by authorities having jurisdiction before installation.
 - 2. Install firestopping material in manner required to achieve F rating and T rating required by UL classification, applicable codes, and authorities having jurisdiction.
 - 3. Install firestopping material with sufficient pressure to ensure uniform density and texture, and to ensure proper filling and sealing of openings to create smoke seal.
 - 4. Install forms and supports to arrest liquid and flowable material leakage and retain materials in openings.
 - 5. Remove form materials after firestopping material has cured unless materials used are permitted or required to remain according to test classifications.
- B. Through Penetration Firestopping Systems: Comply with classification design requirements. Separate cables not in conduit and maintain required separation of penetrating items from edges of openings and from each other.
 - 1. Tool and trowel exposed surfaces to smooth finish, flush with surrounding surfaces unless otherwise required by test classification.
 - 2. Remove excess firestop material promptly as work progresses.
- C. Through Penetration Firestopping:
 - 1. Securely attach device frames to supporting construction.
 - 2. Assembly component parts to ensure proper contact and sealing of gaps and openings around penetrating items.
- D. Fire Resistant Construction Joints:
 - 1. Provide fire resistant systems to match fire rating of adjacent construction.
 - 2. Provide fire resistant systems at following locations:

- a. Voids and gaps in fire rated construction, including control joints and gap at top of fire-rated CMU walls.
- b. Fire rated partition and metal deck flutes.
- c. Changes in partition material.
- d. Floor joints not requiring expansion joint.
- e. Other locations indicated and required by applicable codes.

3.4 FIELD QUALITY CONTROL

- A. Inspection: Owner will engage and pay for services of independent testing consultant to perform quality control inspection.
- B. Do not conceal firestops, fire containments, and fire resistant construction joints prior to required inspection.
- C. Notify authority having jurisdiction and designated inspectors of work released for inspection.
- D. Labels:
 - 1. Provide label for each firestop/smoke seal condition.
 - 2. Securely fasten label immediately adjacent to firestopping condition to allow authorities having jurisdiction and owner's inspection agency to readily identify and confirm system.
- E. Inspection Requirements:
 - 1. Visually examine firestopping, fire containments, and fire resistant construction joints to verify compliance with Contract Documents.
 - 2. Examine firestopping, fire containments, and fire resistant construction joints for proper installation, adhesion, and curing appropriate for each material.
 - 3. Submit written inspection report including following information:
 - a. Identify construction penetrated including fire resistance rating.
 - b. Identify penetrating item.
 - c. Identify products and manufacturers included in each system.
 - d. Identify form material used.
 - e. Firestop classification and description from UL, FM, Warnock Hersey or other independent testing agency.
 - f. Fire containment and fire resistant construction joint description.
 - g. F and T rating.

- h. State whether firestop, fire containment, and fire resistant construction joint is or is not in full compliance with testing agency classification, description and manufacturer's requirements. If variations occur confirm acceptance of variation by manufacturer and authority having jurisdiction.
- F. Re-examine firestopping, fire containments, and fire resistant construction joints immediately prior to concealment by other construction to ensure no damage has occurred since initial inspection.
- G. Correct unacceptable firestopping, fire containments, and fire resistant construction joints, and provide additional inspection, to verify compliance with this Section, at no additional cost to Owner.

3.5 REPAIRS AND MODIFICATIONS

- A. Identify damaged and re-entered seals requiring repair and modification.
- B. Remove loose and damaged materials.
- C. If penetrating items are to be added, remove enough material to permit penetration by new elements, being careful not to damage balance of seal.
- D. Repair holes, cracks, and damage in accordance with manufacturer's instructions to ensure complete smoke seal.
- E. Use only materials approved by manufacturer of original seal as suitable for repair.

3.6 CLEANING

- A. General: Comply with Section 017423.
 - 1. Clean as instructed by manufacturer. Do not use materials or methods which may damage firestop or surrounding construction.
 - 2. Remove stains and correct damage to adjacent surfaces.

3.7 PROTECTION

- A. Protect finished work in accordance with Section 017300.
- B. Protect material subject to traffic from damage.

END OF SECTION 078400

SECTION 079200 – JOINT SEALANTS

PART 1 - - GENERAL

1.1 SUMMARY

A. Related Sections:

1. Section 078400 - Firestopping.
2. Section 092900 - Gypsum Board.
3. Section 093000 - Tiling.

1.2 DEFINITIONS

- A. Use definitions in ASTM C717.
- B. Non-Bleeding: Not capable of exuding liquid chemical components of sealant.
- C. Non-Staining: Not capable of discoloring joint substrate.
- D. Sealant System: Sealant, sealant backing, and primer intended for use in particular condition.

1.3 SUBMITTALS

A. General: Submit in accordance with Section 013323.

B. Product Data:

1. Submit product data and product specifications for each product.
2. Include data to indicate chemical characteristics, performance criteria, limitations, substrate preparation, installation requirements, and curing requirements.
3. Include information for accessories and other required components.
4. Include color charts indicating manufacturer's full color range available of each sealant type for Architect's initial selection.

C. Submit following Informational Submittals:

1. Test Reports: Submit written results of testing specified as part of Source and Field Quality Control articles.
2. Certifications specified in Quality Assurance article.
3. Qualification Data: Manufacturer's and installer's qualification data.
4. Manufacturer's instructions. Include requirements for surface preparation, priming, joint size ratios, adhesion testing, and perimeter conditions requiring special attention.
5. Manufacturer's field reports.

D. Closeout Submittals:

1. Submit under provisions of Section 017836.
2. Warranty: Submit specified warranty.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility:
 1. Provide products for each sealant system from one manufacturer for entire Project, unless otherwise acceptable to Architect.
 2. Provide products from a single manufacturer to ensure material compatibility where different sealant materials come in direct contact with each other.
 3. Provide each sealant system as complete unit, including accessory items necessary for proper function.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section with minimum 5 years experience.
- C. Applicator Qualifications: Acceptable to manufacturer, specializing in applying sealants, with experience on at least 5 projects of similar nature in past 5 years.
- D. Certifications:
 1. Manufacturer's Certification that Products:
 - a. Furnished for Project meet or exceed specified requirements.
 - b. Assembled for each joint are compatible with each other and with joint substrates under conditions of service and application.
 - c. Are suitable for the indicated use.
 2. Manufacturer's certification that sealants, primers, and cleaners, comply with local regulations controlling the use of volatile organic compounds.
 3. Contractor's and installer's certification that products are installed in accordance with Contract Documents, based on inspection and testing specified as part of Field Quality Control.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Comply with requirements of Section 016600.
- B. Deliver materials to site in unopened containers and bundles with labels indicating:
 1. Manufacturer's name.
 2. Product name and designation.
 3. Color.
 4. Expiration period for use.
 5. Working life.
 6. Curing time.
 7. Mixing instructions for multi-component materials.

C. Storage and Protection:

1. Store products within manufacturer's required temperature and humidity ranges.
2. Prior to use, condition products within manufacturer's required temperature range, humidity range, and time period.

1.6 PROJECT CONDITIONS

A. Environmental Requirements:

1. Apply sealant when the following are within manufacturer's limits during and for 24 hours after sealant installation:
2. Ambient and surface temperatures.
3. Relative humidity.
4. Do not apply sealants to wet or frozen surfaces.
5. Comply with manufacturer's requirements regarding application of sealants in vicinity of curing sealants of a different material.

1.7 WARRANTY

- A. Provide warranties under provisions of Section 017836.
- B. Warrant installed products to be free from defects in material, labor, or installation techniques for 20 years on silicones used at exterior building envelope, 5 years on urethanes used at exterior building envelope, 5 years at sealants used at interior locations.
- C. Include coverage for installed sealants and accessories which:
 1. Fail to achieve air tight seal.
 2. Fail to achieve watertight seal.
 3. Exhibit loss of adhesion.
 4. Exhibit loss of cohesion.
 5. Do not cure.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Acrylic Sealant Manufacturers:
 1. Pecora Corporation, Harleysville, PA.
 2. Sonneborn Building Products, Shakopee, MN.
 3. Tremco, Inc., Beachwood, OH.
- B. Acceptable Silicone Sealant Manufacturers:
 1. The Dow Chemical Company, Midland, MI.

2. General Electric Silicones, Waterford, NY.
3. Pecora Corporation, Harleysville, PA.
4. Tremco, Inc., Beachwood, OH.

C. Acceptable Urethane Sealant Manufacturers:

1. Pecora Corporation, Harleysville, PA.
2. Sika Corporation, Lyndhurst, NJ.
3. Sonneborn Building Products, Shakopee, MN.
4. Tremco, Inc., Beachwood, OH.

2.2 MATERIALS

A. Acrylic Latex (Designation AL):

1. Description:
 - a. ASTM C834.
 - b. Non-sag; non-staining; non-bleeding.
 - c. Joint movement range without cohesive/adhesive failure: Plus 7.5 percent to minus 7.5 percent of joint width.
 - d. Color: As selected by Architect from manufacturer's full color range.
2. Acceptable Products:
 - a. AC-20, Pecora Corporation, Harleysville, PA.
 - b. Sonolac, Sonneborn Building Products, Shakopee, MN.
 - c. Acrylic Latex Tremflex 834, Tremco, Inc., Beachwood, OH.

B. Silicone—General Purpose (Designation S-GP):

1. Description:
 - a. ASTM C920:
 - 1) Type: S
 - 2) Grade: NS
 - 3) Class: 25
 - 4) Uses: NT, M, G, A, O
 - b. Single component, neutral curing, non-staining, non-bleeding silicone sealant.
 - c. Medium modulus silicone for metal to metal and metal to adjacent substrates; Low modulus silicone for all other locations.
 - d. Joint movement range without cohesive/adhesive failure: Plus 50 percent to minus 50 percent of joint width.
 - e. Color: Selected by Architect from manufacturer's full color range.
 - f. Acceptable Medium Modulus Products:
 - 1) 795, Dow Corning.
 - 2) Silpruf, General Electric.

- 3) 864, Pecora.
- 4) Spectrem 2, Tremco.

C. Silicone—Sanitary (Designation S-S):

1. Description:

a. ASTM C920:

- 1) Type: S
- 2) Grade: NS
- 3) Class: 25
- 4) Uses: NT, M, G, A, O

- b. Neutral or acid curing, non-staining, non-bleeding, fungicide-containing.
- c. Color: Selected by Architect from manufacturer's full color range.

2. Acceptable Products:

- a. 786 Mildew-Resistant Silicone Sealant, The Dow Chemical Company, Midland, MI.
- b. Sanitary 1700, General Electric Silicones, Waterford, NY.
- c. Tremsil 200 Sanitary, Tremco, Beachwood, OH

D. Urethane—Traffic-Bearing (Designation U-TB):

1. Description:

a. ASTM C920:

- 1) Type: M
- 2) Grade: P or NS
- 3) Class: 25
- 4) Uses: T, M, O

- b. Chemical curing, non-staining, non-bleeding.
- c. Joint movement range without cohesive/adhesive failure: Plus 25 percent to minus 25 percent of joint width.
- d. Shore A hardness: 40 minimum, when tested in accordance with ASTM C661.
- e. Color: Selected by Architect from manufacturer's full color range.

2. Acceptable Products:

- a. Dynatred, Pecora Corporation, Harleysville, PA.
- b. Sikaflex 2c/SL, Sika Corporation, Lyndhurst, NJ.
- c. SL 2 Sealant, Sonneborn Building Products, Shakopee, MN.
- d. THC 901, Tremco, Inc., Beachwood, OH.

2.3 ACCESSORIES

A. Joint Cleaner:

1. Chemical cleaners required by sealant manufacturer for substrates encountered, compatible with sealant backing bond breaker materials.
2. Free of substances capable of staining, corroding, or harming:
 - a. Joint substrates.
 - b. Adjacent nonporous surfaces.
 - c. Sealant.
 - d. Sealant backing.
3. Formulated to promote optimum adhesion of sealants to joint substrates.

B. Primer:

1. Dyed coating material required by sealant manufacturer for enhancing sealant adhesion to joint substrates.
2. Non-staining to joint substrate beyond the substrate surface.
3. Required for use unless not required by results of:
 - a. "Manufacturer's sealant-substrate compatibility and adhesion test" described under Source Quality Control.

C. Sealant Backing Bond Breaker Rod:

1. Comply with ASTM C1330.
2. Non-staining material.
3. Compatible and non-adhering to sealant when tested in accordance with ASTM C1087.
4. Compatible with sealant, joint substrates, primers, and other sealant backing bond breakers.
5. Sealant manufacturer approved.
6. Sized and shaped to provide optimum performance and backing to sealant.
7. Preformed, compressible, resilient, non-staining, non-outgassing, non-waxing, non-extruding, cylinder-shaped plastic foam rods compliant with ASTM D1056.
8. Open Cell Polyurethane: Use not permitted unless required by sealant manufacturer.
9. Closed Cell Polyethylene:
 - a. Non-absorbent to liquid water.
 - b. Use in wall and ceiling joints unless otherwise required by sealant manufacturer.
10. Reticulated Polymeric: Sof®-Rod, Nomaco, Inc., Zebulon, NC.
11. Unless otherwise required by sealant manufacturer, oversize rod to be larger than joint width by following minimum amounts:
 - a. Open Cell Polyethylene: 50 percent.
 - b. Closed Cell Polyethylene: 33 percent.
 - c. Reticulated Polymeric: 25 percent.

D. Elastomeric Tubing Joint Filler for use in traffic bearing surfaces:

1. Neoprene, butyl, EPDM, or silicone tubing compliant with ASTM D1056.
 2. Shore A hardness of 70.
 3. Compatible with sealant, joint substrates, primers, and other sealant backing bond breakers.
 4. Use in pavement joints, unless otherwise required by sealant manufacturer.
 5. Use sealant backing bond breaker tape to separate sealant from rod.
 6. Unless otherwise required by sealant manufacturer, oversize rod to be larger than joint width by 25 percent the following minimum amounts:
- E. Sealant Backing Bond Breaker Tape:
1. Pressure sensitive polyethylene tape or tetrafluoroethylene self-adhesive tape required by sealant manufacturer to suit application.
 2. Minimum Thickness of 11 mils.
- F. Masking Tape: Non-staining, non-absorbent material compatible with sealants and surfaces adjacent to joints.
- G. Tooling Liquids: Non-staining material approved by manufacturer to reduce adhesion of sealant to joint finishing tools.
- H. Adhesives & Sealants: Only use adhesives and sealants in the interior of the building that meet or do not exceed the VOC limits of the current requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168 on the interior of the building.
1. Current requirement refers to the date on which the materials are installed in the building.
 2. Comply with SCAQMD Rule #1168 current as of the date of this specification. Refer to <http://www.aqmd.gov/rules> for the actual current version of the rule that will be applicable at the date of installation during construction.
 3. Interior refers to all building construction that is inside of the exterior weatherproofing material.

2.4 MIXES

- A. Comply with manufacturer's instructions.
- B. Mix thoroughly with mechanical mixer without mixing air into sealants.
- C. Continue mixing until sealant is uniform in color and free from streaks of unmixed materials.

2.5 SOURCE QUALITY CONTROL

- A. Tests:
 1. Coordinate testing of sealant compatibility and adhesion to:
 - a. Sealant backing materials.
 - b. Exterior aluminum door and frame system specified in Division 08.
 - c. Tile specified in Section 093000.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and proceed with work in accordance with Section 017300.
- B. Verify that sealant backing is compatible with sealant.
- C. Verify that substrate surface:
 - 1. Is within manufacturer's moisture content range.
 - 2. Complies with manufacturer's cleanliness and surface preparation requirements.
- D. Joint Width:
 - 1. Verify joints are greater than minimum widths required by manufacturer.
 - 2. If joints are narrower than minimum required widths, widen narrow joints to indicated width.
 - 3. Do not place sealant in joints narrower than manufacturer's required minimum.

3.2 PREPARATION

- A. Prepare, clean, and prime joints in accordance with manufacturer's instructions.
- B. Remove loose materials and matter which might impair adhesion of primer and sealant to substrate.
- C. Remove form release agents, laitance, and chemical retarders, which might impair adhesion of primer and sealant to concrete and masonry surfaces.
- D. Comply with ASTM C1193.
- E. Protect elements adjoining and surrounding work of this Section from damage and disfiguration.
- F. Priming:
 - 1. Prime joint substrates unless priming is not required by:
 - a. "Manufacturer's sealant-substrate compatibility and adhesion test" described in Source Quality Control article.
 - 2. Apply primer to substrate areas where joint sealant is to adhere.
 - 3. Comply with manufacturer's sequencing requirements for joint priming and sealant backing bond breaker rod installation to assure required primer application coverage and rate without placement of primer on backer rod surface to be in contact with sealant and avoid three-sided sealant adhesion.
 - 4. Do not allow spillage and migration of primer onto surfaces not to receive primer.
 - 5. Install sealant to primed substrates after primer has cured.

G. Masking Tape:

1. Use masking tape to prevent contact of primer and sealant with adjoining surfaces that would be permanently stained or damaged by:
 - a. Contact with primer and sealant.
 - b. Cleaning methods used to remove primer and sealant smears.
2. Place continuously along joint edges.
3. Apply masking tape so it does not shift in position after placement.

3.3 APPLICATION

A. General:

1. Comply with requirements of Section 017300.
2. Provide compatible sealant system between dissimilar assemblies and adjacent construction.
3. Seal locations necessary to create and secure continuous air, water, and vapor enclosure even though Contract Documents may not indicate all locations; do not seal weep holes.
4. Seal to prevent migration of water, vapor, and air through joints.
5. Comply with manufacturer's required application temperature and relative humidity ranges. Consult manufacturer when sealant cannot be applied within these ranges.

B. Sealant Backing Bond Breaker:

1. Measure joint dimensions and size materials to achieve manufacturer-required width-to-depth ratios.
2. Install to achieve sealant depth and sealant contact depth no greater than distance required by manufacturer for sealant material, joint width, and joint movement range.
3. Install using blunt instrument to avoid puncturing.
4. Do not:
 - a. Twist, puncture, and tear material.
 - b. Leave gaps between ends of material pieces.
 - c. Stretch or compress material along its length.
 - d. Stretch or compress tape material along its width.
5. Install to provide optimum joint profile and in manner to provide not less than 1/4 inch sealant depth when tooled.
6. Install tape where insufficient joint depth makes use of rod not possible. Match tape width to joint width to prevent three-side adhesion. Do not wrap tape onto sides of the joint.
7. Replace backing bond breaker materials which have become wet with dry materials prior to sealant application.

C. Sealant:

1. Install sealants at same time as installation of backing bond breaker materials.
2. Do not exceed manufacturer's required:

- a. Material shelf life.
 - b. Material working life.
 - c. Installation time after mixing.
3. Comply with manufacturer's requirements for applying different sealant materials in direct contact with each other.
 4. Use gun nozzle size to suit joint size and sealant material.
 5. Install sealant with pressure-operated devices to form uniform continuous bead.
 6. Use sufficient pressure to fill voids and joints full.
 7. Install to adhere to both sides of joint.
 8. Install to not adhere to back of joint; provide sealant backing.
 9. Install sealant free of air pockets and embedded matter.
 10. Recess sealant 1/8 inch from surface of pavements and horizontal surfaces.
- D. Sealant Tooling:
1. Comply with manufacturer's tooling method requirements.
 2. Tool sealant within manufacturer's tooling time limits.
 3. Tooling liquids:
 - a. Comply with manufacturer's requirements regarding use.
 - b. Do not use when not permitted by manufacturer.
 - c. Do not allow tooling liquids to come in contact with surfaces receiving sealant.
 4. Produce smooth exposed surface.
 5. Tool Sealant to be Free of:
 - a. Air pockets and voids.
 - b. Embedded impurities.
 - c. Surface ridges, sags, and indentations.
 6. Achieve full sealant contact and adhesion with substrate.
 7. Form a concave tooled joint shape indicated in Section A of Figure 5 of ASTM C1193, unless otherwise indicated.
 8. Remove excess sealant from surfaces adjacent to joint.
 9. Allow acrylic latex sealant to achieve firm skin before paint is applied.
- E. Masking Tape:
1. Remove immediately after tooling sealant and before sealant skin forms.
 2. Remove without disturbing sealant.

3.4 CLEANING

- A. Clean excess sealants and sealant smears from adjacent surfaces as application progresses; comply with sealant manufacturer's requirements and manufacturer of surface in which joints occur.

- B. Repair or replace defaced or disfigured finishes caused by work of this Section and replace where installation techniques result in unsatisfactory joining of materials and unsightly conditions.

3.5 PROTECTION

- A. Protect in accordance with Section 017300.
- B. Protect sealants from contamination until cured.
- C. Protect sealant joints in horizontal surfaces from foot and vehicular traffic until cured.

3.6 SCHEUDLE

- A. Items Not to be Sealed:
 - 1. Joints, perimeter, and penetrations in fire-rated assemblies. Use firestopping specified in Section 07 8400.
 - 2. Joints, perimeter, and penetrations in sound-rated assemblies. Use acoustical sealant specified with sound-rated assembly in Section 092900.
 - 3. Weep holes in masonry, windows, and doors.
- B. Sealant Schedule:
 - 1. Interior Joints:
 - a. Wall and Ceiling Joints subject to Movement: Designation S-GP.
 - b. Wall and Ceiling Joints not subject to Movement: Designation AL.
 - c. Interior side of exterior openings: S-GP.
 - d. Floor Joints, including tile: Designation U-TB.
 - e. Vertical tile joints: Designation S-GP.
 - f. Interior Sanitary Joints; Joints Between Plumbing Fixtures and Adjoining Floor, Wall, and Ceiling Surfaces; Joints Between Back Splashes and Wall Substrates: Designation S-S.
 - 2. Exterior Joints:
 - a. Perimeter Joints of Aluminum Door and Window Frames: Designation S-GP.
 - b. Other Exterior Joints where Indicated: Designation S-GP.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Standard hollow metal doors and frames.

- B. Related Sections:

- 1. Section 042000 "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
 - 2. Section 087100 "Door Hardware" for door hardware for hollow metal doors and frames.
 - 3. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for field painting hollow metal doors and frames.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door design.
 - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.

C. Other Action Submittals:

1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.
 1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation. Doors and frames to be stacked in vertical upright position.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amweld Building Products, LLC.
 2. Ceco Door Products; an Assa Abloy Group company.

3. Curries Company; an Assa Abloy Group company.
4. Fleming Door Products Ltd.; an Assa Abloy Group company.
5. Republic Builders Products.
6. Steelcraft; an Ingersoll-Rand company.
7. No substitutions. Material from custom hollow metal fabricators will not be accepted on job site unless Architect's prior approval is given in accordance with substitution request requirements.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheets: Carbon steel complying with ASTM A 366 (ASTM A 366M), commercial quality, or ASTM A 620 (ASTM A 620M), drawing quality, special killed.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Glazing: Comply with requirements in Division 08 Section "Glazing."

2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide 1-3/4-inch-thick doors of design indicated, fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
 1. Design: Flush panel.
 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
 - a. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-rated assemblies with R Factor 11 or better.
 - 1) Locations: Exterior doors.
 3. Vertical Edges for Single-Acting Doors: Beveled edge
 - a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).
 4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets.

5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheets. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), (0.053-inch - 1.3-mm-) thick steel, Model 2 (Seamless face and edges).
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), minimum 16 gage (0.053-inch - 1.3-mm-) thick steel, Model 2 (Seamless face and edges).
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheets.
 1. Fabricate frames with mitered or coped corners.
 2. Fabricate frames as face welded joints and back weld joints continuously, unless otherwise indicated.
 3. Frames for Level 3 Steel Doors: 0.067-inch- (1.7-mm-) thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.
 1. Fabricate frames with mitered or coped corners.
 2. Fabricate frames as face welded unless otherwise indicated.
 3. Frames for Level 3 Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
 4. Frames 48-inches and wider in opening width are required to be 0.067-inch- (1.7-mm-) thick steel sheet.
 5. Frames for Wood Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
 6. Frames for Borrowed Lights: 0.053-inch- (1.3-mm-) thick steel sheet.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.6 STOPS AND MOLDINGS

- A. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.

2.7 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inches (0.4 mm) thick.

2.8 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8
- C. Hollow Metal Doors:
 - 1. Exterior Doors:
 - a. Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Top of door to be flush and sealed joints in top edges of doors against water penetration.
 - b. Provide polyurethane core.

2. Astragals: Provide overlapping astragal as noted in door hardware sets in Section 087100 "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted.
 3. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Section 087100 "Door Hardware."
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Continuously backweld joints at exterior frames.
 2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 3. Equal Rabbet Frames: Provide frames with equal rabbet dimensions unless glazing and removable stops required wider dimension on glass side of frame.
 4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48 inches and wider with mortise/butt type hinges at top hinge location.
 5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Section 087100 "Door Hardware."
 6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
 7. Grout Guards: Weld guards boxes to frame at back of hardware mortises in frames at all hinge and strike preps regardless of grouting requirements.
 8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 9. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
 10. Door Silencers: Except on weather-stripped or gasketed doors, drill stops to receive door silencers as follows. Keep holes clear during construction. Silencers to be supplied by frame manufacture regardless if specified in Section 087100 "Door Hardware."
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Section 087100 "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricators shop
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that glazed lites are capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 4. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.9 STEEL FINISHES

- A. Prime Finish: Apply primer immediately after cleaning and pretreating.
1. Shop Primer: Sherwin Williams Kem Bond HS, or equal; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
 1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post installed expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of post installed expansion anchors if so indicated and approved on Shop Drawings.
 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 4. Cast-in-Place or Precast Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
 5. Field Supplied Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
 6. Grouting Requirements:
 - a. Do not grout head of frames unless reinforcing has been installed in head of frame.
 - b. Do not grout vertical or horizontal closed mullion members.
 7. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.
4. Wood and metal light frames for flush wood doors.

- B. Related Sections:

1. Division 08 Section "Hollow Metal Frames and Doors" for wood doors in steel frames.
2. Division 08 Section "Glazing" for glass view panels in flush wood doors.
3. Division 08 Section "Door Hardware" for door hardware for flush wood doors.

1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire-protection ratings for fire-rated doors.

- C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

D. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors from single manufacturer.
- B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.
 - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - 2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.

1.7 WARRANTY

- A. General Warranty: Door manufacturer's warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.
 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Algoma Hardwoods, Inc.
 2. Eggers Industries.
 3. Graham.
 4. Marshfield Door Systems, Inc.
 5. VT Industries Inc.

2.2 DOOR CONSTRUCTION, GENERAL

- A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.
- B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
- C. Particleboard-Core Doors:
1. Particleboard: ANSI A208.1, Grade LD-2.
 2. Blocking: Provide wood blocking in particleboard-core doors as follows:
 - a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
 - b. 5-inch (125-mm) bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
 - c. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.

- D. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 2. Pairs: Provide formed-steel edges and astragals with intumescent seals.
 - a. Finish steel edges to match door hardware (locksets or exit devices).
- E. Mineral-Core Doors:
1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware as follows:
 - a. 5-inch (125-mm) top-rail blocking.
 - b. 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
 - c. 5-inch (125-mm) midrail blocking, in doors indicated to have armor plates.
 - d. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.
 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:
1. Grade: Premium, with Grade A faces.
 2. Species: Select walnut.
 3. Cut: Plain sliced.
 4. Match between Veneer Leaves: Book matched.
 5. Assembly of Veneer Leaves on Door Faces: Running.
 6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 7. Exposed Vertical and Top Edges: Same species as faces.
 8. Core: Particleboard or structural composite lumber.
 9. Construction: Five plies. Stiles and rails are bonded to core, and then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.

2.4 LIGHT FRAMES

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.
1. Wood Species: Same species as door faces.

2. Profile: Flush rectangular beads.
- B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 1. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
 3. Electrical Wiring: Provide flush wood doors receiving electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the electric thru wire hinge or pivot specified in hardware sets in Division 08 "Door Hardware."
- C. Openings: Cut and trim openings through doors in factory.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."

2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Finish doors at factory that are indicated to receive transparent finish.
- C. Transparent Finish:
 1. Grade: Premium.

2. Finish: WDMA TR-6 catalyzed polyurethane, UV cured; Marshfield 0-95 finish.
3. Staining: Match furniture per FF&E Specifications.
4. Effect: Match furniture per FF&E Specifications.
5. Sheen: Match furniture per FF&E Specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Division 08 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
 2. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
 3. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
 4. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.

- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 081417 – MDF COMPOSITE DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. MDF (medium density overlay) composite doors.

1.2 SUBMITTALS

A. Product Data: For each type of door indicated.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate fire-protection ratings for fire-rated doors.

1.3 QUALITY ASSURANCE

A. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."

1.4 WARRANTY

A. Provide manufacturer's standard 10-year warranty

PART 2 - PRODUCTS

2.1 MANUFACTURERS/PRODUCTS

A. Manufacturers/Products: Subject to compliance with requirements, provide products as follows:

1. DoorAmerica; Millenium Infinity Door, 1101.

2.2 DOOR CONSTRUCTION

A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain added urea formaldehyde.

B. Composite doors of MDF and wood bonded together with exterior grade Type 1 adhesive.

- C. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated, complying with the 2006 edition of the International Building Code.

2.3 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
1. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.

2.4 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
1. Finish faces, all four edges, edges of cutouts, and mortises.
- B. Factory-Finish: Primed for field painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hardware: For installation, see Division 08 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
 2. Clearance between bottom of door and raised non-combustible sill shall not exceed 3/8 inch.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 081416

SECTION 081433 - STILE AND RAIL WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Interior stile and rail wood doors.
2. Finishing stile and rail wood doors.
3. Fitting stile and rail wood doors to frames and machining for hardware.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include details of construction.

- B. Shop Drawings: For stile and rail wood doors. Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data, including those for stiles, rails, panels, and moldings (sticking); and other pertinent data, including the following:

1. Dimensions of doors for factory fitting.
2. Locations and dimensions of mortises and holes for hardware.
3. Undercuts.
4. Requirements for veneer matching.
5. Doors to be factory finished and finish requirements.
6. Fire-protection ratings for fire-rated doors.

- C. Samples for Verification: Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edgings representing typical range of color and grain for each species of veneer and solid lumber required. Finish Sample with same materials proposed for factory-finished doors.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of door, from manufacturer.
- B. Sample Warranty: For special warranty.

- C. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is a certified participant in AWI's Quality Certification Program.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in opaque plastic bags or cardboard cartons.
- C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.
- B. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during remainder of construction period.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship, or have warped (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section, within specified warranty period.
1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 2. Warranty shall be in effect during the following period of time from date of Substantial Completion:
 - a. Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain stile and rail wood doors from single manufacturer.

2.2 MATERIALS

- A. General: Use only materials that comply with referenced standards and other requirements specified.
 - 1. Assemble interior doors, including components, with either dry-use or wet-use adhesives complying with ASTM D 5572 for finger joints and with ASTM D 5751 for joints other than finger joints.

2.3 INTERIOR STILE AND RAIL WOOD DOORS

- A. Interior Stile and Rail Wood Doors: Interior doors complying with WDMA I.S.6, "Industry Standard for Wood Stile and Rail Doors," and with other requirements specified.
 - 1. WDMA Design Group:
 - a. Louvered Design: As indicated on Drawings, rounded slats, slanted.
 - b. One-panel Design: Marshfield Door Systems: K-6000.
 - 2. Finish and Grade: Transparent and Premium or Select.
 - 3. Wood Species: Select Walnut, plain sliced..
 - 4. Stile and Rail Construction: Edge-glued solid lumber or veneered, structural composite lumber.
 - 5. Mark, label, or otherwise identify stile and rail wood doors as complying with WDMA I.S.6 and grade specified. Include panel design number if applicable.
 - 6. Thickness: 1-3/4" at Entry door, 1-3/8" at closet doors, unless otherwise indicated.

2.4 STILE AND RAIL WOOD DOOR FABRICATION

- A. Fabricate stile and rail wood doors in sizes indicated for field fitting.
- B. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels unless otherwise indicated:
 - 1. Clearances: Provide 1/8 inch (3 mm) at heads, jambs, and between pairs of doors. Provide 1/2 inch (13 mm) from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide not more than 3/8 inch (10 mm) from bottom of door to top of threshold.
 - a. Comply with NFPA 80 for fire-rated doors.
 - 2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
 - 3. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) on lock edge; trim stiles and rails only to extent permitted by labeling agency.

2.5 FINISHING

- A. Finish wood doors at woodworking shop.
- B. For doors indicated to be shop finished, comply with WDMA I.S.6A, "Industry Standard for Architectural Stile and Rail Doors," and with other requirements specified.
 - 1. Finish faces and all four edges of doors, including mortises and cutouts. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- C. Use only paints and coatings that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: WDMA TR-4 conversion varnish or WDMA TR-6 catalyzed polyurethane.
 - 3. Staining: Match furniture as indicated in Interior FF&E specifications.
 - 4. Effect: Match furniture as indicated in Interior FF&E specifications.
 - 5. Sheen: Match furniture as indicated in Interior FF&E specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 1. Clearances: Provide 1/8 inch (3 mm) at heads, jambs, and between pairs of doors. Provide 1/2 inch (13 mm) from bottom of door to top of decorative floor finish or

covering unless otherwise indicated. Where threshold is shown or scheduled, provide 3/8 inch (10 mm) from bottom of door to top of threshold unless otherwise indicated.

- a. Comply with NFPA 80 for fire-rated doors.
 2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
- D. Factory or Shop-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081433

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 1. Access doors and frames for walls and ceilings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each door face material.
- D. Schedule: Types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Access Panel Solutions.
2. Acudor Products, Inc.
3. Alfab, Inc.
4. Babcock-Davis.
5. Cendrex Inc.
6. Elmdor/Stoneman Manufacturing Co.; Div. of Acorn Engineering Co.
7. Jensen Industries; Div. of Broan-Nutone, LLC.
8. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
9. Karp Associates, Inc.
10. Larsen's Manufacturing Company.
11. Maxam Metal Products Limited.
12. Metropolitan Door Industries Corp.
13. MIFAB, Inc.
14. Milcor Inc.
15. Nystrom, Inc.
16. Williams Bros. Corporation of America (The).

- B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.
- C. Flush Access Doors with Concealed Flanges as noted on the key notes and reflected ceiling plans:
 - 1. Basis-of-Design Product: Indicated on Drawings
 - 2. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
 - 3. Locations: Ceiling located in suspended GWB substrate
 - 4. Door Size: 16" x 16"
 - 5. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage
 - a. Finish: Factory finish.
 - 6. Frame Material: Nominal 0.060 inch (1.52 mm), 16 gage.
 - 7. Hinges: Manufacturer's standard.
 - 8. Hardware: Latch.
- D. Hardware:
 - 1. Latch: Cam latch operated by screwdriver.

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same type as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
1. For cylinder locks, furnish two keys per lock and key all locks alike.
 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

2.4 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 083213 - SLIDING ALUMINUM-FRAMED GLASS DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes sliding aluminum-framed glass doors for exterior locations.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.

- B. Shop Drawings: For sliding aluminum-framed glass doors.

- 1. Include plans, elevations, sections, and details.
 - 2. Detail attachments to other work, and between units, if any.
 - 3. Include hardware and required clearances.

- C. Samples for Verification: For sliding aluminum-framed glass doors and components required, prepared on Samples of size indicated below:

- 1. Main Framing Member: 12-inch-long (300-mm-long) section with weather stripping, glazing bead, and factory-applied color finish.
 - 2. Hardware: Full-size units with factory-applied finish.

- D. Product Schedule: For sliding aluminum-framed glass doors. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Product Test Reports: For each sliding aluminum-framed glass door, for tests performed by a qualified testing agency, and for each class and performance grade indicated, tested at AAMA gateway size.
- C. Field quality-control reports.
- D. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes, weather stripping, operable panels, and operating hardware to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating sliding aluminum-framed glass doors that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.
- B. Installer Qualifications: An installer acceptable to sliding aluminum-framed glass door manufacturer for installation of units required for this Project.

1.8 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of sliding aluminum-framed glass doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Failure to meet performance requirements.
- b. Structural failures including excessive deflection.
- c. Excessive water leakage or air infiltration.
- d. Faulty operation of movable panels and hardware.
- e. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- f. Failure of insulating glass.
- g. .

2. Warranty Period:

- a. Sliding Door: Five years from date of Substantial Completion.
- b. Insulating-Glass Units: 10 years from date of Substantial Completion.
- c. Aluminum Finish: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Provide Series 3014 non-thermal, heavy commercial sliding glass doors by EFCO Corporation, or a comparable product by one of the following:
 - 1. EFCO Corporation.
 - 2. Graham Architectural Products Corporation.
 - 3. Kawneer North America; an Alcoa company.
 - 4. TRACO.
- B. Source Limitations: Obtain sliding aluminum-framed glass doors from single source from single manufacturer.
- C. System Depth: 4-1/2 inches.

2.2 PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 - 1. Product Certification: AAMA certified with label attached to each door.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
 - 1. Minimum Performance Class: AW-PG75.
 - C. Air Infiltration: Less than 0.10 cfm/sf at 6.24 p.s.f. pressure.
 - D. Water Infiltration: No leakage at 15.0 p.s.f pressure.
- E. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum total fenestration product SHGC of 0.33.
- F. Condensation-Resistance Factor (CRF): Provide sliding aluminum-framed glass doors tested for thermal performance according to AAMA 1503, showing a CRF of 45.
- G. Thermal Movements: Provide sliding aluminum-framed glass doors, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

- H. Sound Transmission Class (STC): Rated for not less than 28 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
- I. Outside-Inside Transmission Class (OITC): Rated for not less than 23 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.
- J. Windborne-Debris-Impact Resistance: Not required.

2.3 SLIDING ALUMINUM-FRAMED GLASS DOORS

- A. Frames and Door Panels: Fabricated from aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
- B. Threshold and Sill Cap/Track: Provide extruded-aluminum threshold and track of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior; with manufacturer's standard finish.
 - 1. Low-Profile Floor Track: ADA-ABA compliant.

2.4 GLAZING

- A. Glass and Glazing: Manufacturer's standard glazing system that produces weathertight seal. Comply with requirements indicated in Section 088000 "Glazing."

2.5 HARDWARE

- A. General: Provide manufacturer's standard hardware, fabricated from a corrosion-resistant material compatible with aluminum complying with AAMA 907 and designed to smoothly operate, tightly close, and securely lock sliding aluminum-framed glass doors.
- B. Door Pulls: Provide manufacturer's standard pull.
 - 1. Color and Finish: Match door frame.

2.6 ACCESSORIES

- A. Fasteners: Noncorrosive and compatible with door members, trim, hardware, anchors, and other components.
 - 1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.
- B. Anchors, Clips, and Accessories: Provide anchors, clips, and accessories of aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron for sliding aluminum-framed glass doors, complying with ASTM B 456 or ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

1. Windborne-Debris Resistance: Provide anchors of same design used in windborne-debris resistance testing.

2.7 FABRICATION

- A. Fabricate sliding aluminum-framed glass doors in sizes indicated. Include a complete system for assembling components and anchoring doors.
- B. Fabricate sliding aluminum-framed glass doors that are reglazable without dismantling panel framing.
- C. Weather Stripping: Provide full-perimeter weather stripping for each door panel.
- D. Weep Holes: Provide weep holes and internal drainage passages to conduct infiltrating water to exterior.
- E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.
- F. Factory-Glazed Fabrication: Glaze sliding aluminum-framed glass doors in the factory where practical and possible for applications indicated. Comply with requirements in Section 088000 "Glazing" and with AAMA/WDMA/CSA 101/I.S.2/A440.

2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of threshold substrate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight sliding aluminum-framed glass door installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing doors, hardware, accessories, and other components.
- B. Windborne Debris Resistance: Anchor sliding aluminum-framed glass doors that have been tested for windborne debris resistance to structure using anchoring method, fastener type, and fastening frequency identical to that used in windborne debris resistance testing.
- C. Install sliding aluminum-framed glass doors level, plumb, square, true to line, without distortion, without warp or rack of frames and panels, and without impeding thermal movement; anchored securely in place to structural support; and in proper relation to wall flashing, vapor retarders, air barriers, water/weather barriers, and other adjacent construction.
- D. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.
- E. Install sliding aluminum-framed glass doors and components to drain condensation, water penetrating joints, and moisture migrating within doors to the exterior.
- F. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Test and inspect installed sliding aluminum-framed glass doors as follows:

1. Testing Methodology: Test sliding aluminum-framed glass doors for air infiltration and water resistance according to AAMA 502.
 2. Air-Infiltration Testing:
 - a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
 - b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.
 3. Water-Resistance Testing:
 - a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
 - b. Allowable Water Infiltration: No water penetration.
 4. Testing Extent: Three sliding aluminum-framed glass doors of each type as selected by Architect and a qualified independent testing and inspecting agency. Conduct tests after perimeter sealants have cured.
 5. Test Reports: Prepared according to AAMA 502.
- C. Sliding aluminum-framed glass door will be considered defective if it does not pass tests and inspections.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Lubricate hardware and moving parts.
- B. Adjust operating panels and screens to provide a tight fit at contact points and weather stripping for smooth operation, without binding, and a weathertight closure. Adjust hardware for proper alignment, smooth operation, and proper latching without unnecessary force or excessive clearance.
- C. Clean exposed surfaces immediately after installing sliding aluminum-framed glass doors. Avoid damaging protective coatings and finishes. Remove nonpermanent labels, excess sealants, glazing materials, dirt, and other substances.
- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- E. Protect sliding aluminum-framed glass door surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances contact sliding aluminum-framed glass door surfaces, remove contaminants immediately according to manufacturer's written instructions.
- F. Refinish or replace sliding aluminum-framed glass doors with damaged finishes.
- G. Replace damaged components.

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34-14102-00
FOR REVIEW - NOT FOR CONSTRUCTION

END OF SECTION 083213

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Exterior insulated service doors.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

- 1. Component Importance Factor: 1.0.

- B. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.

- 1. Wind Loads: Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward.

- C. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.

- 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.

- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
 - 5. Show locations of locking devices, and other accessories.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

PART 2 - PRODUCTS

2.1 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm) and as required to meet requirements.

2. Insulation: Fill slats for exterior doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.
 3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
 4. Gasket Seal: Provide insulated slats with manufacturer's standard interior-to-exterior thermal break or with continuous gaskets between slats.
- B. Endlocks and Windlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
- C. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminum extrusions to match curtain slats and finish.
- D. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.
- E. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. (0.406 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283 or DASMA 105.
- F. Operation Cycles: Not less than 10,000.
 1. Include tamperproof cycle counter.

2.2 DOOR ASSEMBLIES

- A. Insulated Service Doors: Overhead coiling door formed with curtain of interlocking metal slats.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACME Rolling Doors.
 - b. Alpine Overhead Doors, Inc.
 - c. Alumatec Pacific Products.
 - d. Amarr Garage Doors.
 - e. ASTA Door Corporation.
 - f. C.H.I. Overhead Doors.
 - g. City-Gates.
 - h. Clopay Building Products.
 - i. Cookson Company.
 - j. Cornell Iron Works, Inc.
 - k. Janus International Corporation.
 - l. Lawrence Roll-Up Doors, Inc.
 - m. McKeon Rolling Steel Door Company, Inc.

- n. Metro Door.
- o. Overhead Door Corporation.
- p. QMI Security Solutions.
- q. Raynor.
- r. Southwestern Rolling Steel Door Co.
- s. Wayne-Dalton Corp.

2.3 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.

2.4 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 - 1. Lock Cylinders: Cylinders specified in Section 087100 "Door Hardware".
 - 2. Keys: Two for each cylinder.
- C. Chain Lock Keeper: Suitable for padlock.

2.5 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
 - 1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
 - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.
- B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
 - 1. Provide pull-down straps or pole hooks for doors more than 84 inches (2130 mm) high.

2.6 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.7 MANUAL DOOR OPERATORS

- A. Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.
- B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf (111 N).

2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
 1. Color: As selected by the Architect from manufacturer's standard range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

3.3 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather-resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Exterior aluminum-framed storefronts.
2. Exterior aluminum doorframes.
3. Exterior and manual swing entrance doors.

- B. Related Sections:

1. Division 07 Section "Sheet Metal Flashing and Trim" for metal flashing installed under storefront framing.

1.3 DEFINITIONS

- A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
4. Dimensional tolerances of building frame and other adjacent construction.
5. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferred to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - d. Noise or vibration created by wind and thermal and structural movements.

- e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units to function properly.
- B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Loads:
- 1. Wind Loads: As indicated on Drawings.
 - 2. Seismic Loads: As indicated on Drawings.
- D. Deflection of Framing Members:
- 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m).
 - 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
- E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
- 1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 - 2. Test Durations: As required by design wind velocity but not less than 10 seconds.
- F. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- G. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa).
- H. Water Penetration Under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- I. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.

- J. Average Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having average U-factor of not more than 0.63 Btu/sq. ft. x h x deg F (3.57 W/sq. m x K) when tested according to AAMA 1503.

1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
 - 3. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- C. Qualification Data: For qualified Installer.
- D. Warranties: Special warranties specified in this Section.
- E. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of aluminum-framed systems.
 - 2. Include design calculations.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
 - 1. Engineering Responsibility: Preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.

- B. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water leakage through fixed glazing and framing areas.
 - e. Failure of operating components to function properly.
 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for aluminum-framed systems is based on Kawneer; Trifab VG 451/451T. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
1. Arch Aluminum & Glass Co., Inc.
 2. EFCO Corporation.
 3. Pittco Architectural Metals, Inc.
 4. Traco.
 5. Tubelite Inc.
 6. United States Aluminum.
 7. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
 8. YKK AP America Inc.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 3. Extruded Structural Pipe and Tubes: ASTM B 429.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Thermally broken.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Front.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 2. Reinforce members as required to receive fastener threads.
 3. Exposed fasteners are not permitted.

- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.
- F. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.4 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
 - 1. Door Construction: 2-inch (50.8-mm) overall thickness, with minimum 0.188-inch (4.8-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - 2. Door Design: Narrow stile; 5-inch (127-mm) nominal width.
 - a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.
 - 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide non-removable glazing stops on outside of door.
- B. Door Hardware: As specified in Division 08 Section "Door Hardware."

2.5 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.6 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."

- B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.7 FABRICATION

- A. Form aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 4. Physical and thermal isolation of glazing from framing members.
 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 6. Provisions for field replacement of glazing from interior.
 7. Fasteners, anchors, and connection devices that are concealed from view.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).
- E. Storefront Framing: Fabricate components for assembly using shear-block system or screw-spline system as required to meet performance requirements.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 1. At exterior doors, provide compression weather stripping at fixed stops.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 2. At exterior doors, provide weather sweeps applied to door bottoms.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Powder coat finish complying with AAMA 2604, AKZO NOBEL "INTERPON D2000", or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 - 6. Seal joints watertight, unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" and to produce weathertight installation.

- E. Install components plumb and true in alignment with established lines and grades, without warp or rack.
- F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- G. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.
- H. Install glazing as specified in Division 08 Section "Glazing."
- I. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).
 - 3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch (3 mm).

3.3 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
 - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

END OF SECTION 084113

SECTION 084113.13 – ALUMINUM-FRAMED FOLDING PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Interior sliding/folding aluminum and glass door system, including aluminum frame, threshold, panels, sliding/folding and locking hardware, weather stripping, glass and glazing.

- B. Related Sections:

1. Division 08 Section “Aluminum-Framed Entrances and Storefronts” for interior entrance and storefront systems.
2. Division 10 Section “Operable Partitions” for manually operated acoustical panel partitions.

1.3 SUBMITTALS

- A. Detail Drawings: Indicate dimensioning, direction of swing, configuration, swing panels, typical head jamb, side jambs and sill details, type of glazing material, and handle height.
- B. Product Data: Manufacturer’s literature including independently tested data listing performance criteria and Owner’s Manual with installation instructions.
- C. Contract Closeout Submittal: Submit Owner’s Manual from manufacturer. Identify with project name, location and completion date, type and size of unit installed.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Provide complete, precision built, engineered, pre-fitted unit by a single source manufacturer with at least 15 years experience in providing folding/sliding door systems for large openings.
 1. The manufacturer shall have a quality system registration to the ISO9001:2000 standard.

- B. Installer Qualifications: Installer experienced in the installation of manufacturer's products or other similar products for large openings. Installer to provide reference list of at least three projects of similar scale and complexity successfully completed in the last 3 years.

1.5 WARRANTY

- A. Provide manufacturer's standard warranty against defects in materials and workmanship.
- B. Warranty Period: Ten years for roller mechanisms. For all other components, one year (two years if unit is installed by manufacturer's certified trained installer) from date of delivery by manufacturer.

1.6 SITE CONDITIONS, DELIVERY, STORAGE AND HANDLING

- A. In addition to general delivery, storage and handling requirements specified in Division 01, comply with the following:
1. Deliver materials to job site in sealed, unopened cartons or crates. Protect units from damage. Store material under cover, protected from weather and construction activities.
- B. Field Measurements: Verify actual locations of structural supports for aluminum-framed folding panels by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed folding panels without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 OPERABLE GLASS PANELS

- A. Operable Glass Panels: Operable aluminum-framed glass panel partition system with acoustical properties, including panels, suspension system, operators, and accessories.
1. Product: Subject to compliance with requirements, provide the following:
 - a. Nana Wall Systems, Inc.; Nana Wall SL45 Monumental Aluminum Framed Folding/Paired Panel System.
- B. Panel Operation: Manually operated, continuously hinged panels.
- C. Panel Construction: Manufacturer's standard glazed panels, reinforced as required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place

partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

1. Factory-Glazed Fabrication: Glaze operable glass panels in the factory where practical and possible for applications indicated. Comply with manufacturer's written requirements and with requirements in Division 08 Section "Glazing."
- D. Frame and Panels: From manufacturer's standard profiles, provide head jamb, side jambs, and panels with dimensions shown on the Drawings.
 1. Provide panels with horizontal mullions at specified heights from the bottom of the panel.
 2. Provide standard bottom rail or manufacturer's standard kickplate with height specified.
 3. Aluminum Extrusion: Extrusions with nominal thickness of 0.078 inch (2.0 mm). Alloy specified as AIMgSi0.5 with strength rated as 6063-T5 or F-22 (European standard). Anodized conforming to AAMA 611.
- E. Aluminum Finish:
 1. Clear anodized.
- F. Glass and Glazing:
 1. Safety Glass: Provide glass products complying with testing requirements in 16 CFR 1201, for Category II materials, unless those of Category I are expressly indicated and permitted.
 2. Glass: Manufacturer's standard glass and glass assemblies as indicated and complying with the following:
 - a. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Type I (transparent flat glass), Class 1 (clear), Quality-Q3.
- G. Locking Hardware and Handles:
 1. Main Entry Panel: On the main entry panel for models with a swing panel, provide manufacturer's standard lever handles on the inside and outside, a Schlage compatible lock set with lockable latch, multi-point locking with a dead bolt and rods at the top and bottom on primary panel only. Rods to be concealed and not edge mounted. Depression of handles withdraws latch. Lifting of handles engages rods and turn of key or thumb turn engages deadbolt and operates lock. If there is a secondary swing panel, provide two point locking with flat handles on inside only for the secondary swing panel.
 - a. Stainless steel lever handles in a brushed satin finish.
 2. On all other secondary swing panels and pairs of folding panels, provide manufacturer's standard flat handles [OR removable custodial handles] and concealed two point locking hardware operated by 180 degree turn of handle between each pair. Face applied flush bolt locking will not be allowed.
 3. Flat Handle Finish: Stainless steel in a brushed satin finish.
 4. Provide handle height centered at 41-3/8 inches from bottom of panel.

5. Aluminum locking rods with standard fiber glass reinforced polyamide end caps at top and bottom. Rods to have a stroke of 15/16 inch (24 mm).
- H. Sliding/Folding Hardware: Provide manufacturer's standard combination sliding and folding hardware with top and bottom tracks.
1. For each pair of folding panels, provide cardanic, independently suspended, four wheeled coated with fiber glass reinforced polyamide upper running carriage and lower guide carriage.
 2. Provide manufacturer's standard zinc die cast powder coated hinges that are closest to match to finish of frame and panels [OR stainless steel hinges]. Provide stainless steel security hinge pins with set screws.
 3. Adjustment: Provide system capable of specified amount of adjustments without removing panels from tracks without needing to remove panels from tracks, 1/16 inch (1.5 mm) in width per hinge.
- I. Other Components:
1. Threshold: Provide flush sill in the same finish as panel finish or clear anodized flush sill.
 2. Weatherstripping: Provide manufacturer's standard double layer EPDM or brush seals with a two layer polyamide fin at both inner and outer edge of door panels or on frame for sealing between panels and between panel and frame.
 3. Provide stainless steel screws for connecting frame components.
- J. Dimensions: Fabricate operable glass panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
1. Panel Width: Equal widths.

2.2 FABRICATION

- A. Use extruded aluminum frame and panel profiles, corner connectors and hinges, sliding and folding hardware, locking hardware and handles, glass and glazing and weather stripping as specified herein to make a folding glass wall. Factory pre-assemble as is standard for manufacturer and ship with all components and installation instructions.
- B. Sizes and Configurations: See drawings for selected custom dimensions within maximum frame sizes possible as indicated in manufacturer's literature. See drawings for selected number of panels and configuration. Inward opening unit. Contact manufacturer for other stacking options and layouts.

2.3 SUSPENSION SYSTEMS

- A. Suspension Tracks: Steel or aluminum mounted directly to overhead structural support, designed for type of operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch (2.54 mm)

between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

1. Panel Guide: Aluminum; finished with factory-applied, decorative, protective finish.
- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install frame in accordance with manufacturer's recommendations and installation instructions.
- B. Installer to provide appropriate anchorage devices and to securely and rigidly fit frame in place, absolutely level, straight, plumb and square. Install frame in proper elevation, plane and location, and in proper alignment with other work.
- C. Install panels, handles and lock set in accordance with manufacturer's recommendations and installation instructions.
- D. If necessary, adjust hardware for proper operation.

END OF SECTION 084113.13

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes aluminum windows for exterior locations.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For manufacturer's warranties.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.

- B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of materials and finishes beyond normal weathering.
 - e. Failure of insulating glass.
 2. Warranty Period:
 - a. Window: 10 years from date of Substantial Completion.
 - b. Glazing Units: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
1. Window Certification: AMMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
1. Minimum Performance Class: CW.
 2. Minimum Performance Grade: 35.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K).
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40.

- E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.
- F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.
- G. Sound Transmission Class (STC): Rated for not less than 26 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
- H. Outside-Inside Transmission Class (OITC): Rated for not less than 30 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

2.3 ALUMINUM WINDOWS

- A. Operating Types: Provide the following operating types in locations indicated on Drawings:
 - 1. Fixed.
- B. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
 - 1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.
- C. Glass: Clear annealed glass, ASTM C 1036, Type 1, Class 1, q3.
 - 1. Kind: Fully tempered.
- D. Insulating-Glass Units: ASTM E 2190, certified through IGCC as complying with requirements of IGCC.
 - 1. Glass: ASTM C 1036, Type 1, Class 1, q3.
 - a. Tint: Clear.
 - b. Kind: Annealed, Fully tempered.
 - 2. Lites: Two.
 - 3. Filling: Fill space between glass lites with air.
 - 4. Low-E Coating: Sputtered on second surface.

E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

1. Dual Glazing:

- a. Interior Lite: Glass.
- b. Exterior Lite: Glass.

F. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

A. Subsills: Provide thermally broken, extruded-aluminum subsills.

2.5 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

D. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.

E. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design wind loads of window units.

F. Window Assemblies: Provide fixed units in configuration indicated.

G. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
 - 1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
 - 2. Air-Infiltration Testing:
 - a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
 - b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.
 - 3. Water-Resistance Testing:
 - a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
 - b. Allowable Water Infiltration: No water penetration.
 - 4. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
 - 5. Test Reports: Prepared according to AAMA 502.
- C. Remove and replace noncomplying windows and retest as specified above.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- E. Prepare test and inspection reports.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
 - 1. Keep protective films and coverings in place until final cleaning.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Related Sections:

1. Section 081416 "Flush Wood Doors".
2. Section 081433 "Stile and Rail Wood Doors".

1.2 SUBMITTALS

A. General: Submit in accordance with Section 013323.

1. Submit 6 typed copies of hardware submittals per DHI Vertical Format.

B. Product Data: For each item.

1. Include sample of warranty customized for this project.

C. Hardware Schedules: Indicate hardware required for each opening.

1. Use same reference numbers for openings as Drawings.
2. Include glossary of abbreviations, symbols and codes contained in schedule.
3. Coordinate schedule with submittal requirements of related door and frame Sections.
4. Include product name, catalog number, and manufacturer of each item.
5. Include type, style, model number, function, size, fastenings, finish and other pertinent data for each item.
6. Indicate degree of opening for closers, overhead stops, overhead holders, and other similar hardware items.

D. Samples: (Not required for this project.)

1.3 QUALITY ASSURANCE

A. General Requirements: Hardware has been specified by manufacturer's name, brand and catalog numbers for purpose of establishing basis for quality, design and operational function.

1. Except where specifically indicated otherwise, equivalent products from other listed manufacturers are also acceptable.
2. Provide designated product, or where more than one product or manufacturer is listed, provide equivalent product of one of other listed manufacturers.
3. Obtain each type of hardware from single manufacturer.
4. Hardware Sets within this Section are not complete with respect to thicknesses of doors, hand, backset, method of fastening, and other detail requirements.

5. Review Drawings and Door Schedules thoroughly and provide required hardware for openings, including openings which may have been inadvertently omitted from Door Schedules.
 6. Should opening be omitted or opening not indicated with hardware set, provide hardware of same quality, design and function as specified for similar openings.
 7. Furnish hardware complete with brackets, plates, fittings, fastenings and other accessories required for installation.
 8. Provide screws, nuts, bolts, through-bolts, washers, grommets and other fastening devices necessary for proper installation of hardware; match finish of hardware being attached. Non-ferrous or corrosion resistant type required where exposed to exterior atmosphere.
 9. Provide concealed fastening wherever possible. Where exposed, use countersunk Phillips oval-head type screws, except flat head for hinges.
 10. Do not attach hardware to metal frames and metal doors with self-tapping or sheet metal screws.
 11. Wood Screws: Full thread.
 12. Machine Screws: Undercut head and full thread.
 13. Through-bolts: Anchor overhead door closers to fire-rated doors with through-bolts or with screws fastened to blocking in door.
- B. Regulatory Requirements: Comply with Americans with Disabilities Act (ADA) including ADA Accessibility Guidelines to accommodate barrier free design.
1. Comply with NFPA 80 for hardware at fire-rated assemblies.
 2. Provide hardware which has been tested and listed by UL or Warnock Hersey for fire-rated assemblies of types which comply with requirements of door and frame labels.
- C. Hardware Supplier Qualifications: Finish hardware supplier who has been furnishing hardware in Project's vicinity for period of not less than two years, and who is, or who employs Architectural Hardware Consultant (AHC) who will be available at reasonable times during course of Work for consultation about Project's hardware requirements.
- D. Certification: After completion of hardware installation, finish hardware supplier and manufacturer's representative will submit written certification attesting that hardware has been installed in accordance with manufacturer's templates and instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 016600.
1. Pack each hardware item separately. Include manufacturer's printed installation instructions, trim, fasteners, accessories, and special tools necessary for installation.
 2. Legibly mark and adequately label each package indicating opening for which intended. Provide markings corresponding with approved Hardware Schedule.
 3. Store hardware off the floor on adequate shelving, in a clean, dry and secure area to protect from damage and loss.

1.5 WARRANTY

- A. Special Warranty: Prepare and submit in accordance with Section 017836.

1. Manufacturer's warranty stating closers will be free from defects in materials and workmanship for period of ten years, except for electrical components which are warranted for period of two years.

PART 2 - PRODUCTS

A. Manufacturer	Products
1. Schlage	Locks and latches
2. Rockwood	Pulls
3. Saflok	Electronic locks
4. Lcn	Closers
5. Source direct imports	Sliding glass door hardware
6. K.n. Crowder mfg., inc.	Sliding wood door hardware
7. Rixson	Overhead stops/holders
8. Trimco/bbw	Stops, flat goods
9. Mckinney	Hinges, roller latches
10. Ives	Door viewers and guards
11. Safemark systems	Door viewer covers
12. Pemko	Door bottoms/gaskets/thresholds

2.2 FINISHES

- A. Except where indicated otherwise in Hardware Sets, comply with following:
 1. Butt Hinges: Stainless steel US32D.
 2. Spring Hinges: Stainless steel US32D.
 3. Locksets and Latches: Satin chrome 626.
 4. Pulls: Satin chrome 626.
 5. Door Viewer: Satin Chrome 626.
 6. Floor/wall Stops: Satin Chrome 626.
 7. Overhead Stops/Holders: Satin chrome 626.
 8. Weatherstripping, Seals and Sweep Strips: Aluminum.

2.2 CYLINDERS AND KEYING

- A. All keyed cylinders shall be keyed to the existing master key system.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and proceed with Work in accordance with Section 017300

3.2 INSTALLATION

- A. Install hardware plumb, level, and true to line in accordance with manufacturer's templates, Section 017300, and Project conditions.
 1. Install fire rated hardware in accordance with NFPA 80.
 2. Where cutting and fitting is required on substrates to be field painted or similarly finished, install, fit, remove and store hardware prior to finishing. Reinstall hardware after finishing operations are completed.
 3. Do not install surface mounted items until finishes have been completed on substrate.
 4. Reinforce attachment substrates as necessary for installation and operation.
 5. For substrates which are not factory prepared for hardware:
 - a. Mortise work to correct size and location without gouging, splintering or causing irregularities in exposed finish work.
 - b. Fit faces of mortised components snug and flush without excessive clearance.
 6. Set thresholds at exterior doors in bed of sealant. Remove excess sealant.
 7. All electrical hardware specified herein shall be installed per paragraph A. All wire connections and testing shall be done by the section 281300 contractor. Wire, junction boxes and the like shall be provided by the section 281300 contractor.

3.3 ADJUSTING

- A. Check and adjust each operating hardware item to ensure correct operation and function.
 1. Ensure weatherstripping and seals do not inhibit closing and positive latching of door.
 2. Lubricate moving or operating components as recommended by hardware manufacturer. Use graphite type lubrication if none other is recommended.
 3. Replace defective materials or units which cannot be adjusted to operate as intended. Reinstall items found improperly installed.
 4. Prior to date of Substantial Completion, readjust and relubricate hardware items as necessary.

3.4 HARDWARE LOCATIONS

- A. Locations:
 1. Butt Hinges:
 - a. Top: 5 inches from inside head of frame down to top of hinge.
 - b. Bottom: 10 inches from finish floor to bottom of hinge.
 - c. Intermediate: Equally spaced between top and bottom hinges.
 - d. Intermediate at Dutch Doors: 5 inches from split line to respective top and bottom hinges.
 2. Butt Hinge Backset:
 - a. 5/16 inch on frame from stop to edge of hinge mortise.

- b. 1/4 inch on door from back face to edge of hinge mortise.
3. Floor Stops: Place to permit maximum swing of door and to prevent door hardware from hitting wall. Place within 3 inches of latch edge of door.

3.5 HARDWARE SETS

- A. See drawings for additional door hardware information. Refer to door schedule and related information concerning the following hardware groups. Quantities indicated in any instance are for supplier convenience only and are not guaranteed.

HW1 – Guestroom Entry Doors

- h
3 (ea) Spring Hinges, 1552, 4-1/2 x 4-1/2
1 (ea) Electronic lock Quantum MT RFID x Gala
1 (ea) Door viewer U700
1 (ea) Door view cover Speyeguard
1 (set) Gasket S773 head and jambs
1 (ea) Door shoe 2173AV
1 (ea) Door guard 482B x edge guard
1 (ea) Floor stop W1211

HW2 – Guestroom Toilet Sliding Glass Doors

- 1 (set) Barn Door System: HPDKINGPB-SC
1 (ea) Track
1 (ea) Track fascia with returns
1 (ea) "F" trim
1 (ea) "V" seal
1 (ea) Floor guide
2 (ea) Track stop assemblies
1 (ea) Soft close damper assembly
2 (ea) Glass clamp assemblies
1 (ea) Wall mount assembly
1 (ea) Ladder loop assembly

HW3 – Sliding Closet Doors

- 3 (ea) Tracks C104
6 (ea) Hangers C-911
6 (ea) In-track stops C-100HD
1 (ea) Guide threshold C-238-3
6 (set) Spring-loaded guides C-200B
6 (ea) Pulls C-71

HW4 – Swinging Closet Doors

- 6 (ea) Hinges TA2314, 3-1/2 x 3-1/2
2 (ea) Ball catch, 1555
2 (ea) Wall / Floor Stop 1270 WVCP / W1211 (as appropriate)

AQUA WAIKIKI WAVE
BUILDING PACKAGE

34-14102-00
FOR REVIEW - NOT FOR CONSTRUCTION

2 (ea) Pulls. Provide per furniture specifications, mount vertically.

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:

1. Glass for sliding aluminum-framed glass doors.
2. Glass for aluminum entrances and storefronts.
3. Glazing sealants and accessories.
4. Glass toilet room doors.

- B. Related Requirements:

1. Section 083213 "Sliding Aluminum-Framed Glass Doors".
2. Section 087100 "Door Hardware" for hardware applied to glass toilet room doors.
3. Section 088400 "Glass Shower Compartments."

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of the following products; 12 inches (300 mm) square.
 1. Insulating glass.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For glass.
- C. Product Test Reports: For insulating glass, for tests performed by a qualified testing agency.
 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved[**and certified**] by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.11 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Glass Product: Subject to compliance with requirements, provide product indicated on glass schedules or comparable product by one of the following:
 - 1. AGC Glass Company North America, Inc.
 - 2. Cardinal Glass Industries.

3. Cristacurva.
4. Dlubak Corporation.
5. Gardner Glass, Inc.
6. GGI; General Glass International.
7. Glasswerks LA, Inc.
8. GTI; Glaz-Tech Industries.
9. Guardian Industries Corp.; SunGuard.
10. Hartung Glass Industries.
11. JE Berkowitz, LP.
12. Northwestern Industries, Inc.
13. Oldcastle BuildingEnvelope™.
14. Pilkington North America.
15. PPG Industries, Inc.
16. Schott North America, Inc.
17. Tecnoglass.
18. Trulite Glass & Aluminum Solutions, LLC.
19. Vetrotech Saint-Gobain.
20. Viracon, Inc.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

1. Obtain tinted glass from single source from single manufacturer.
2. Obtain reflective-coated glass from single source from single manufacturer.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
 1. Design Wind Pressures: Determine design wind pressures applicable to Project according to the Building Code of the City and County of Honolulu, Hawaii, and Chapter 6 of ASCE 7-05, based on heights above grade indicated on Drawings.
 - a. Basic Wind Speed: 105 mph (47 m/s).
 - b. Importance Factor: 1.0.
 - c. Exposure Category: C.

- d. Occupancy Category: II.
 - e. Topographic Factor: Kzt 12.
 - f. Directionality Factor: Kd 0.8.
 - 2. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
 - 3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
 - 4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- D. Windborne-Debris-Impact Resistance: Not required.
- E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
- 1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
 - 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
 - 1. Minimum Glass Thickness for Exterior Lites: 6 mm.
 - 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.
- C. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- D. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- E. Glass for Glass Toilet Room Doors: Fully-tempered as specified in Paragraph 2.4.C, 3/8-inch (10 mm) thickness with maximum opacity acid-etching on exterior side only.

2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
 - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
 - 2. Spacer: Aluminum with mill or clear anodic finish.
 - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Field-applied sealants shall have a VOC content of not more than 250 g/L.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

2.7 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.9 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep systems.
 3. Minimum required face and edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- D. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- E. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- F. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- G. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- H. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

3.4 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Install gaskets so they protrude past face of glazing stops.

3.5 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.6 INSULATING GLASS SCHEDULE

A. Tinted Glass Type : Low-E-coated, tinted insulating glass.

1. Basis-of-Design Product: PPG Industries, Inc.; Solarblue/Solarban 60 (3).
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Tinted fully tempered float glass.
5. Tint Color: Blue.
6. Interspace Content: Air.
7. Indoor Lite: Clear fully tempered float glass.
8. Low-E Coating: Pyrolytic or sputtered on third surface.
9. Winter Nighttime U-Factor: 0.29 maximum.
10. Summer Daytime U-Factor: 0.27 maximum.
11. Visible Light Transmittance: 45 percent minimum.
12. Solar Heat Gain Coefficient: 0.33 maximum.
13. Safety glazing required.

B. Clear Glass Type : Low-E-coated, clear insulating glass.

1. Basis-of-Design Product: PPG Industries, Inc.; Solarban 60 (3).
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Clear fully tempered float glass.
5. Interspace Content: Air.
6. Indoor Lite: Clear fully tempered float glass.
7. Low-E Coating: Pyrolytic or sputtered on third surface.
8. Winter Nighttime U-Factor: 0.29 maximum.
9. Summer Daytime U-Factor: 0.27 maximum.
10. Visible Light Transmittance: 45 percent minimum.
11. Solar Heat Gain Coefficient: 0.33 maximum.
12. Safety glazing required.

END OF SECTION 088000

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following types of silvered flat glass mirrors:
 - 1. Annealed glass mirrors with safety backing qualifying as safety glazing.
- B. Related Sections:
 - 1. Section 102800 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
- B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.
- C. Qualification Data: For qualified Installer.
- D. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
- C. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.
- D. Glazing Publications: Comply with the following published recommendations:

1. GANA's "Glazing Manual" unless more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined in this Section or in referenced standards.
2. GANA Mirror Division's "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which mirror manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SILVERED FLAT GLASS MIRRORS

- A. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arch Aluminum & Glass Co., Inc.
 - b. Gardner Glass, Inc.
 - c. Gilded Mirrors, Inc.
 - d. Guardian Industries.

- e. Independent Mirror Industries, Inc.
 - f. Stroupe Mirror Co., Inc.
 - g. Sunshine Mirror; Westshore Glass Corp.
 - h. Virginia Mirror Company, Inc.
 - i. Walker Glass Co., Ltd.
- B. Annealed Monolithic Glass Mirrors: Mirror Glazing Quality, clear, float glass with a minimum 91 percent visible light transmission.
1. Nominal Thickness: 6.0 mm.

2.2 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Franklin International; Titebond Division.
 - b. Laurence, C. R. Co., Inc.
 - c. Macco Adhesives; Liquid Nails Division.
 - d. OSI Sealants, Inc.
 - e. Palmer Products Corporation.
 - f. Pecora Corporation.
 - g. Royal Adhesives & Sealants; Gunther Mirror Mastics Division.
 - h. Sommer & Maca Industries, Inc.
- D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.3 MIRROR HARDWARE

- A. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.
 1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch (9.5 and 22 mm) in height, respectively.
 - a. Products: Subject to compliance with requirements, provide one of the following:

- 1) Laurence, C. R. Co., Inc.; CRL Standard "J" Channel, D638A.
 - 2) Sommer & Maca Industries, Inc.; Aluminum Shallow Nose "J" Moulding Lower Bar.
 - 3) Sommer & Maca Industries, Inc.; Heavy Gauge Aluminum Shallow Nose "J" Moulding Lower Bar.
2. Top Trim: U-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively with continuous cleat.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Laurence, C. R. Co., Inc.; CRL "U" Channel, D1638A and cleat, D1637.
 - 2) Sommer & Maca Industries, Inc.; Aluminum Deep Nose "J" Moulding Upper Bar.
 - 3) Sommer & Maca Industries, Inc.; Heavy Gauge Aluminum Deep Nose "J" Moulding Lower Bar.
3. Finish: Clear bright anodized.
- B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.4 FABRICATION

- A. Mirror Sizes: To suit Project conditions, and before tempering, cut mirrors to final sizes and shapes.
 - B. Cutouts: Fabricate cutouts before tempering for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.
 - C. Mirror Edge Treatment: Flat polished.
 1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
- D. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint as recommended in writing by film-backing manufacturer to produce a surface free of bubbles, blisters, and other imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
- B. Provide a minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- C. Wall-Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
 1. Top and Bottom Aluminum J-Channels: Provide setting blocks 1/8 inch (3 mm) thick by 4 inches (100 mm) long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch (6.4 mm) wide by 3/8 inch (9.5 mm) long at bottom channel.
 2. Install mastic as follows:
 - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
 - b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
 - c. After mastic is applied, align mirrors and press into place while maintaining a minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface.

3.4 CLEANING AND PROTECTION

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. Do not permit edges of mirrors to be exposed to standing water.
- C. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- D. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300

SECTION 088400 – GLASS SHOWER COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 1. Glass shower compartments.

1.2 ACTION SUBMITTALS

- A. Product Data: For each glass product, hardware and glazing material indicated.
- B. Shop Drawings: Submit shop drawings of shower compartments including dimensions, details of attachments to adjoining surfaces, and hardware.

1.3 QUALITY ASSURANCE

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 1. GANA Publications: GANA's "Glazing Manual."
- B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

2.2 HARDWARE

- A. Shower Compartment Basis-of-Design product: As indicated in Interiors Finish Schedule.
 1. Hardware set to include trolleys, upper and lower tracks, pulls, etc., for a complete system.

2.3 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Applications: Apply to locations indicated by manufacturer.

2.4 MONOLITHIC-GLASS TYPES

- ### A. Glass Type: Clear fully tempered float glass.
1. Thickness: As indicated.
 2. Provide safety glazing labeling.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

3.2 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. All manufactured by USG (United States Gypsum Company, USG Interiors), Chicago, IL, USA, in compliance with applicable ASTM Standards; or equal.
1. USG Drywall Suspension System
 2. USG Drywall Suspension System Wall-to-Wall

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide materials and construction identical to those tested according to ASTM E 119.
- B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413.
- C. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- D. Performance Requirements: Fabricate and install systems as indicated but not less than that required to comply with ASTM C754 under the following conditions:
1. A pre-engineered drywall suspension system consisting of straight main tees (for Wall-to-Wall system) that join together to support screw attached interior gypsum panels and independently supported air diffusers, where applicable.

2. Maximum deflection of 1/360 of distance between supports.
3. Nonstructural components that are permanently attached to structures and their support attachments, shall be designed and constructed to resist the effects of earthquake motions in accordance to local jurisdiction.

2.3 MATERIALS

- A. USG Drywall Wall-to-Wall Suspension Systems – Commercial quality, cold-rolled steel, hot dipped galvanized finish for use in corridors and short span applications.
 1. Main Tees: Fire-Rated Heavy Duty classification 1.617" high x 8' long, integral reversible splice with 1-1/2" knurled face.
 2. Wall Moldings: Single web with knurled face, 1-1/2" x 1" x 12' Long, DGWM24
- B. Grid Suspension Assemblies: Listed products establish standard of quality and are manufactured by United States Gypsum Company (USG), Chicago, IL; or equal.

2.4 FRAMING SYSTEMS

- A. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.
 1. Minimum Base-Metal Thickness: 24 gauge
 2. Depth: as required to match existing conditions 3-5/8 inches (92 mm), 2-1/2 inches (64 mm) or 1-5/8 inches (41 mm).
- B. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 1. Minimum Base-Metal Thickness: 24 gauge
- C. Furring Channels: 7/8", 24 gauge.
- D. Z-shaped furring: 20 gauge unless indicated otherwise.

2.5 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire,
- B. Hanger Attachments to Concrete:
 1. Anchors: Capable of sustaining a load equal to 5 times that imposed as determined by ASTM E 488.
 - a. Type: Postinstalled, chemical anchor or Postinstalled, expansion anchor.
 2. Powder-Actuated Fasteners: Capable of sustaining, a load equal to 10 times that imposed as determined by ASTM E 1190.

- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch- wide flanges.
 - 1. Depth: 2 inches (51 mm).

2.6 AUXILIARY MATERIALS

- A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- E. Direct Furring:
1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.3 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 3. Do not attach hangers to steel roof deck.
 4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 6. Do not connect or suspend steel framing from ducts, pipes, or conduit.

- D. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Interior gypsum board.
 - 2. Tile backing panels.
 - 3. Skim coating existing walls and concrete ceiling surfaces indicated.

1.2 SUBMITTALS

- A. General: Submit in accordance with Section 013323.
- B. Product Data:
 - 1. Submit product data for:
 - a. Acoustical sealants.
 - b. Acoustical Outlet box pads.
- C. Submit following Informational Submittals:
 - 1. Certifications specified in Quality Assurance article.
 - 2. Manufacturer's instructions. Include applicable temperature and humidity ranges, special procedures, and perimeter conditions requiring special attention.

1.3 QUALITY ASSURANCE

- A. Single Source Responsibility: Except where specified otherwise, obtain gypsum board products, trim, joint treatment, and accessories from single manufacturer or from manufacturers recommended by prime manufacturer of gypsum board products.
- B. Certifications:
 - 1. Submit manufacturer's certification that products furnished for Project meet or exceed specified requirements.
 - 2. Submit certification for each proposed fire rated assembly attesting compliance with indicated requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of Section 016600.

B. Storage and Protection:

1. Store in dry ventilated space off ground.
2. Protect materials from surface contamination, soiling, corrosion, construction traffic, and damage.
3. Support on level platform and fully protect from weather and direct sunlight exposure.
4. Store and support gypsum board in flat stacks to prevent sagging.
5. Protect materials to keep them dry. Remove wet gypsum board from Project site.
6. Protect gypsum board panels to prevent damage to edges, ends, and surfaces.
7. Do not bend or damage metal trim.

1.5 PROJECT CONDITIONS

- A. Environmental Requirements: Comply with more restrictive of ASTM C840, or manufacturer's written requirements under which products can be installed.
1. Maintain minimum uniform 50 degrees F temperature in building for 48 hours before and continuously until applied joint treatment and bonding adhesives are thoroughly dry.
 2. Do not allow ambient temperature to exceed 95 degrees F.
 3. Provide ventilation to remove moisture in excess of that required for drying of joint treatment materials after its application. Avoid drafts during dry, hot weather to prevent too rapid drying.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD PRODUCTS

A. Acceptable Manufacturers:

1. Certainteed
2. G-P Gypsum Corporation
3. National Gypsum Company.
4. United States Gypsum Company.

B. Gypsum Board:

1. Comply with ASTM C1396.
2. Type X or manufacturer's proprietary fire rated core for fire rated and shaftwall assemblies and locations where indicated; regular type at other assemblies.
3. Maximum available lengths to minimize end-to-end butt joints, square cut ends, tapered edge.
4. Thickness: 5/8 inch, except where indicated otherwise.

C. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

1. Comply with ASTM C1396.
2. Core: Mold and moisture resistant gypsum core, 5/8 inch, Type X.

3. Surface paper: 100% recycled content moisture/mold/mildew resistant paper on front, back, and long edges.
4. Maximum available lengths to minimize end-to-end butt joints, square cut ends, tapered edge.
5. Locations: Toilet Rooms and interior surfaces of exterior walls.
6. Mold/Mildew Resistance: 10 when tested in accordance with ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
7. Product and Manufacturer, or equal:
 - a. XP Wallboard, National Gypsum Company.
 - b. Proroc® Moisture And Mold Resistant With M2tech, Certainteed

2.2 TILE BACKING PANELS

- A. Non-Cementitious Backer Units: ASTM C 1178. Apply to all walls and ceiling indicated to receive gypsum board as substrate for tile or simulated tiles/stone tub and shower surround panels.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Georgia-Pacific Corporation; DensShield Tile Backer.
 - b. CertainTeed Corp.; GlasRoc Tile Backer.
 2. Mold resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.3 METAL TRIM

- A. General:
 1. Comply with ASTM C1047.
 2. Material: Zinc alloy or galvanized steel.
 3. Uncoated sheet metal thickness: 26 gage minimum.
 4. Flanges designed for concealment in joint compound, flange width to suit installation requirements.
- B. Corner Beads at Straight Surfaces:
 1. Drywall Corner Bead, Alabama Metal Industries Corporation (AMICO), Birmingham, AL.
 2. Cornerbead, Clinch-On Products, Mounds View, MN.
 3. Wallboard Corner Bead, National Gypsum Company, Charlotte, NC.
 4. 100 Series Dur-A-Bead, United States Gypsum Company, Chicago, IL.
- C. Edge Trim Beads:
 1. Drywall L-Metal, Alabama Metal Industries Corporation (AMICO), Birmingham, AL.
 2. L-Bead and U-Bead, Clinch-On Products, Mounds View, MN.
 3. Number 100 and 200 Wallboard Casing, National Gypsum Company, Charlotte, NC.

4. 200 Series, United States Gypsum Company, Chicago, IL.

D. Control Joints:

1. V-Shaped slot.
2. Acceptable Products and Manufacturers:
 - a. N-093, Alabama Metal Industries Corporation (AMICO), Birmingham, AL.
 - b. E-Z Strip Expansion Joint, National Gypsum Company, Charlotte, NC.
 - c. 093, United States Gypsum Company, Chicago, IL.

2.4 JOINT TREATMENT AND ADHESIVE MATERIALS

A. Joint Compound:

1. Comply with ASTM C475.
2. Board manufacturer's standard ready-mixed joint compounds low-VOC joint compounds with no detectable amounts of crystalline silica based on NIOSH Method 7500.
3. Compounds specifically manufactured for topping coats are not permitted for first coat on metal trim and taping.
4. Use board manufacturer's joint compound unaffected by humidity at moisture-resistant gypsum board.
5. Mixing:
 - a. Mix compounds in strict accordance with manufacturer's directions.
 - b. Mix only enough at one time to be used during recommended pot life of compound.

B. Joint Compound for Tile Backing Panels:

1. Non-Cementitious Backer Units: As recommended by backer unit manufacturer.

C. Joint Reinforcement Tape for Gypsum Board: Paper reinforcing tape complying with ASTM C475.

D. Joint Reinforcement for Tile Backing Panels: As recommended by backing panel manufacturer.

E. Adhesives & Sealants: Only use adhesives and sealants in the interior of the building that meet or do not exceed the VOC limits of the CURRENT requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168 on the interior of the building.

1. Current requirement refers to the date on which the materials are installed in the building.
2. Comply with SCAQMD Rule #1168 current as of the date of this specification. Refer to <http://www.aqmd.gov/rules> for the actual current version of the rule that will be applicable at the date of installation during construction.
3. Interior refers to all building construction that is inside of the exterior weatherproofing material.

2.5 SURFACING MATERIAL

A. Primer/Surfacer:

1. Flat latex basecoat for use on surfaces located in areas of intense lighting and indicated to receive a Level 4 finish. Basecoat is in addition to primer and finish coating specified in Section 099000.
2. Products: Subject to compliance with requirements, provide one of the following products:
 - a. "Builders Solution System Interior Latex Primer/Surfacer", A63W100; Sherwin Williams.
 - b. "SHEETROCK First Coat"; USG Corporation.

B. Primer/Surfacer for Existing Concrete Deck to be Painted: Alkali-resistant as recommended by joint compound manufacturer.

2.6 ACCESSORIES

A. General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.

B. Backer Plates:

1. Type: 16 gage uncoated metal thickness steel sheet, galvanized in accordance with ASTM A653, G60.
2. Length: Sufficient to extend to nearest studs beyond maximum dimension of attached item and engage fasteners from attached item; span minimum 3 studs.
3. Height: 6 inch minimum or higher where required to accommodate item being fastened.
4. When manufacturer of attached item has more rigorous mounting plate requirements, comply with manufacturer's requirements.

C. Fasteners:

1. Fasteners for Metal Framing:

- a. Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved.
- b. Comply with the gypsum board manufacturer requirements for indicated applications.

2. Gypsum Board Fasteners:

- a. Self-drilling, self-tapping, bugle head screws conforming to ASTM C1002, length to suit application.
- b. Type S screws for 0.0329 to 0.0179 inches; 21 to 26 gage thick metal framing and furring.

- c. Type S-12 screws for 0.1046 to 0.0359 inches; 12 to 20 gage thick metal framing and furring.
 - d. Type G screws for gypsum board to gypsum board.
- D. Acoustical Insulation: Refer to Section 072100 for exposed acoustical insulation under roof decks. Following is for partition acoustical insulation:
- 1. Maximize use of recycled material with minimum of 20 percent recycled glass cullet.
 - 2. Use formaldehyde free materials where available.
 - 3. Comply with ASTM C665, Type I.
 - 4. Mineral or glass fiber, friction fit, without integral vapor barrier membrane.
 - 5. Flame spread 25 or less when tested in accordance with ASTM E84.
 - 6. Thickness to match wall stud depth unless noted otherwise.
 - 7. Fire-rated assemblies: Use products tested for fire rated assemblies.
 - 8. Non-fire-rated assemblies: Use 2.5 to 3 pound density glass or mineral fiber products.
 - 9. Acceptable Mineral Fiber Products:
 - a. FBX 450, Fibrex, Westmont, IL.
 - b. Thermafiber Sound Attenuation Fire Blankets, United States Gypsum Company, Chicago, IL.
 - 10. Acceptable Glass Fiber Products:
 - a. Sound Attenuation Batts, Owens Corning, Toledo, OH.
 - b. Sound Control Batts, CertainTeed Vinyl Building Products, Valley Forge, PA.
 - c. Sound Control Batts, Johns Manville, Denver, CO.
- E. Acoustical Sealant - Concealed Locations:
- 1. Description:
 - a. Non-hardening, non-drying, non-skinning, non-staining, non-bleeding, non-sag synthetic rubber.
 - b. Capable of maintaining air-tight seal.
 - c. For use in concealed locations not exposed to view.
 - d. Specifically manufactured as acoustical sealant.
 - 2. Acceptable Products:
 - a. Acoustical Sealant; Tremco, Inc., Beachwood, OH.
 - b. BA-98 Acoustical Sealant; Pecora Corporation, Harleysville, PA.
- F. Acoustical Sealant - Exposed Locations:
- 1. Description:
 - a. ASTM C834.
 - b. Non-sag, non-staining, non-bleeding, and paintable.
 - c. Joint movement range without cohesive/adhesive failure: Plus 7.5 percent to minus 7.5 percent of joint width.
 - d. Color: As selected by Architect from manufacturer's standard colors.

2. Acceptable Products:

- a. Chem-Calk 600; Bostik, Middleton, MA.
- b. AC-20, Pecora Corporation, Harleysville, PA.
- c. Sonolac, Sonneborn Building Products, Shakopee, MN.
- d. Acrylic Latex, Tremco, Inc., Beachwood, OH.
- e. USG Acoustical Sealant, United States Gypsum Company, Chicago, IL.

G. Acoustical Outlet Box Pads

1. Minimum thickness - 1/8 inch.
2. Adhesion - adheres readily to metal or plastic.
3. Service temperature – 30 degrees to 200 degrees F.
4. Shall contain no asbestos.
5. Minimum shelf life - 1 year.
6. Non Fire Rated Products:
 - a. "Lowry's Outlet Box Pads" as manufactured by Harry A. Lowry & Associates, Inc., Sun Valley, CA.
 - b. "Sound Pad #68" as manufactured by L.H. Dottie Co., City of Commerce, CA.

7. Fire Rated Products:

- a. "Flamesafe FSP 1077 Putty Pads" as manufactured by W.R. Grace & Co., Hartfield, PA.
- b. "Putty Pads" as manufactured by Specified Technologies Inc., Somerville, NJ.
- c. "Hilti CP617 Putty Pads" as manufactured by Hilti, Tulsa, OK.
- d. "3M Fire Barrier Moldable Putty Pads type MPP-X" to fit box size as manufactured by 3M, St. Paul, MN.
- e. "Metacaulk ® Putty Pads" as manufactured by RectorSeal, Houston, TX.

H. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20.

I. Tile Backer Units Accessories:

1. Fasteners: Corrosion resistant type required by board manufacturer for securing units.

PART 3 -- EXECUTION

3.1 EXAMINATION

- A. Examine conditions and proceed with work in accordance with Section 017300.
- B. Verify rough-in utilities and blocking are in proper position.

3.2 PREPARATION

- A. Items Which Require Backer Plates or Blocking:

1. Coordinate sizes and locations.
2. Install additional studs for attachment of backer plates and blocking in required locations to receive surface mounted accessories as indicated or as required by accessory manufacturer.
3. Elimination of backer plates and blocking is not permitted.
4. Direct attachment of items to studs is not permitted.

3.3 GYPSUM BOARD INSTALLATION

A. General:

1. Comply with more stringent requirements of GA 216, ASTM C840, manufacturer, and these Specifications.
2. Install gypsum board in accordance with GA 600 for fire-rated assemblies.
3. Install impact resistant gypsum board at locations indicated.
4. Install gypsum board panels with face side out.
5. Use boards of maximum length to minimize end joints.
6. Abut boards without forcing; neatly fit ends and edges of board and do not place butt ends against tapered edges with gap between adjacent panels no greater than 1/16 inch. Hold bottom of board 1/4 inch above floor.
7. Support ends or edges of board directly on framing or furring members.
8. Joint Staggering:
 - a. Ceilings: Stagger end joints not less than one framing member.
 - b. Walls: Stagger vertical joints on opposite side of walls to occur on alternate framing members.
 - c. Fire-Rated Assemblies: Comply with fire-rated assembly design requirements for joint staggering.
9. Do not locate gypsum board joints within 12 inches of external corners of windows, doors, or other such openings, except when control joints are installed at corners.
10. Cut openings in board with no greater than 1/4 inch gap around electrical outlets, plumbing, light fixtures, piping and other similar penetration items and small enough to be covered by plates and escutcheons; coordinate size of gap around penetrations in fire-rated assemblies with firestopping requirements of Section 078400.
11. Do not install imperfect, damp and damaged boards.
12. In concealed spaces above ceilings where designated walls extend full height to structure above, install boards in full coverage on both faces of framing system for fire, sound, air, and smoke-rated walls.
13. Fit gypsum panels around ducts, pipes, and conduits.
14. Where walls intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4 to 1/2-inch wide joints to install sealant.
15. In concealed spaces above ceiling where designated chase walls extend full height to structure above, install boards in full coverage on one face of framing system. Fasten horizontal stud or 1-1/2 inch wide 20 gage galvanized steel straps vertically spaced no more than 36 inches apart with top strap no more than 6 inches from top of wall.
16. Attach gypsum panels to steel studs so that leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

17. Attach gypsum panels to framing provided at openings and cutouts.
18. Isolate perimeter of non-load-bearing gypsum board walls at structural abutments, except floors, as detailed. Provide 1/4 to 1/2-inch wide spaces and trim edges with LC-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant for exposed locations.
19. Control and Expansion Joints: Gypsum Association Publication GA 234. Use for fire-resistance rated and for non-fire-rated conditions.
 - a. Spacing: In accordance with GA 234.
 - b. Do not bridge building control and expansion joints with gypsum board. Utilize details shown in referenced standard.
 - c. Terminate gypsum board on each side of joints.
 - d. Comply with manufacturer requirements for constructing control and expansion joints in fire-rated and shaftwall assemblies.
 - 1) Locate studs on both sides of joints. Attach two layers of gypsum board strips to back of one stud to fill area behind joint; provide continuous fire barrier behind joint without restricting movement.

B. Fasteners:

1. Attachment Methods:
 - a. Attach board to framing and furring with screws.
 - b. Attach board to board with screws.
 2. Except where indicated otherwise or where required for fire rated assemblies, space fasteners in compliance with more restrictive requirements of referenced installation standards or manufacturer's requirements.
 3. Attach board to supplementary framing and blocking which provide additional support at openings and cutouts.
- C. Ceilings: Place with long edge perpendicular to orientation of furring or framing members.
- D. Single Layer Wall Installation: Install vertically in manner which will minimize end-butt joints, unless specific orientation is required by fire-rating design.
- E. Double Layer Wall Installation:
1. Install gypsum board for base layer, place long edge parallel to framing or furring members, unless specific directional requirement is established by fire-rating design.
 2. Install gypsum board for face layer, place parallel to base layer with offset joints, unless specific direction is required by fire-rating design.
 3. Secure base layer with fasteners.
 4. Secure face layer with fasteners or adhesive supplemented with fasteners, except where fire rated assemblies require only fasteners.

3.4 APPLYING TILE BACKING PANELS

- A. Non-Cementitious Backer Units: ANSI A108.11, at showers, tubs, and other walls to receive tile.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 SOUND ASSEMBLIES

- A. Comply with ASTM E497.
- B. Gypsum Board:
 - 1. Fasten gypsum board to resilient channels between framing members supporting resilient channels.
 - 2. Do not use fasteners whose length is longer than depth of resilient channels.
- C. Acoustical Insulation:
 - 1. Install acoustical insulation in walls where indicated.
 - 2. Place insulation for full distance of space between studs for full coverage of sound-rated assembly.
 - 3. Fit insulation tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind walls and tight to items passing through walls.
- D. Acoustical Sealant:
 - 1. Seal with continuous bead at gypsum board edges on both faces of walls which receive acoustical insulation.
 - 2. Seal perimeter of face layer in single layer assemblies using acoustical sealant for exposed locations.
 - 3. Seal perimeter of base layer in double layer assemblies using acoustical sealant for concealed or exposed locations.
 - 4. Seal openings and cutouts; fill open spaces between board and fixtures, cabinets, ducts and other flush or penetrating items using acoustical sealant for exposed locations.
 - 5. Seal behind control and expansion joints using acoustical sealant for concealed or exposed locations.
 - 6. Electrical Boxes:
 - a. Seal sides and backs of to completely close off openings and joints.
 - b. Seal joint between boxes and board.
 - 7. Setting track in sealant bead, in lieu of applying sealant to gypsum board panels, is not permitted.
- E. Acoustical Outlet Box Pads:

1. Install outlet box pads over all junction boxes within all partitions and gypsum board ceilings containing sound insulation including but not limited to demising walls, corridor walls, walls adjacent to stairwells, shafts, etc.
2. Use fire rated box pads where required to maintain the fire rating of the partition, wall or ceiling assembly.
3. Install box pads according to manufacturer's written instructions.
4. Brush or wipe construction dust and dirt from box surface. If surface is contaminated with oil, etc., wipe with Xylene or Toloulene to remove residue.
5. Center outlet box pad on the back of the junction box. Mold around conduit and cable entering the box. Mold cover around box sides covering all openings and press firmly into place.

F. Intersections with Non-Sound-Rated Assemblies:

1. Extend sound-rated construction to completely close sound flanking paths through non-sound-rated construction.
2. Install acoustical sealant for exposed locations at joints between face layers at vertical interior angles of intersecting assemblies.

3.6 TRIM INSTALLATION

- A. Install trim flush using longest practical length; miter corners and intersections.
- B. Fasten flanges by screws, stapling, or clinching in accordance with manufacturer's instructions.
- C. Install corner beads at visually-exposed external corners, unless otherwise indicated.
- D. Install edge trim where edge of board would be exposed or semi-exposed and where board abuts dissimilar materials.
- E. Control Joints: Coordinate placement and locations with Architect prior to commencement of work. Install control joints where indicated on Drawings and additionally in accordance with following:
 1. Locate at joints of maximum stress, at points of natural weak planes, such as at openings and at corners of offsets in walls exceeding 30'-0" in length.
 2. Extend control joints from both corners of door frames to top of wall where doors occur in long runs of wall.
 3. Where gypsum board is vertically continuous, as at stairwells and other long vertical wall areas, provide horizontal control joints at each floor level at top runner of shaftwall, at slip joints in shaftwall framing, and breaks in shaftwall framing.
 4. Locate in ceilings with area exceeding 900 square feet, where framing or furring changes direction, and spaced apart not more than 30'-0".
 5. Locate in ceilings where wings of "L", "U", and "T" shaped areas are joined.
 6. Provide mineral fiber acoustical insulation or gypsum panel backing at control joints in fire-rated assemblies to maintain fire rating.

3.7 GYPSUM BOARD TREATMENTS

A. General:

1. Apply joint treatment to gypsum board joints (both directions); flanges of corner beads, edge trim, and control joints; penetrations; fasteners; surface defects; and elsewhere to prepare surfaces for decoration and specified levels of gypsum board finish.
 2. Comply with manufacturer requirements for hardening and drying of joint treatment prior to application of succeeding coats.
- B. Prefill: Fill open joints, rounded and beveled edges, and damaged areas, flush with adjoining surfaces using prefill compound.
- C. Apply joint tape over gypsum board joints and to architectural metal trim with concealed face flanges as required by architectural metal trim manufacturer and as required to prevent cracks from developing in joint compound at flange edges.
- D. Levels of Finish:

1. Comply with GA-214; italicized commentary is excluded; replace words "may" and "should" with "shall."
2. Locations to receive Level 5 Finish: Skim-coated areas.
3. Locations to Receive Level 4 Finish: Areas to be painted and areas of VWC.
 - a. In addition to GA-214, Level 4 Finish gypsum board in areas of intense lighting shall receive one coat of specified basecoat/surfacer to entire surface at manufacturer's recommended coverage rate or mil thickness.
4. Locations to Receive Level 3 Finish: Areas to receive texture finish and areas to receive glass-fiber faced tile backing gypsum board used as a tile substrate.
5. Locations to Receive Level 2 finish: Fire-rated and smoke-rated assemblies in ceiling plenums and concealed areas.
6. Locations to Receive Level 1 Finish: Non-fire-rated and non-smoke-rated assemblies in ceiling plenums and concealed areas.
7. Non-Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.8 SKIM COATING EXISTING WALLS AND CONCRETE DECK FOR PAINTING

- A. Remove existing ceiling texture entirely from concrete decks to remain exposed.
- B. Prime walls and concrete deck in accord with primer / surfacer.
- C. Skim coat walls and concrete deck smooth and ready for painting.

3.9 ADJUSTING

- A. Adjust and align metal framing to properly receive final finishes in accordance with required tolerances.

- B. Correct damages, defects, and leave work ready for decoration. Clean compounds from trim. Visible cracks, nail heads, tool marks, waves, distortions, or other similar defects shall not appear in finished work.

3.10 CLEANING

- A. Clean as recommended by manufacturer. Do not use materials or methods which may damage finish or surrounding construction.
- B. Promptly remove joint compound from surfaces not intended to receive compound.

3.11 PROTECTION

- A. Protect finished work in accordance with Section 017300.
- B. Protect metal framing from damage detrimental to finished work.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Glass mosaic tile.
2. Porcelain tile.
3. Waterproof membrane for thinset applications.
4. Sound isolation membrane.
5. Metal edge strips.

- B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Section 092900 "Gypsum Board" for glass-mat, water-resistant backer board.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

C. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product.
- D. Product Test Reports: For tile-setting and -grouting products.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
 2. Obtain waterproof membrane and sound isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
1. Waterproof membrane.
 2. Crack isolation membrane.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.3 TILE PRODUCTS

- A. Tile: Refer to Standard Guestroom Interior Finish Schedule.

2.4 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

- B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ARDEX GmbH.
- b. Boardi Products Corporation; a QEP company.
- c. Bonsal American, an Oldcastle company.
- d. Bostik, Inc.
- e. C-Cure.
- f. Custom Building Products.
- g. Jamo Inc.
- h. Laticrete International, Inc.
- i. MAPEI Corporation.
- j. Merkrete by Parex USA, Inc.
- k. National Applied Construction Products, Inc.
- l. Southern Grouts & Mortars, Inc.
- m. TEC; H.B. Fuller Construction Products Inc.

2.5 SOUND ISOLATION MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

- B. Thin Bed Sheet Sound Isolation Membrane: ASTM C 627 and ANSI A 118.12. Sheet membrane consisting of rubber / synthetic polymer sheet specifically designed for use in thin set tile or stone flooring.

1. Use: Thin bed sound isolation.
2. Nominal Thickness: 3 mm (1/8").
3. ASTM E492/E989 IIC Rating: 65.
4. ASTM E2179 IIC Rating: 20.
5. Acceptable Product: 170 Sound and Crack Isolation Mat; Laticrete International, Inc.

2.6 SETTING MATERIALS

- A. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.
1. Basis-of-Design Product: Subject to compliance with requirements, provide 254 Platinum by Laticrete International, Inc., or comparable product by one of the following:
 - a. ARDEX GmbH.
 - b. Boardi Products Corporation; a QEP company.
 - c. Bonsal American, an Oldcastle company.
 - d. Bostik, Inc.
 - e. C-Cure.
 - f. Custom Building Products.
 - g. Jamo Inc.
 - h. Laticrete International, Inc.
 - i. MAPEI Corporation.
 - j. Merkrete by Parex USA, Inc.
 - k. Southern Grouts & Mortars, Inc.
 - l. Summitville Tiles, Inc.
 - m. TEC; H.B. Fuller Construction Products Inc.
 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.7 GROUT MATERIALS

- A. High-Performance Tile Grout: ANSI A118.7. Provide as Alternate Bid.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Fusion Pro single component grout by Custom Building Products, or comparable product by one of the following:
 - a. ARDEX GmbH.
 - b. Boardi Products Corporation; a QEP company.
 - c. Bonsal American, an Oldcastle company.
 - d. Bostik, Inc.
 - e. C-Cure.
 - f. Custom Building Products.
 - g. Jamo Inc.
 - h. Laticrete International, Inc.
 - i. MAPEI Corporation.
 - j. Southern Grouts & Mortars, Inc.
 - k. Summitville Tiles, Inc.
 - l. TEC; H.B. Fuller Construction Products Inc.
 2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

3. No sealing required
 4. Microban Antimicrobial product protection.
- B. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less. Provide as **Base Bid**.
1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Spectralock Pro Grout by Laticrete International, Inc., or comparable product by one of the following:
 - a. Atlas Minerals & Chemicals, Inc.
 - b. Boardi Products Corporation; a QEP company.
 - c. Bonsal American, an Oldcastle company.
 - d. Bostik, Inc.
 - e. C-Cure.
 - f. Custom Building Products.
 - g. Jamo Inc.
 - h. Laticrete International, Inc.
 - i. MAPEI Corporation.
 - j. Merkrete by Parex USA, Inc.
 - k. Sauereisen.
 - l. Southern Grouts & Mortars, Inc.
 - m. Summitville Tiles, Inc.
 - n. TEC; H.B. Fuller Construction Products Inc.

2.8 MISCELLANEOUS MATERIALS

- A. Trowelable Underlays and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.9 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with adhesives bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
 - b. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
1. Ceramic Mosaic Tile: AS recommended by tile manufacturer.
 2. Porcelain Tile: As recommended by tile manufacturer.

- H. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

3.4 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.5 SOUND ISOLATION MEMBRANE INSTALLATION

- A. Install sound isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

3.6 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 1. Remove grout residue from tile as soon as possible.
 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Ceramic Tile Installation: TCNA F125A; thinset mortar on sound isolation membrane.
 - a. Thinset Mortar: Latex- portland cement mortar.
 - b. Grout: Water-cleanable epoxy grout.

B. Bathtub/Shower Wall Installations, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA B420; thinset mortar on waterproof membrane over coated glass-mat, water-resistant gypsum backer board.
 - a. Thinset Mortar: Latex-portland cement mortar.
 - b. Grout: Water-cleanable epoxy grout; **Base Bid**: High-performance. Sanded: **Alternate Bid**.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 DEFINITIONS

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For components with factory-applied color finishes.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 1. Acoustical Panel: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
- D. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
 - a. Smoke-Developed Index: 450 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.8 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.
- D. Antimicrobial Fungicide Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING (ACT-X)

- A. Basis-of-Design Products: Subject to compliance with requirements, provide products listed on the Drawings or comparable products by one of the following:
 1. Armstrong World Industries, Inc.
 2. USG Interiors, Inc.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Postinstalled expansion anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
 - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
 - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
 - 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch- (3.5-mm-) diameter wire.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated on the Drawings, or a comparable product by one of the following:
 - 1. Chicago Metallic Corporation.

2. USG Interiors, Inc.
- B. Cap Finish: Painted white, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. Install panels with pattern running in one direction parallel to short axis of space.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test

- them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
- b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
 - C. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
 - D. Prepare test and inspection reports.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.
- C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.
- D. Product Schedule: For resilient base and accessory products. Use same designations indicated in Interior Finish Schedule.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Furnish not less than 10 linear feet (3 linear m) for every or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. FloorScore Compliance: Resilient base and stair accessories shall comply with requirements of FloorScore certification.
- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 THERMOSET-RUBBER BASE RB

- A. Manufacturers: Subject to compliance with requirements, provide the following:
 - 1. Johnsonite; A Tarkett Company.
- B. Product Style and Location:
 - a. As indicated on Interior Finish Schedule and Drawings..
- C. Height: 4 inches (102 mm).
- D. Lengths: Manufacturer's standard length.
- E. Outside Corners: Job formed.
- F. Inside Corners: Job formed.
- G. Colors: As indicated by manufacturer's designations.

1. Color: As indicated in Interior Finish Schedule.

2.3 RUBBER MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Flexco.
 2. Johnsonite; A Tarkett Company.
 3. Roppe Corporation, USA.
- B. Description: Rubber reducer strip for resilient flooring joinder for tile and carpet transition strips.
- C. Profile and Dimensions: As indicated.
- D. Locations: Provide rubber molding accessories in areas indicated.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
 1. Adhesives shall have a VOC content of 50 g/L or less except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less.
 2. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 6 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 6 inches in length.
 - a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 1. Remove adhesive and other blemishes from exposed surfaces.
 2. Sweep and vacuum horizontal surfaces thoroughly.
 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Vinyl composition floor tile.
2. Laminated vinyl floor tile.

- B. Related Sections:

1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 1. Show details of special patterns.
- C. Samples for Verification: Full-size units of each color and pattern of floor tile required.
- D. Product Schedule: For floor tile. Use same designations indicated on Drawings.
- E. Qualification Data: For qualified Installer.
- F. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Floor Tile: Provide one unopened carton of each color and type of resilient tile flooring used.

PART 2 - PRODUCTS

2.1 VINYL COMPOSITION FLOOR TILE (VCT-1)

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

B. Size: 12" x 12".

2.2 LAMINATED VINYL FLOOR TILE (LVT-1)

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings.
- B. Size: As indicated on Drawings.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. VCT Tile Adhesives: Not more than 50 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are same temperature as space where they are to be installed.
 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 1. Lay tiles in pattern indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 1. Lay tiles with grain running in one direction (east, west) and in pattern of colors and sizes indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

- G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 1. Remove adhesive and other blemishes from exposed surfaces.
 2. Sweep and vacuum surfaces thoroughly.
 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096800 - CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. General: Submit in accordance with Section 013323.
- B. Product Data: Submit product data for each product.
- C. Carpet manufacturer shall provide shop drawings showing columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet. The following items shall be included as applicable:
 - 1. Carpet type, color, and dye lot.
 - 2. Locations where dye lot changes occur.
 - 3. Seam locations, types, and methods.
 - 4. Type of subfloor.
 - 5. Type of installation.
 - 6. Pattern type, repeat size, location, direction, and starting point.
 - 7. Pile direction.
 - 8. Type, color, and location of insets and borders.
 - 9. Type, color, and location of edge, transition, and other accessory strips.
 - 10. Transition details to other flooring materials.
- D. Samples: Submit manufacturer's full range of carpet patterns and colors samples for each scheduled type.
- E. Submit following Informational Submittals:
 - 1. Certifications specified in Quality Assurance article.
 - 2. Qualification Data: Manufacturer's and installer's qualification data.
- F. Carpet manufacturer shall provide the manufacturer's installation instructions.
- G. Closeout Submittals:
 - 1. Maintenance data; Submit under provisions of Section 017823.
 - 2. Warranty: Submit specified warranty. Submit under provisions of Section 017836.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: Acceptable to manufacturer with experience on at least 5 projects of similar nature in past 5 years.
- B. Certifications:

1. Contractor's and installer's certification that products are installed in accordance with Contract Documents.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of Section 016600.

1.4 PROJECT CONDITIONS

- A. Environmental Requirements:

1. Comply with manufacturer's written requirements under which products can be installed.
2. Store carpet materials in spaces where they will be installed for at least 48 hours before beginning installation.
3. Maintain minimum temperature of 65 degrees F and maximum relative humidity of 65 percent for minimum of 24 hour prior to installation. Maintain temperature for 72 hours after installation.

- B. Substrate Conditions: Do not install carpet over concrete slabs until they are cured and are sufficiently dry to achieve bond with adhesive as determined by manufacturer's bond and moisture tests.

1.5 SEQUENCING

- A. Install carpet after other finishing operations, including painting, have been completed.

1.6 WARRANTY

- A. Comply with provisions of Section 017836.
- B. Warrant installation of carpet, adhesives, and accessories for 2 years. Include coverage as applicable for:
 1. Shrinkage and stretching.
 2. Tuft bind and edge unraveling.
 3. Peaking and doming.
 4. Failure to perform as specified in manufacturer's instructions due to installation.

PART 2 - PRODUCTS

2.1 CARPET

- A. Materials: As indicated in interiors finish materials specifications.

2.2 ACCESSORIES

- A. Patching compound:
 - 1. Pre-mixed latex recommended by carpet manufacturer.
 - 2. Gypsum based products not allowed.
 - 3. Compatible with adhesive and curing and sealing compound on concrete.
- B. Adhesives:
 - 1. General: Water based adhesive approved by carpet and cushion manufacturer.
 - 2. Antimicrobial: Manufacturer's standard.
 - 3. Adhesives & Sealants: Only use adhesives and sealants in the interior of the building that meet or do not exceed the VOC limits of the CURRENT requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168 on the interior of the building.
 - a. Current requirement refers to the date on which the materials are installed in the building.
 - b. SCAQMD Rule #1168 referenced in section 018113 is current as of the date of this specification. Refer to <http://www.aqmd.gov/rules> for the actual current version of the rule that will be applicable at the date of installation during construction.
 - c. Interior refers to all building construction that is inside of the exterior weatherproofing material.
- C. Seam Adhesive: Hot-melt seaming adhesive and tape or similar product required by carpet manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and proceed with Work in accordance with Section 017300
- B. Bond and Moisture Tests:
 - 1. Perform in accordance with flooring manufacturer's requirements to determine suitability of concrete subfloor for receiving carpet flooring with regard to moisture content and curing compounds.
 - 2. Test concrete slabs in accordance with ASTM E1907 to ensure moisture content is 3 percent or less.
 - 3. Test with calcium chloride in accordance with ASTM F1869 to ensure vapor transmission rate less than 4 pounds per 1000 sq. ft.
 - 4. Submit report to Owner. If subfloor's moisture vapor permeance is in excess of flooring manufacturer's limits for issuing warranty, prepare slab and apply vapor retarder underlayment system acceptable to manufacturer, or use manufacturer's adhesive for application on substrates containing excessive moisture.
- C. Do not begin flooring work until concrete substrate has cured for minimum of 90 days.

3.2 PREPARATION

- A. Remove ridges and bumps. Fill depressions, low spots, cracks, joints, holes, indentations, and other defects with leveling and patching compounds.
- B. Clean substrate to remove paint, dirt, oil, grease, sealers, release agents, hardening compounds, curing compounds, residual adhesives, and substances which could impair performance of adhesive materials.
- C. Broom clean and vacuum surfaces to remove dust and debris.

3.3 INSTALLATION

A. General:

1. Install in accordance with CRI-104, Section 017300, and carpet manufacturer's shop drawings.
2. Install carpet square and aligned with adjacent surfaces.
3. Cushion Installation:
 - a. Install cushion in accordance with manufacturer's instructions.
 - b. Use maximum size pieces.
 - c. Install cushion seams at right angles to carpet seams. Butt cushion edges tight with no gaps. Lay cushion so that carpet seams do not fall directly over carpet seams.
 - d. Butt edges together and tight to edge.
 - e. Remove air pockets and ridges and slightly stretch.
 - f. Adhere securely around projections and contours.
 - g. Secure to sub-floor.
 - h. Apply pressure-sensitive adhesive to floor in accordance with adhesive manufacturer's instructions.
 - i. Press cushion surface with flat object to ensure positive floor contact.
 - j. Trim excess cushion along perimeter of installation area.
4. Layout carpet rolls and verify carpet match before cutting.
5. Double cut carpet, to allow intended seam and pattern match. Make cuts straight, true and unfrayed.
6. Lay carpet with run or pile in same direction as anticipated traffic.
7. Lay carpet tight and flat with uniform appearance.
8. Do not change run of pile where carpet is continuous through wall opening from one room into another room.
9. Cut and fit carpet around interruptions and penetrations.
10. Seam Location:
 - a. Locate seams in accordance with carpet manufacturer's seaming diagrams.
 - b. Center seams directly under doors where indicated at doorways.
11. Seam Joining:
 - a. Tape seams and press by hand to produce even pile.
 - b. Form seams straight, not overlapped or peaked, and free of gaps.

- c. Seam joints tight and flush.
 - 12. Apply seam adhesive and press by hand to produce even pile.
- B. Double Glue Down for Corridors:
- 1. Apply carpet adhesive on cushion in accordance with adhesive manufacturer's instructions.
 - 2. Lay carpet firmly in place. Trim perimeter edges of carpet.
 - 3. Roll carpet with 35 pound roller to ensure tight and positive contact with cushion.
- C. Stretch-In Installation for Guestrooms:
- 1. Comply with CRI 104, Section 12, "Stretch-in Installations."

3.4 CLEANING

- A. Clean as required by manufacturer. Do not use materials or methods which may damage finish surface or surrounding construction.
- B. Vacuum carpet using commercial machine with face-beater element.
- C. Remove spots in accordance with manufacturer's instructions. Replace entire carpet where spots cannot be removed.

3.5 PROTECTION

- A. Protect finished work in accordance with manufacturer's written recommendations.
- B. Comply with CRI 104, Section 15: "Protection of Indoor Installation."
- C. Maintain protection satisfactory to manufacturer and installer to ensure carpet not damaged at time of Substantial Completion.

END OF SECTION 096800

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes modular, tufted carpet tile.
- B. Related Sections include the following:
 1. Section 096813 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 2. Carpet tile type, color, and dye lot.
 3. Type of subfloor.
 4. Type of installation.
 5. Pattern of installation.
 6. Pattern type, location, and direction.
 7. Type, color, and location of insets and borders.
 8. Type, color, and location of edge, transition, and other accessory strips.
 9. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 1. Carpet Tile: Full-size Sample.
 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- (300-mm-) long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

- E. Qualification Data: For Installer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.
- G. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- H. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
 - 1. Flooring subcontractor shall not subcontract installation labor without advance approval from the Architect and Owner.
- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.7 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excess static discharge, and delamination.
 3. Warranty Period: 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

PART 2 - PRODUCTS

2.1 CARPET TILE (CPT-X)

- A. Products: Subject to compliance with requirements, provide the following:
1. Manufacturers/Products: As indicated on the Drawings.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
1. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
 4. Seven days prior to installation, provide the Architect and Owner written documentation of the results of calcium chloride and pH tests at a rate of one test per 2,000 square feet, or enough to meet manufacturer's requirements for the warranty.
 5. Provide to the Architect and Owner written documentation of the space temperature and relative humidity for the seven days prior to the start of installation.
 6. Installation shall be a 100% pressure sensitive type.
 7. One week prior to installation, submit to the Architect and Owner the name and credentials of the project foreman that will be responsible for quality control on the project. The foreman will be required to be on the project during 50% or more of the installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.
- H. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 2. Remove yarns that protrude from carpet tile surface.
 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 097216 - VINYL COATED FABRIC WALL COVERINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Vinyl wall covering and trim.

1.2 SUBMITTALS

- A. General: Submit in accordance with Section 013323.
- B. Product Data: Submit product data for each product not provided by Owner.
- C. Shop Drawings: Submit drawings showing wall elevations with seaming layout.

1.3 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in wall covering installation with 3 years documented experience.
- B. Regulatory Requirements:
 - 1. Test: ASTM E84.
 - 2. Flame spread index shall not exceed 25.
 - 3. Smoke density index shall not exceed 450.
- C. Certifications: Submit manufacturer's certification that products furnished for Project meet or exceed specified requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, handle, and protect products under provisions of Section 016600.
- B. Inspect roll materials on site to verify acceptance.
- C. Protect packaged adhesive from temperature cycling and cold temperatures.
- D. Do not store roll goods on end.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Provide continuous ventilation and heating to maintain surface and ambient temperatures above 65 deg F within area of Work once wall covering installation is started.
- B. Do not apply adhesive when substrate surface temperature or ambient temperature is below 60 deg F, or when relative humidity is above 40 percent, unless otherwise required by manufacturer's instructions.

- C. Provide illumination of greater than 80 footcandles measured mid-height at substrate surface while painting is in progress.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Vinyl Wall Covering (WC): As indicated in interiors finish materials specifications.
- B. Adhesives:
 - 1. Type recommended by wall covering manufacturer to suit application to substrate; water based.
 - 2. Provide adhesive which is mildew resistant and non-staining.
 - 3. Provide strippable-type adhesive for use with wall coverings applied over gypsum drywall.
- C. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.
- D. Substrate Primer and Sealer: As recommended by wall covering manufacturer.
- E. Adhesives: Only use adhesives in the interior of the building that meet or do not exceed the VOC limits of the CURRENT requirements of South Coast Air Quality Management District (SCAQMD) Rule No. 1168 on the interior of the building.
 - 1. Current requirement refers to the date on which the materials are installed in the building.
 - 2. SCAQMD Rule #1168 referenced in section 018113 is current as of the date of this specification. Refer to <http://www.aqmd.gov/rules> for the actual current version of the rule that will be applicable at the date of installation during construction.
 - 3. Interior refers to all building construction that is inside of the exterior weatherproofing material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and proceed with Work in accordance with Section 017300

3.2 PREPARATION

- A. Remove electrical and telephone plates.
- B. Correct minor defects and clean substrates.
- C. Sand glassy surfaces; shellac marks which may bleed.
- D. Vacuum clean surfaces free of loose particles.

- E. Apply 1 coat of primer sealer to substrate surfaces.
- F. Remove wall covering materials from packaging and allow to acclimatize to area of installation 24 hours before application.

3.3 INSTALLATION

- A. Apply adhesive and wall covering in accordance with manufacturer's written recommendations.
- B. Use wall covering in roll number sequence.
- C. Razor trim edges on flat work table. Do not razor cut on gypsum board surfaces.
- D. Wall Covering Installation:
 1. Apply wall covering smooth, without wrinkles, gaps or overlaps.
 2. Eliminate air pockets and fully bond to substrate surface.
 3. Butt edges tight.
 4. Hang by reversing alternate strips except on matched patterns.
 5. Install seams vertically and plumb, at least 6 inches away from any corner.
 6. Trim selvages to provide color uniformity and pattern match at seams.
 7. Install wall covering before installation of bases, hardware, cabinets, or items attached to or spaced slightly from wall surface.
 8. Do not install wall covering more than 1/4 inch below top of resilient base.
 9. If applicable, apply wall covering to electrical and telephone plates prior to replacing.
- E. Install termination trim, as indicated.
- F. Remove excess wet adhesive from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.4 CLEANING

- A. Clean as recommended by manufacturer. Do not use materials or methods which may damage finish or surrounding construction.
- B. Clean wall covering of excess adhesive, dust, dirt and other contaminants.
- C. Replace wall plates and accessories removed prior to installation.

3.5 PROTECTION

- A. Protect finished work in accordance with manufacturer's written recommendations.

END OF SECTION 097216

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
 1. Existing concrete.
 2. New and existing painted steel.
- B. Related Requirements:
 1. Division 08 Sections for factory priming doors with primers specified in this Section.
 2. Section 099123 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.
 3. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on exterior wood substrates.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

D. Field Quality Control Reports:

1. Submit reports for testing in "Field quality Control" article.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Davis Paint Company.
 - 3. ICI Paints.
 - 4. Porter Paints
 - 5. PPG Architectural Finishes, Inc.
 - 6. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
- C. Colors:
 - 1. To be determined by Architect.

2.3 PRIMERS/SEALERS

- A. Primer Sealer, Water Based:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide PPG; 3030 Bond Prep Primer Sealer, or comparable product by one the manufacturers indicated.

2.4 METAL PRIMERS

- A. Primer, Urethane-based Zinc, Anti-Corrosive for Unpainted Metal:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams; Corothane I Galvpac 1K Zinc Primer, or comparable product by one of the manufacturers indicated.
- B. Water-based Acrylic Primer for Previously Painted Metal:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Devoe Coatings; 4020 Devflex WB DTM Acrylic Primer, or comparable product by one of the manufacturers listed.

2.5 WATER-BASED PAINTS

- A. Latex Acrylic Coating, Exterior, Water Based (Gloss Level 3):
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide PPG; Fortis 350 2402 Acrylic Exterior Satin Enamel, or comparable product by one of the manufacturers indicated.
- B. Water-based Urethane (High Gloss)
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide PPG; Amershield VOC Aliphatic Urethane Gloss Enamel, or comparable product by one of the manufacturers indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 - 1. Existing brick masonry: Remove loose mortar and repoint joints where gaps exist.
- E. Steel Substrates: Remove rust and loose paint, if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
 - 1. SSPC-SP 2.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- G. Existing Painted Steel Substrates:
 - 1. SSPC-SPZ, Scuff sanding, and cleaning.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Paint entire exposed surface of window frames and sashes.

5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Adhesion Testing: Provide a minimum of six (6) "tape tests" according to ASTM D3359, tow (2) per railing on existing painted surfaces after finish painting.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

- A. Existing Concrete, Non-traffic Substrates:

1. Latex Acrylic Coating System:
 - a. Primer/Sealer: Latex, exterior, matching topcoat, if required.
 - b. Intermediate Coat: Latex acrylic coating, exterior.
 - c. Topcoat: Latex acrylic coating, exterior.

- B. New Painted Steel Substrates:

1. Water-Based Urethane Coating System:

- a. Prime Coat: Urethane-based zinc primer.
- b. Intermediate Coat: Water-based urethane.
- c. Topcoat: Water-based urethane.

C. Existing Painted Steel Substrates:

1. Prime Coat: Water-based acrylic primer.
2. Intermediate Coat: Water-based urethane.
3. Top Coat: Water-based urethane.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Field painting of exposed interior items and surfaces.

1.2 SUBMITTALS

- A. Reference Division 1 section "Submittal Procedures" for Confirmation Notice Submittal requirements, if applicable, in lieu of product literature. Samples required.
- B. Product Data: For each product indicated.
- C. Benchmark Samples for each type of coating.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Painting products manufactured or supplied by the following manufacturer are the basis of design products: Subject to compliance with requirements, provide products of the following manufacturer:

1. Benjamin Moore & Co.
2. Davis Paint Company.
3. ICI Paints.
4. Porter Paints.
5. PPG Architectural Finishes, Inc.
6. Sherwin-Williams Company (The).

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

1. Use only fillers and primers recommended in writing by the primary coating manufacturer for the substrate and coating used.

- B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.

2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
- C. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- D. Colors: Match colors as indicated by manufacturer, number and name in the interior finish schedule.

PART 3 - EXECUTION

3.1 GENERAL

- A. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
- B. Do not paint prefinished items, shop finished materials, concealed surfaces, finished metal surfaces, operating parts, and labels.
 1. Prefinished items include factory-finished components.
 2. Concealed surfaces include walls or ceilings in generally inaccessible spaces.
 3. Finished metal surfaces.
 4. Operating parts: moving parts of operating equipment, valves, linkages, sensing devices and the like.
 5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.3 APPLICATION

- A. Comply with procedures specified in PDCA P4 for inspection and acceptance of surfaces to be painted.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
- C. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting. Reinstall items removed after painting is complete.
- D. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 1. Provide barrier coats over incompatible primers or remove and reprime.
 - 2. Cementitious Materials, including existing concrete floor surfaces of penthouses: Remove efflorescence, chalk, dust, dirt, grease and oils by power washing or other means acceptable to the coating manufacturer.
 - a. Do not damage existing surfaces.
 - 3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
 - c. If transparent finish is required, backprime with spar varnish.
 - 4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - a. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
 - 5. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- E. Material Preparation: Maintain containers, and stir and mix materials in accordance with manufacturers' recommendations.

- F. Exposed Surfaces: Areas visible when permanent or built-in fixtures, grilles, convector covers and similar components are in place.
 - 1. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 2. Paint backsides of access panels and removable or hinged covers to match exposed surfaces.
 - G. Sand lightly between each succeeding enamel or varnish coat.
 - H. Omit primer over metal surfaces that have been shop primed and touchup painted.
 - 1. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance.
 - I. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
 - 1. When applying to existing surfaces where partial painting, touch-up or patch and repair are indicated or required, apply coatings to the nearest corner, break in surface plane, expansion or control joint, or similar obvious demarcation point.
 - 2. Minimum Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by manufacturer.
 - 3. Prime Coats: Apply a prime coat(s) as recommended by manufacturer: apply to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
 - 4. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
 - 5. Electrostatic Application: At existing elevator hoistway doors and frames, apply paints with a slight static electric charge while spraying, to ensure a durable, smooth finish.
 - J. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
 - K. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- ### 3.4 CLEANING AND PROTECTING
- A. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

- B. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- C. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 - 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.5 INTERIOR PAINT SCHEDULE

- A. Gypsum Board and Plaster Substrates, Vertical:
 - 1. Latex over Latex Sealer System:
 - a. Prime Coat: Sherwin-Williams; ProMar 200 Zero VOC Interior Latex Primer.
 - b. Intermediate Coat: Latex interior matching topcoat.
 - c. Top Coat: Sherwin-Williams; ProMar 400 Zero VOC Interior Latex Eg-shel.
- B. Gypsum Board Ceilings and Soffits:
 - 1. Latex over Latex Sealer System:
 - a. Prime Coat: Sherwin-Williams; ProMar Zero VOC Interior Latex, Flat.
- C. Hollow Metal Door Frames / Painted Wood / MDF Doors:
 - 1. Light Industrial System:
 - a. Prime Coat: Sherwin-Williams; Pro Industrial Pro-Cryl Universal Primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Top Coat: Sherwin-Williams; Pro Industrial Zero VOC Acrylic, semi-gloss.
- D. Existing Elevator Hoistway Doors and Frames:
 - 1. Electrostatic Application:
 - a. Prime Coat: Sherwin-Williams; All-surface Enamel Oil Primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Top Coat: Sherwin-Williams; ProMar 200 Interior Alkyd, semi-gloss.

END OF SECTION 099123

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes surface preparation and the application of wood finishes on the following substrates:
 - 1. Interior Substrates:
 - a. Dressed lumber (finish carpentry).
- B. Related Sections include the following:
 - 1. Division 09 Section "Interior Painting" for surface preparation and application of standard paint systems on interior substrates.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of finish system and in each color and gloss of finish indicated.
 - 1. Submit Samples on representative samples of actual wood substrates, 8 inches (200 mm) square.
 - 2. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of MPI's current "MPI Approved Products List" for each product category specified in Part 2, with the product proposed for use highlighted.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in its "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and finish systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

- A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply exterior finishes in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Benjamin Moore & Co.
 2. ICI Paints.
 3. Kwal-Howells Paint.
 4. PPG Architectural Finishes, Inc.

5. Sherwin-Williams Company (The)

2.2 MATERIALS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.

B. VOC Content of Field-Applied Interior Primers, Stains, and Transparent Finishes: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to primers, stains, and transparent finishes that are applied in a fabrication or finishing shop:

1. Flat Primers: VOC content of not more than 50 g/L.
2. Nonflat Primers: VOC content of not more than 150 g/L.
3. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
4. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
5. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
6. Floor Coatings: VOC not more than 100 g/L.
7. Shellacs, Clear: VOC not more than 730 g/L.
8. Stains: VOC not more than 250 g/L.

2.3 WOOD FILLERS

A. Wood Filler Paste: MPI #91.

1. VOC Content: E Range of E2.

2.4 STAINS

A. Interior Wood Stain (Semitransparent): MPI #90.

1. VOC Content: E Range of E2.

2.5 POLYURETHANE FINISHES

A. Interior, Oil-Modified, Clear Urethane (Satin): MPI #57, Gloss Level 4.

1. VOC Content: E Range of E2.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
 - 1. Maximum Moisture Content of Wood Substrates: 15 percent when measured with an electronic moisture meter.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes.
 - 3. Begin finish application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 4. Beginning application of finish system constitutes Contractor's acceptance of substrate and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be finished. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
 - 1. After completing finishing operations, reinstall items that were removed; use workers skilled in the trades involved. Remove surface-applied protection if any.
- C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 1. Remove surface dirt, oil, or grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.
 - 3. Countersink steel nails, if used, and fill with putty tinted to final color to eliminate rust leach stains.
- D. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.

3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for finish and substrate indicated.

2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

- A. Finish Carpentry Substrates:
 1. Polyurethane Varnish Over Stain System: MPI INT 6.3E.
 - a. Stain Coat: Interior wood stain (semitransparent), to match furniture per FF&E Specifications.
 - b. Two Finish Coats: Interior, oil-modified, clear urethane (satin).

END OF SECTION 099300

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Plastic-laminate-faced toilet compartments configured as toilet enclosures and urinal screens.

- B. Related Sections:

1. Section 061035 "Miscellaneous Rough Carpentry" for blocking.
2. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 1. Each type of material, color, and finish required for units, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.
 2. Each type of hardware and accessory.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- B. Stainless-Steel Castings: ASTM A 743/A 743M.
- C. Particleboard: ANSI A208.1, Grade M-2 with 45-lb (20.4-kg) density, made with binder containing no urea formaldehyde.
- D. Plastic Laminate: NEMA LD 3, general-purpose HGS grade, 0.048-inch (1.2-mm) nominal thickness.
- E. Adhesives: Manufacturer's standard product that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 PLASTIC-LAMINATE-FACED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Accurate Partitions Corporation.

2. All American Metal Corp.
 3. American Sanitary Partition Corporation.
 4. Ampco, Inc.
 5. Bobrick Washroom Equipment, Inc.
 6. Bradley Corporation; Mills Partitions.
 7. Flush Metal Partition Corp.
 8. General Partitions Mfg. Corp.
 9. Global Steel Products Corp.
 10. Knickerbocker Partition Corporation.
 11. Marlite.
 12. Metpar Corp.
 13. Rockville Partitions Incorporated.
 14. Sanymetal; a Crane Plumbing company.
 15. Shanahan's Limited.
 16. Tex-Lam Manufacturing, Inc.
 17. Weis-Robart Partitions, Inc.
- B. Toilet-Enclosure Style: Overhead braced.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, Screen, and Pilaster Construction: One-piece, plastic-laminate facing sheets pressure laminated to core material without splices or joints in facings or cores; with laminate applied to edges before faces to seal edges and prevent laminate from being pried loose. Seal exposed core material at cutouts to protect core from moisture.
1. Core Material: Particleboard.
 2. Doors and Panels: Finished to not less than 1 inch (25 mm) thick.
 3. Pilasters: Provide construction to comply with one of the following:
 - a. Finished to not less than 1-1/4 inches (32 mm) thick and with internal, nominal 0.134-inch- (3.42-mm-) thick, steel-sheet reinforcement.
 - b. Finished to 1-1/4 inches (32 mm) thick and with manufacturer's standard steel-sheet core laminated to both sides of honeycomb of resin-impregnated kraft paper in lieu of particleboard core.
 - c. Finished to not less than 1 inch (25 mm) thick and with internal, nominal 0.120-inch- (3.04-mm-) thick, steel-sheet reinforcement.
- E. Pilaster Sleeves (Caps): Formed from stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- F. Brackets (Fittings):
1. Stirrup Type: Ear or U-brackets, stainless steel.
- G. Plastic-Laminate Finish: One color and pattern in each room.
1. Color and Pattern: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
1. Material: Stainless steel.
 2. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
 3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.4 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - - GENERAL

1.1 SUMMARY

- A. Section Includes: Corner guards.

1.2 SUBMITTALS

- A. General: Submit in accordance with Section 013323.
- B. Product Data: Submit manufacturer's descriptive technical data including test performance data and performance characteristics for each product.
- C. Samples for Initial Selection: Submit actual material finish samples for selection.
- D. Submit following Informational Submittals:
 - 1. Certifications specified in Quality Assurance article.
 - 2. Qualification data: Manufacturer's qualification data.
 - 3. Manufacturer's instructions.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture and fabrication of wall protection devices with 5 years experience.
- B. Certifications: Submit manufacturer's certification that products furnished for Project meet or

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of Section 016600.

PART 2 - - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. IPC Door and Wall Protection Systems; Division of InPro Corporation, Muskego, WI.

2.2 CORNER GUARDS

- A. "Flexible Corner Guards", and as follows:
1. Material: Vinyl extruded from chemical and stain resistant flexible polyvinyl chloride, in .110" (2.8 mm) thickness.
 2. Size: 1-1/2 inches by 1-1/2 inches by full height.
 3. Colors: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

- A. Primers and Adhesives:
1. Field-applied heavy duty adhesive recommended by corner guard manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and proceed with Work in accordance with Section 017300
- B. Verify that substrate finishes are complete and attachment devices in hollow walls are accurately located.

3.2 INSTALLATION

- A. Install in accordance with Section 017300 and approved shop drawings.
- B. Locate devices where indicated.
- C. Corner guards to be installed from top of finished wall base, full height to ceilings.
- D. Use attachment devices or adhesive as specified and as recommended by manufacturer.

3.3 CLEANING

- A. Remove protective coverings from devices at final cleaning stage.

END OF SECTION 102600

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Public-use washroom accessories.
2. Guestroom bathroom accessories.
3. Childcare accessories.

- B. Related Sections:

1. Division 08 Section "Mirrors" for frameless mirrors.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

- B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.

1. Approved full-size Samples will be returned and may be used in the Work.

- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

- D. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

- E. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.

B. Toilet Tissue (Roll) Dispenser TTD-1:

1. Basis-of-Design Product: Bobrick #B-686 with theft resistant spindle #283-604.
2. Description: Double-roll dispenser.
3. Mounting: Surface mounted.
4. Operation: Non-locking type.
5. Capacity: Designed for up to 5 ½" (140 mm) (180 sheets) diameter tissue rolls.
6. Material and Finish: Bright Polished Stainless Steel.

C. Toilet Tissue (Roll) Dispenser TTD-2:

1. Basis-of-Design Product: Bobrick #B-2888.
2. Description: Double-roll dispenser.
3. Mounting: Surface mounted.
4. Operation: Locking type.
5. Capacity: Designed for up to 5 ½" (140 mm) (180 sheets) diameter tissue rolls.
6. Material and Finish: Bright Polished Stainless Steel.

D. Combination Towel (Folded) Dispenser/Waste Receptacle TD/WR:

1. Basis-of-Design Product: Bobrick #B-3944.
2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
3. Mounting: Recessed with projecting receptacle.
4. Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
5. Minimum Waste-Receptacle Capacity: 12 gal. (45.4 L).
6. Material and Finish: Stainless steel, No. 4 finish (satin).
7. Liner: Reusable heavy-gauge vinyl liner: Part #3944-12.
8. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.

E. Towel (Folded) Dispenser TD::

1. Basis-of-Design Product: Bobrick #B-35903.
2. Description: Unit for dispensing C-fold or multifold towels.
3. Mounting: Recessed.

4. Towel-Dispenser Capacity: 300 C-fold or 400 multifold paper towels.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

F. Liquid-Soap Dispenser SD-1:

1. Basis-of-Design Product: Bobrick #B-2111.
2. Description: Designed for dispensing soap in liquid or lotion form.
3. Mounting: Vertically oriented, surface mounted.
4. Capacity: 40 oz.
5. Materials: Stainless steel, No. 4 finish (satin).
6. Refill Indicator: Window type.

G. Liquid-Soap Dispenser SD-2:

1. Basis-of-Design Product: Bobrick #822.
2. Description: Designed for dispensing soap in liquid or lotion form.
3. Mounting: Deck mounted on vanity.
4. Capacity: 34 fl.oz.
5. Materials:
 - a. Corrosion-resistant valve
 - b. Vertical tank is satin-finish stainless steel
 - c. Vandal resistant
 - d. Valve operates with less than 5lb of force (22.2N).

H. Grab Bar Public Restrooms GB-X:

1. Basis-of-Design Product: Bobrick #B-6806.99.
2. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
3. Outside Diameter: 1-1/2 inches (38 mm).
4. Configuration and Length: As indicated on Drawings.
5. Mounting: Flanges with concealed fasteners.

I. Vendor SNV-1:

1. Basis-of-Design Product: Bobrick #B-37063.
2. Type: Sanitary napkin and tampon.
3. Mounting: Fully recessed, designed for 4-inch (100-mm) wall depth.
4. Operation: Single coin (25 cents).
5. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
6. Lockset: Tumbler type with separate lock and key for coin box.

J. Vendor SNV-2:

1. Basis-of-Design Product: Bobrick #B-370639.
2. Type: Sanitary napkin and tampon.

3. Mounting: Surface mounted.
4. Operation: Single coin (25 cents).
5. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
6. Lockset: Tumbler type with separate lock and key for coin box.

K. Sanitary-Napkin Disposal Unit SND-1/SND-2:

1. Basis-of-Design Product: Bobrick #B-353 and #B-354 as conditions require.
2. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
3. Receptacle: Removable, leak-proof, 1.2 gal (4.6L) plastic.
4. Material and Finish: Stainless steel, No. 4 finish (satin).

L. Mirror Unit MR:

1. Basis-of-Design Product: Bobrick #B-166 1836.
2. Frame: Stainless-steel channel.
 - a. Corners: Manufacturer's standard.
3. Integral Shelf: 5 inches (127 mm) deep.
4. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
5. Size: 18" x 36".

2.3 GUESTROOM BATHROOM ACCESSORIES

- A. Provide products indicated in Interiors Specifications.

2.4 CHILDCARE ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Specialties, Inc.
 2. Brocar Products, Inc.
 3. Diaper Deck & Company, Inc.
 4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
 5. Koala Kare Products; a division of Bobrick Washroom Equipment, Inc.
 6. SSC, Inc.
 7. Tubular Specialties Manufacturing, Inc.

B. Diaper-Changing Station BCS-1:

1. Basis-of-Design Product: Koala Kare Products KB110-SSRE.
2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
 - a. Engineered to support a minimum of 250-lb (113-kg) static load when opened.
3. Mounting: Fully recessed.
4. Operation: By pneumatic shock-absorbing mechanism.
5. Material and Finish: Stainless steel, No. 4 finish (satin), with polyethylene interior.
6. Liner Dispenser: Built in.

C. Diaper-Changing Station BCS-2:

1. Basis-of-Design Product: Koala Kare Products KB200-01.
2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
 - a. Engineered to support a minimum of 250-lb (113-kg) static load when opened.
3. Mounting: Surface mounted.
4. Operation: By pneumatic shock-absorbing mechanism.
5. Material and Finish: HDPE in manufacturer's standard grey color.
6. Liner Dispenser: Built in.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.

- B. Related Requirements:

- 1. Section 104416 "Fire Extinguishers."
- C. Scope of Work: Remove existing fire extinguishers and cabinets and replace with new fire extinguishers and cabinets where indicated: "FEC" on Code Plans.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
- B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FIRE-PROTECTION CABINET "FEC"

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fire-End & Croker Corporation.
 - b. GMR International Equipment Corporation.
 - c. Guardian Fire Equipment, Inc.
 - d. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - e. Larsens Manufacturing Company.
 - f. Modern Metal Products, Division of Technico Inc.
 - g. Nystrom, Inc.
 - h. Potter Roemer LLC.
 - i. Strike First Corporation of America.
- B. Cabinet Construction: Fire-rated at fire-resistance-rated partitions indicated on Code Plans.
 - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- (1.09-mm-) thick cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Stainless-steel sheet.
 - 1. Shelf: Same metal and finish as cabinet.
- D. Recessed Cabinet:
 - 1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide semi-recessed at walls less than 6" deep and not part of a chase.

- E. Cabinet Trim Material: Stainless-steel sheet.
- F. Door Material: Stainless-steel sheet.
- G. Door Style: Flush opaque panel, frameless, with no exposed hinges.
- H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide recessed door pull and friction latch.
 - 2. Provide concealed hinge permitting door to open 180 degrees.
- I. Accessories:
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated..
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Silk-screened or Decals.
 - 3) Lettering Color: Black.
 - 4) Orientation: Vertical.
- J. Materials:
 - 1. Stainless Steel: ASTM A 666, Type 304.
 - a. Finish: No. 4 directional satin finish.

2.3 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Provide factory-drilled mounting holes.
 - 3. Prepare doors and frames to receive locks.
 - 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.

2. Fabricate door frames of one-piece construction with edges flanged.
 3. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
 1. Fire-Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
 2. Provide inside latch and lock for break-glass panels.

3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Identification: Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Sections:
 1. Division 10 Section "Fire Protection Cabinets".

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.
- C. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Failure of hydrostatic test according to NFPA 10.
- b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Amerex Corporation.
- b. Ansul Incorporated; Tyco International Ltd.
- c. Badger Fire Protection; a Kidde company.
- d. Buckeye Fire Equipment Company.
- e. Fire End & Croker Corporation.
- f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
- g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
- h. Larsen's Manufacturing Company.
- i. Moon-American.
- j. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
- k. Potter Roemer LLC.
- l. Pyro-Chem; Tyco Safety Products.

2. Valves: Manufacturer's standard.

3. Handles and Levers: Manufacturer's standard.

4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 MOUNTING BRACKETS (FE)

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.
 - c. Badger Fire Protection; a Kidde company.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - g. Larsen's Manufacturing Company.
 - h. Potter Roemer LLC.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Horizontal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

AQUA WAIKIKI WAVE
BUILDING PACKAGE

34-14102-00
FOR REVIEW - NOT FOR CONSTRUCTION

END OF SECTION 104416

SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Wardrobe lockers, including the following:
 - a. Double tier.

- B. Related Sections include the following:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood base.
2. Section 096519 "Resilient Tile Flooring" for resilient base where indicated.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.
 1. Show locker fillers, trim, base, sloping tops, and accessories. Include locker-numbering sequence.
- C. Samples for Initial Selection: Manufacturer's color charts.
- D. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain locker units and accessories through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver lockers until spaces to receive them are clean, dry, and ready for locker installation.
- B. Protect lockers from damage during delivery, handling, storage, and installation.
- C. Deliver master keys, control keys, and combination control charts to Owner.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 1. Art Metal Products; Div. of Fort Knox Storage Co.
 2. DeBourgh Manufacturing Co.
 3. Hadrian Manufacturing, Inc.
 4. List Industries, Inc.
 5. Lyon Metal Products, Inc.
 6. Penco Products, Inc.; Subsidiary of Vesper Corporation.
 7. Republic Storage Systems Co., Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Requirements: For lockers indicated to be accessible, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1

2.3 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 366/A 366M, matte finish, suitable for exposed applications, and stretcher leveled or roller leveled to stretcher-leveled flatness.
- B. Galvanized Steel Sheet: ASTM C 653/A 653M, commercial quality, G60 (Z180) coating designation; mill phosphatized; suitable for exposed applications, and stretcher leveled or roller leveled to stretcher leveled flatness.
- C. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.

2.4 WARDROBE LOCKERS (Knock-down Construction)

- A. Body: Form backs, tops, bottoms, sides, and intermediate partitions from steel sheet; flanged for double thickness at back vertical corners. Comply with the following:
 - 1. Back-Material Sheet Thickness: 24 gage 0.0239 inch (0.60 mm).
 - 2. Side-Material Sheet Thickness: 24 gage 0.0239 inch (0.60 mm).
 - 3. Exposed Ends: Form exposed ends of nonrecessed lockers from minimum 16 gage 0.0598 inch (1.50 mm) thick steel sheet.
 - 4. Size: 12"wide x 12" deep x 72" high.
 - 5. Configuration: Double-tier.
- B. Frames: Form channel frames from minimum 16 gage 0.0598 inch thick steel sheet; lapped and welded at corners. Form continuous integral door strike on vertical frame members. Provide resilient bumpers to cushion door closing.
 - 1. Latch Hooks: Form from minimum 12 gage 0.1046-inch- thick steel; welded or riveted to door frames.
 - 2. Cross Frames: Form intermediate channel cross frames between tiers from minimum 16 gage 0.0598 inch thick steel sheet. Weld to vertical frame members.
- C. Doors: One-piece steel sheet, formed into channel shape at vertical edges and flanged at right angles at top and bottom edges. Fabricate to prevent springing when opening or closing, and to swing 180 degrees. Comply with the following:
 - 1. Sheet Thickness: 16 gage 0.0598 inch.
 - 2. Reinforcement: Brace or reinforce inner face of doors more than 15 inches wide.
 - 3. Acoustical Treatment: Fabricate lockers for quiet operation with manufacturer's standard rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact.
 - 4. Louvered Vents: Stamped, louvered vents in door face, as follows:
 - a. Single-Tier Lockers: No fewer than six louver openings at top and bottom.
 - b. Double-Tier Lockers: No fewer than three louver openings at top and bottom.
 - c. Six-Tier Lockers: No fewer than two louver openings at top and bottom.
- D. Shelves: Provide hat shelf in single-tier units; fabricated from minimum 24 gage 0.0239 inch (0.60 mm) thick, formed steel sheet; flanged on all edges.
- E. Hinges: Steel, full loop, five or seven knuckle; tight pin; minimum 2 inches high. Weld to inside of door frame and to door.
 - 1. Provide at least three hinges for each door more than 42 inches high and at least two hinges for each door 42 inches high or less.
- F. Recessed Handle and Latch: Manufacturer's standard housing, formed from 20 gage, 0.0359 inch thick nickel-plated steel or stainless steel, with integral door pull, recessed for latch lifter and locking devices; nonprotruding latch lifter; and automatic, prelocking, pry-resistant latch, as follows:

1. Provide minimum three-point latching for each door more than 42 inches high; minimum two-point latching for each door 42 inches high or less.
- G. Accessible Lockers: 5%, but less than one of the lockers shall be accessible per the Performance Requirements, including the following:
 1. Bottom of locker minimum 9 inches off the floor, or provide an extra shelf placed 9 inches off the floor for side access.
 2. Symbol of accessibility attached to door.
 3. Hooks as per typical lockers.
 4. ADA-compliant padlockable handle and latch.

2.5 LOCKER ACCESSORIES

- A. Interior Equipment: Furnish each locker with the following items, unless otherwise indicated:
 1. Hooks: Manufacturer's standard zinc-plated, ball-pointed steel. Provide one double-prong ceiling hook, and not fewer than two single-prong wall hooks for single-, double-, and triple-tier units. Attach hooks with at least two fasteners.
- B. Number Plates: Manufacturer's standard etched, embossed, or stamped, aluminum number plates with numerals at least 3/8 inch high. Number lockers in sequence indicated. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
- C. Continuously Sloping Tops: Manufacturer's standard, fabricated from minimum 16 gage steel sheet, for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practicable, without visible fasteners at splice locations, finished to match lockers. Provide fasteners, filler plates, supports, and closures, as follows:
 1. Closures: Vertical-end type.
 2. Sloped top corner fillers, mitered.
 3. Slope tops at 25 degree pitch.
- D. Filler Panels: Fabricated from minimum 14 gage steel sheet in an unequal leg angle shape, and finished to match lockers.

2.6 FABRICATION

- A. Knocked-Down Construction (Wardrobe): Fabricate lockers for nominal assembly at Project site.
- B. Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch. Weld frame members together to form a rigid, one-piece assembly.
 1. Form locker-body panels, doors, shelves and accessories from one-piece steel sheet.

2.7 FINISHES, GENERAL

- A. Finish all steel surfaces and accessories, except prefinished stainless-steel and chrome-plated surfaces.
- B. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 STEEL SHEET FINISHES

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.
- B. Powder-Coated Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard baked-polymer finish consisting of a thermosetting powder topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 - 1. Color and Gloss: To be selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine concrete bases and concrete locker room benches for suitable conditions where metal lockers are to be installed.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install metal lockers and accessories level, plumb, rigid, and flush according to manufacturer's written instructions.
- B. Assemble knocked-down lockers with standard fasteners, with no exposed fasteners on door faces and face frames.

- C. Anchor lockers to floors and walls at intervals recommended by manufacturer, but not more than 36 inches o.c. Install anchors through backup reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.
- D. Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach sloping top units to lockers, with closures at exposed ends.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust doors and latches to operate easily without binding.
- B. Clean interior and exposed exterior surfaces and polish stainless-steel and nonferrous-metal surfaces.
- C. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit locker use during construction.
- D. Touch up marred finishes, or replace locker units that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113

SECTION 11400 - FOODSERVICE EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

- A. The work referred to in this section consists of furnishing all labor, material and services required to provide and deliver all equipment hereinafter specified into the building, uncrate, assemble, hang, set in place, level, and completely install, exclusive of final utility connections.
- B. Coordinate but do not install (unless specifically directed to do so in the technical specifications) Owner and Vendor-supplied equipment noted on the drawings or in the specifications as NIKEC. Show on roughing in plans the sizes, utilities, and other requirements as furnished in the Specifications, by Owner or appropriate supplier in submittals as if the equipment is contractor furnished.
- C. Coordinate and show sizes, utilities, and other requirements as determined by physical inspection for equipment noted as existing to be reused. Include costs for marking, removing, storing, cleaning, redelivering and installing such equipment. All requirements within the project manual apply to reused equipment except warranty as if contractor furnished including but not limited to code compliance and accessories necessary to conform with the new application. Kitchen Equipment Contractor (KEC) to alert Design team if bringing reused equipment to code is cost prohibitive.

1.2 SUBMITTALS

- A. Upon award of Contract, furnish the Architect with reproducible copies of the following drawings, in accordance with the approved project schedule, which shall be made on sheets equal in size and matching the bid set drawing size. Reproduced copies of bid documents will not be accepted for this purpose in any fashion.
 1. Equipment specified for fabrication shall be detailed and fully dimensioned to a minimum scale of $\frac{3}{4}'' = 1'-0''$ (1:20) for plan and elevation views and $1\frac{1}{2}'' = 1'-0''$ (1:10) for sections.
 2. Prepare foodservice equipment plan drawings at $\frac{1}{4}'' = 1'-0''$ (1:50) indicating the exact location for the foodservice equipment including contractor supplied equipment. Prepare separate electrical and mechanical dimensioned rough-in drawings at $\frac{1}{4}'' = 1'-0''$ (1:50) showing exact point of penetration of floors, walls, and ceilings for all services required to operate the equipment that the Contractor shall furnish, including the requirements for Contractor supplied and installed refrigerant and beverage piping line runs. These drawings shall also show exact locations of final connections to equipment. Indicate floor drains, floor sinks, receptacles, lights, and other special conditions related to the equipment known to the Contractor but provided under other Sections. These dimensions shall be taken from the centerline of columns, or finished walls if required.
 3. Prepare separate Special Conditions drawings showing the location and size of all bases, depressions, grease interceptors, special height walls, openings in walls for equipment or

- operations, and critical dimensions, etc. Drawings shall be drawn to a scale of not less than $\frac{1}{4}'' = 1'-0''$ (1:50).
4. Any modifications to the layout after bid documents were issued are not included and are the responsibility of the KEC.
 5. The following note is to be added to each drawing sheet:
[KEC name] takes sole responsibility for the accuracy of this drawing and its content. All site conditions and requirements of equipment being provided including sizes and clearances have been accommodated. [KEC name] will provide any requested clarifications or interpretations necessary to aid the project team.
- B. Manufacturers' Data: Upon award of Contract, submit bound copies of Manufacturers' Illustrations and Technical Data to the Architect for review prior to procurement. Items of Standard Manufacture shall be submitted, including items purchased to be built into fabricated equipment. Each illustration shall be marked to describe accurately the item to be furnished as specified, including voltage, phase, load, accessories, etc.
- C. Manufacturers' List: Submit in writing a list of all manufacturers' representatives of the foodservice equipment, such as convection ovens, ranges, etc., and their authorized service agencies' addresses and telephone numbers.
- D. Foundation Data: Data and drawings shall be submitted for each item, if any, requiring special foundations, structures, or supports. Such foundations, structures, or supports will be provided and installed by other appropriate trades in accordance with the drawings and specifications which shall be provided by the Contractor and reviewed by the Architect.
- E. Operation and Maintenance Manuals: Provide three bound copies of operation, maintenance, and parts manuals for all equipment items of standard manufacture including standard component assemblies built into all custom-fabricated items.
- F. Review by the Architect of the drawings and brochures submitted by the Contractor does not waive the responsibility of the Contractor to furnish each item of equipment in complete compliance with the specifications and contract drawings.
- G. The number of copies of all submittals shall be as determined by the Architect.
- H. Samples: Samples of materials, products, and fabrication methods shall be submitted for review at no additional cost, before proceeding with the work.
- I. Substituted equipment:
1. Where three (3) specific manufacturers are specified, only those manufacturers will be acceptable for bidding purposes. Alternative will be considered only if submitted in writing during the pre-bid conference.
 2. If no substitutions are submitted prior to bid date, it will be presumed by all parties concerned that none are being offered, and the bid is being submitted in full accordance with the Contract Documents. No alternate equipment (Substitutions) will be considered after contract has been awarded. Contractor is responsible for updating and coordinating

with General Contractor all drawings (size and utility requirements) with approved alternate equipment.

3. All requests for the consideration of alternatives shall be in writing and all requests shall include the following information:
 - a. Alternative manufacturer's name, model number, and most current catalog information, including all applicable options and accessories.
 - b. Clear defined statements detailing the deviations from the bid specifications inherent with the acceptance of the alternate submission.
 - c. Provide a cost comparison/difference between prime equipment specified in bid and proposed alternate.
 - d. Final approval of the acceptance of any alternatives will be made jointly by Design-Builder and Owner.

1.3 QUALITY ASSURANCE

- A. Standard Products: Materials, products, and equipment furnished under this contract shall be the standard items of manufacturers regularly engaged in the production of such materials, products, and equipment and shall be of the manufacturers' latest design that complies with the specifications.
- B. Manufacturers' Qualifications: Manufacturers shall be regularly engaged in the production of the items furnished and shall have demonstrated the capability to furnish similar equipment that performs the functions specified or indicated herein.
- C. Installation Qualifications: Contractor shall use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work defined in this Section.
- D. Coordination of Work: Coordinate work with the respective trades performing preparatory work for installation of equipment under this Contract, including, but not limited to: construction of pits, trenches, receptors; rough-in of supply, waste and vent piping; electrical connections; and field verification of dimensions.
- E. Product Options: Drawings indicate foodservice equipment based upon equipment specified herein. All substitutions shall be in compliance with the requirements in Division 1 (or Section I, if appropriate.).
- F. Conflict: Where written specifications and drawings conflict or appear to conflict, request clarification. Prior to receiving clarification use the greater quality or greater quantity.
- G. Specified Identification System: Each model number designated in this specification includes the code *F026 as a suffix to identify FoodStrategy, Inc. located in Rockville, Maryland as the specifying consultant for this project. This code is part of the international Specified Identification System (SIS) used throughout the foodservice industry. Its purpose is to identify the specifier to equipment vendors manufacturers in the event that request for clarification or other such communication with FoodStrategy is necessary during the bid preparation and project execution. Submission of a bid on this project requires maintenance of this number on all project correspondence, including fax and email, when communicating with manufacturers and/or their

representatives and is not to be removed from any documentation by the bidder. Upon bid acceptance the selected Kitchen Equipment Contractor agrees to maintain this code on all purchase orders generated for this project as a condition of the contract.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver foodservice equipment in containers designed to protect equipment and finish until final installation. Make arrangements to receive equipment at project site at a time and place agreed with the General Contractor. If the site is not ready for delivery, then either delay delivery or arrange to hold in a secure and protected warehouse until delivery can be made to job site.
- B. Store foodservice equipment in original containers and in location to provide adequate protection to equipment while not interfering with other construction operations. Coordinate with other trades so that worktables, serving counters and equipment are not used for scaffolding or as workbenches.
- C. Handle foodservice equipment carefully to avoid damage to components, enclosures, and finish. Do not install damaged foodservice equipment; replace and return damaged components to equipment manufacturer. In the event of damage, make all repairs and replacements necessary to the approval of the Design-Builder and at no additional cost to the owner.

1.5 APPLICABLE CODES AND STANDARDS

- A. Except as otherwise indicated, each item of equipment shall comply with the latest current edition of the following standards as applicable to the manufacture, fabrication, and installation of the work in this section. Comply with all Federal, State, and Municipal regulations and notifications which bear on the execution of this work. Call to the attention of the Owner in writing any design conflict with the requirements of the Americans with Disabilities Act (ADA) during Bid Process so resolution can be implemented prior to Contract Award.
 - 1. NSF Standards: Comply with applicable National Sanitation Foundation standards and criteria and provide NSF "Seal of Approval" on each manufactured item and on major items of custom-fabricated work.
 - 2. UL / ETL / CSA Standards: For electrical components and assemblies, provide either UL / ETL / CSA listed products or, where no listing service is available, provide a complete index of the components used as selected from the UL / ETL / CSA "Recognized Component Index." For fire extinguishing systems comply with UL 300.
 - 3. ANSI Standards: Comply with applicable ANSI standards for electric-powered and gas-burning equipment; for piping to compressed-gas cylinders; and for plumbing fittings, including vacuum breakers and air gaps, to prevent siphonage in water piping.
 - 4. AGA / CGA: All gas-fired equipment shall be AGA / CGA approved, equipped to operate on the type gas available at the job site, and shall contain 100% automatic safety shut-off devices.

5. NFPA Standards: Comply with NFPA Bulletin 96 for exhaust systems; with NFPA Bulletins 13, 17, 17A and 96 for fire extinguishing systems; and with NFPA 54, National Fuel Gas Code and NFPA 70, National Electrical Code.
6. ASME Code: Comply with ASME boiler code requirements for steam-generating and steam-heated equipment; provide ASME inspection, stamps, and certification of registration with National Board.
7. SMACNA Guidelines: Provide seismic restraints for food service equipment to comply with the Sheet Metal and Air Conditioning Contractors National Association's (SMACNA) "Kitchen Equipment Fabrication Guidelines", appendix 1, "Guidelines for Seismic Restraints of Kitchen Equipment", unless otherwise indicated.
8. ASHRAE: Provide mechanical refrigeration systems complying with the American Society of Heating, Refrigerating and Air Conditioning Engineers' ASHRAE 15, "Safety Code for Mechanical Refrigeration".

1.6 PROJECT CONDITIONS

- A. Visit the job site to field check actual wall dimensions and roughing-in and be responsible for furnishing, fabricating, and installing the equipment in accordance with the available space and utility services as they exist on the job site for an accurate fit.
- B. Check all door openings, passageways, elevators, etc., to be sure that the equipment can be conveyed to its proper location within the building and, if necessary, check with the Contractor regarding the possibility of holding wall erection, placement of doorjambs, windows, etc., for the purpose of moving the equipment to its proper location. Any removal and rebuilding of walls, partitions, doorjambs, etc., necessary to place the equipment or, if caused by incorrect information on the Contractor's drawings, shall be done at the expense of the Contractor.
- C. Physically check the location and utility size of all "rough-ins" at the job site for compatibility with the equipment being installed before finished floors, walls, and/or ceilings are in place.
- D. Check electrical characteristics and water, steam, and gas pressure. Provide pressure-regulating valves where required for proper operation of equipment.

1.7 GUARANTIES AND WARRANTIES

- A. Self-contained or remote refrigeration systems furnished under this Contract shall be provided with start-up and a one-year service contract providing free service, 24 hours per day, seven days per week, including parts and labor. Hermetic or semi-hermetic compressors shall be covered by the manufacturers' factory warranty for an additional four years. Other equipment provided shall include a one-year warranty covering parts and labor, plus any extended warranties as normally provided by individual manufacturers. Equipment including refrigeration systems both self-contained and remote shall be warranted by the Contractor on the project for one year as indicated in the preceding sentence. The first day of the first year commences upon the issuance of a certificate of occupancy for each area.

PART 2 - PRODUCTS**2.1 GENERAL**

- A. The equipment and its component parts shall be new and unused. All items of standard manufactured equipment shall be current models at the time of delivery. Parts subject to wear, breakage, or distortion shall be accessible for adjustment, replacement, and repair.
- B. Means shall be provided to ensure adequate lubrication for moving parts. Oil holes, grease fittings, and filler caps shall be accessible without the use of tools.
- C. Plastic nameplates, to identify controls on fabricated equipment and when specified elsewhere, shall be provided of two-ply, 1/16" (2 mm), rigid plastic material which shall be specifically manufactured for engraving such nameplates. The finished nameplate shall be machine engraved with white letters on a black background and shall have edges beveled at a 45° angle. Nameplates shall be attached using an adhesive recommended by the manufacturer of the engraved material.
- D. The design of the equipment shall be such as to provide for safe and convenient operation. Covers or other safety devices shall be provided for all items of equipment presenting safety hazards. Such guards or safety devices shall not present substantial interference to the operation of the equipment. Guards shall provide easy access to guarded parts.
- E. Trim shall not be an acceptable substitute for accuracy and neatness. When trim is required and accepted by Architect in lieu of rejection of items of equipment, it shall be the Contractor's responsibility to provide same at no additional cost.
- F. Unless otherwise specified herein, no material lighter than #20 gauge shall be incorporated into the work. Gauges for sheet iron and sheet steel shall be U.S. Standard Gauges and finished equipment gauge thickness shall not vary more than 5% plus or minus from the thickness indicated below.

<u>GAUGE</u>	<u>THICKNESS</u>	<u>GAUGE</u>	<u>THICKNESS</u>
#10	0.1406" (3.0mm)	#16	0.0625" (1.6mm)
#12	0.1094" (2.5mm)	#18	0.0500" (1.25mm)
#14	0.0781" (2.0mm)	#20	0.0375" (1.0mm)

- G. Materials or work described in words which have a well-known and accepted technical or trade meaning shall be held to refer to such accepted meanings.

2.2 MATERIALS

- A. Submit a certified copy of the mill analysis of materials if requested by the Architect.

- B. Stainless steel sheets shall conform to American Society for Testing and Materials (ASTM) specification A240, Type 304 Condition A, 18-8, having a No. 4 finish. A No. 2B finish shall be acceptable on surfaces of equipment not exposed to view. Sheets shall be uniform throughout in color, finish, and appearance.
- C. Stainless steel tubing and pipe shall be Type 304, 18-8, having a No. 4 finish, and shall conform to either ASTM A213 if seamless or ASTM A249 if welded.
- D. Rolled shapes shall be of the cold-rolled type conforming to ASTM A36.
- E. Galvanized sheet steel shall conform to ASTM A526; where extensive forming to take place, conform to ASTM A527; conform to ASTM A525, coating designation G115, chemical treatment.
- F. Galvanized steel sheets shall be cold-rolled, stretcher leveled, bonderized, and rerolled to ensure a smooth surface.
- G. Castings shall be corrosion-resisting metal containing not less than 30% nickel. Castings shall be rough ground, polished, and buffed to bright luster and free from pit marks, runs, checks, burrs, and other imperfections. In lieu of corrosion-resisting metal castings, die-stamped or cast 18-8 stainless steel will be acceptable.
- H. Millwork materials shall be free from defects impairing strength, durability, or appearance; straight and free from warpage; and of the best grade for their particular function. Wood shall be well seasoned and kiln dried and shall have an average moisture content of 8%, a maximum of 10%, and a minimum of 5%.
 - 1. Plywood and other woodwork of treatable species, where so required by the code, shall be fire-retardant treated to result in a flame spread rating of 25 or less with no evidence of significant progressive combustion when tested for 30 minutes duration under ASTM E84 and shall bear the testing laboratory mark on a surface to be concealed.
 - 2. Concealed softwood or hardwood lumber shall be of poplar, Douglas fir, basswood, red oak, birch, maple, beech, or other stable wood and shall be select or better grade, unselected for color and grain, surfaced four sides, square-edged, and straight. Basswood may be used where fire-retardant treated materials are required.
 - 3. Plywood for transparent finish shall conform to U.S. Product Standard PS-51-71, Type I (fully waterproofed bond), with architectural grade face veneers of species as specified, free of all pin knots, patches, color streaks and spots, sapwood, and other defects. Plywood designated to have plywood cores shall be of either 5 ply or 7 ply construction. Plywood so designated on the drawings and plywood not otherwise shown shall have a particle board core, cross banding of veneers, and face and back veneers. Particle board cores shall have a 45-pound density, except where the fire retardant treatment requires cores of lesser density.
 - 4. Face veneers shall be matched for color and grain to produce balance and continuity of character. Mineral streaks and other discolorations, worm holes, ruptured grain, loose texture, doze, or shake will not be permitted. Face veneer leaves on each surface shall be full-length, book matched, center matched, and sequence matched. Surfaces shall be sequenced and blueprint matched. Veneers not otherwise indicated shall be plain sliced.

Backing veneers for concealed surfaces shall be of a species and thickness to balance the pull of the face veneers.

5. Hardwood plywood for painted surfaces shall conform to U.S. Product Standard PS-51-71, Type I, and shall have sound birch, maple, or other approved close grain hardwood faces suitable for a paint finish.
 6. Perforated hardboard shall be a tempered hardboard, $\frac{1}{4}$ " (6 mm) thick, conforming to Federal Specification LLL-B-810B, Type I, SIS, Finish B (primed), Design B (perforated), with $\frac{1}{4}$ " (6 mm) diameter holes spaced on 1" (25 mm) centers both ways.
 7. Plastic laminate surfaces shall be laminated with thermosetting decorative sheets of the color, pattern, and style as selected by the Architect. Horizontal surfaces shall be laminated with sheets conforming to Federal Specification L-P-508F, Style D, Type I (general purpose), Grade HP, Class 1, $\frac{1}{16}$ " (2 mm) thick, satin finish, with rough sanded backs. Vertical surfaces shall be laminated with sheets conforming to Federal Specification L-P-598F, Style D, Type II, (vertical surface), Grade HP, Class 1, non-forming, satin finish, $\frac{1}{32}$ " (1 mm) thick or heavier. Surfacing for curved surfaces shall be laminated from sheets conforming to Federal Specification L-P-508F, Style D, Type III (post-forming), Grade HP, Class 1, satin finish. Balance sheets for backs in concealed locations shall be either reject material of the same type and thickness as the general purpose grade facing or may be .020" (0.5 mm) thick laminate backing sheets conforming to Federal Specification L-P-00508E, Style ND, Type V (backing sheet), Grade HP.
 8. Adhesive for application of plastic laminate to wood substrates of counter tops shall be a phenolic, resorcinol, or melamine adhesive conforming to Federal Specification MMM-A-181C and producing a waterproof bond. Adhesive for applying plastic laminate to vertical surfaces shall be either a waterproof type or a water resistant type such as a modified urea-formaldehyde resin liquid glue conforming to Federal Specification MMM-A-188C. Contact adhesive will not be acceptable.
 9. Plywood for laminate assemblies shown or specified with plywood core shall be of the 5 or 7 ply construction with sanded close-grain hardwood face and back veneers, laminated with waterproof glue, in thickness shown, conforming to U.S. Product Standard PS-51-71. Particle board for plastic laminate assemblies shown or specified with particle board wood core shall conform to U.S. Products Standard CS-236-66, Type 1 or 2, Grade B (45 pound density), Class 2; except where fire-retardant treatment is required, the density shall conform to the treatment requirements.
- I. Sealant: ASTM C 920; type S, Grade NS, Class 25, use, NT. Provide elastomeric sealant, NSF certified for end use application indicated. Provide sealant that, when cured and washed, meet requirements of Food and Drug Administration's 21 CFR, Section 177.2600 for use in areas that come in contact with food. Dow-Corning #780 or General Electric "Silastic" or approved equal in either clear or approved color to match surrounding surfaces and applied in accordance with sealant manufacturers' recommendations for smooth, sealed finish.
- J. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), Class 1 (clear), Quality q3 (glazing select). Provide products complying with ANSI Z97.1, manufactured by horizontal (roller hearth) process and $\frac{1}{4}$ " (6 mm) thick, unless otherwise indicated. Provide exposed safety edges, if any, seamed before tempering.

- K. Sound Dampening: NSF-certified, non-absorbent, hard-drying, sound deadening coating. Provide coating compounded for permanent adhesion to metal in 1/8" (3 mm) thickness that does not chop, flake, or blister.

2.3 FINISHES

- A. Paint and coatings shall be of an NSF approved type suitable for use in conjunction with foodservice equipment. Such paint or coating shall be durable, non-toxic, non-dusting, non-flaking, and mildew resistant; shall comply with all governing regulations; and shall be applied in accordance with the recommendations of the manufacturer.
- B. Exterior, galvanized parts, exposed members of framework, and wrought steel pipe where specified to be painted shall be cleaned, properly primed with rust-inhibiting primer, degreased, and finished with two (2) coats of epoxy-based gray hammertone paint, unless otherwise specified.
- C. Stainless steel, where exposed, shall be polished to a #4 commercial finish. Where unexposed, finish shall be #2B. The grain of polishing shall run in the same direction wherever possible. Where surfaces are disturbed by the fabricating process, such surfaces shall be finished to match adjacent undisturbed surfaces.
- D. Galvanized shelving shall not be painted.
- E. Fabricated equipment shall be spray coated with plastic suitable for protecting the equipment during transport and installation. The coating shall be easily removable and shall be removed after the equipment installation is complete at the work site or, alternatively, when directed by the Architect.
- F. Exposed surfaces on brass, bronze, or steel shall be plated with chromium over nickel in accordance with Federal Specifications WW-P-541, Paragraph 9.5 and Table 9.4, unless otherwise specified.

2.4 ELECTRICAL AND MECHANICAL REQUIREMENTS

- A. Standard UL / ETL / CSA listed materials, devices, and components shall be selected and installed in accordance with NEMA Standards and recommendations and as required for safe and efficient use and operation of the foodservice equipment without objectionable noise, vibration, and sanitation problems.
 1. Provide recognized commercial grade signals, "on-off" pushbuttons or switches, and other speed and temperature controls as required for operation of each item, complete with pilot lights and permanent engraved, plastic laminate signs and graphics identifying each item. Provide stainless steel cover plates at controls and signals.
 2. Each item requiring electrical power shall be equipped with either a terminal box for permanent connection or with cord and plug for interruptible connection, as indicated. Provide NEMA standard grounding type plugs, where used.
 3. Furnish foodservice equipment completely wired internally using wire and conduit suitable for a wet location, including a separate grounding wire. Provide electrical outlets and

receptacles required to be mounted on or in fabricated equipment and interconnect to a suitable terminal box (subpanel, starter, or disconnect switch if so specified) with all wires neatly tagged showing item number, voltage characteristics, and load information.

4. Receptacles for all wall- and floor-mounted outlets will be provided to be used for plug-in equipment with characteristics as noted on the drawings. Provide Hubbell three-wire or four-wire grounding-type connectors and neoprene cords installed on each item of plug-in equipment to match receptacles provided.
5. Electrically heated equipment shall be internally wired to a thermostatic control and an "on-off" red neon light indicator, which shall be mounted in a terminal box on a removable stainless steel access panel.
6. Only rigid steel zinc-coated conduit shall be used, painted to match adjacent surfaces where exposed. Wiring shall be run concealed wherever possible.
7. Provide on, or for, each motor-driven appliance or electrical heating or control unit, a suitable control switch or starter of the proper type and rating.
8. Appliances shall be furnished complete with motors, driving mechanism, starters, and controllers, including but not limited to, master switches, timers, cutouts, reversing mechanism, and other electrical equipment if and as applicable. Wiring and connection diagrams shall be furnished with electrically operated machines and for electrically wired fabricated equipment.
9. Appliances shall be of rigid construction, free from objectionable vibration. Quietness of operation of all foodservice equipment is a requirement. Remove or repair any equipment producing objectionable noise and/or vibration as directed by the Architect.
10. Motors shall be of the drip-proof, splashproof, or totally enclosed type, having a continuous duty cycle and ball bearings, except small timing motors which may have sleeve bearings. Motors shall have windings impregnated to resist moisture. Motors located where subject to deposits of dust, lint, or other similar matter from the machine on which installed shall be of the totally enclosed type. Motors shall have ample power to operate the machines for which designated under full load operating conditions without exceeding their nameplate ratings. Horsepower requirements on driven equipment shall be determined by the manufacturer based on normal operation at maximum capacity. The nominal rated motor horsepower shall be not less than the horsepower required for normal operation of the equipment at maximum capacity. Insulation shall be NEMA Class B, or better.
11. Cover plates shall be furnished and installed for all electrical outlets, receptacles, switches, etc., to match the material and finish of the equipment to which they will be fastened.
12. Switches, controls, etc., shall be conspicuously labeled as to use with plastic nameplates secured to the adjacent surface as previously specified in Article 2.01-C. Submit a sample for approval if requested by Architect.
13. Where specified for custom fabricated equipment, provide compartment with electrical sub-panel which shall be pre-wired in conduit concealed in cabinet body construction and connected to all electrical components built into or set upon the counter. Electrical sub-

panel shall be UL / ETL / CSA listed, 3-phase, 4-wire circuit breaker type with a ground buss main breaker and individual breakers for each serviced load. Buss shall be copper and the circuit breakers shall be the molded case, bolt-on type with thermomagnetic quick-make, quick-break trip. Multi-pole circuit breakers shall have an internal trip bar. The circuit breakers shall have an interrupting capacity of 10,000 amperes at 120 volts and there shall be a separate breaker for each connected load. Each breaker shall be sized for 125% of the connected load and a minimum of two (2) extra, single pole, 20 amp circuit breakers shall be provided. The loads shall be connected through the breakers in a phased sequence to balance the load on each phase.

- B. Water inlets shall be located above the positive water level wherever possible to prevent siphoning of liquids into the water supply system. Wherever conditions shall require a submerged inlet, a suitable type of check valve (except in jurisdictions where check valves are prohibited) and vacuum breaker shall be provided with the fixture to prevent siphoning. Where exposed, piping and fittings shall be chrome-plated. Where vacuum breaker piping is through equipment, provide chrome-plated escutcheon plates to cover holes.
1. Provide and install indirect waste lines from equipment which will discharge into floor drains or safe wastes, chrome-plated where exposed. Extend to a point at least 1" (25 mm) (or as required by local or state code) above the rim of the floor drain, cut bottom on 45° angle and secure in position.
 2. Horizontal piping lines shall be run at the highest possible elevation and not less than 6" (150 mm) above the floor, through equipment where possible.
 3. No exposed piping in or around fixtures or in other conspicuous places shall show tool marks or more than one thread at the fitting.
 4. Steam operating valves on or in fabricated and purchased foodservice equipment shall be provided with composition hand wheels, which shall remain reasonably cool in service.
 5. Provide suitable gas and liquid pressure-reducing valves for equipment with such components that might reasonably be expected to be affected over a period of time by adverse pressure conditions, including but not limited to dishwashers, booster heaters, coffee urns, ranges, steam boilers, etc.
- C. Provide and install complete refrigeration systems [charged, started, and operating properly] including, but not limited to:
1. Compressors, condensers, racks, coils, vibration eliminators, sight glasses (moisture indicating type), expansion valves, filters, oil separators, thermostats, defrost time clocks, all controls and control wiring, liquid line driers, piping, and refrigeration grade copper tubing with all sweat joints using Safety-Silv No. 1200 or approved equal silver solder (with as few joints as possible).
 2. Where specifications call for pre-piped lines (i.e., from a fixture to a valve compartment, etc.), provide such work in strict conformance with other sections of the specifications which set forth standards for this type of work or in conformity with the requirements of the ASHRAE Standards or local authorities, whichever is the greater.

3. Mechanically refrigerated cold pans shall have a normally closed liquid line electric solenoid valve installed before the expansion valve and wired to a silent-type toggle switch complete with an "on-off" red neon light indicator and both mounted in a terminal box on a removable access panel. This switch shall be fed by a separate control circuit and shall not be wired into the compressor circuit so that it shall stop the flow of refrigerant to the cold pan and not turn off the compressor. The compressor shall then pump down and turn off through the action of the pressure control.
4. Each refrigeration item specification is written to provide minimum specifications and scope of work. Refrigeration equipment shall be designed and installed to maintain the following general temperatures unless otherwise specified.

a.	Walk-In Refrigerators	1.7°C / 35°F
b.	Walk-In Freezers	-23.3°C / -10°F
c.	Reach-In Refrigerators	1.7°C / 35°F
d.	Reach-In Freezers	-23.3°C / -10°F
e.	Undercounter Refrigerators	1.7°C / 35°F
f.	Undercounter Freezers	-23.3°C / -10°F
g.	Cold Pan	-17.8°C / 0°F
h.	Work Rooms	10°C / 50°F
5. Provide electrical and refrigeration components needed by the completed system and complete all refrigeration and control connections of and to said components.
6. Provide evaporator coil defrost system on all walk-in refrigerator and freezer rooms where the refrigeration systems are designed to operate at room temperature of less than 35°F (1.7°C).
7. Verify the requirements of and provide any or all additional refrigeration specialty(s) or component(s) required or recommended by the manufacturer for proper operation under the specific operating conditions and location of each system specified.
8. When freezers are located on grade and measure 400 square feet (36 m^2) or greater, floors will be protected against "frost-heave" by use of a closed glycol system or equivalent heating system. This system will be contained within refrigeration package and will utilize heat generated by this machinery.
9. Verify and provide manufacturer's certification (or certification by manufacturer's authorized agent) that the equipment selection hereinafter specified for each refrigeration system is properly sized and shall meet the operating requirements set forth for each system regarding maintaining specified operating temperature, hours of compressor running time, and system pressures and velocities as recommended by the equipment manufacturer(s).
10. During check-out and initial operation, verify that:
 - a. Controls are properly adjusted.

- b. Condensers are equipped with an overload protector.
 - c. A competent service mechanic is on site during the first eight (8) hours of operation.
 - d. Switches, starters, and controls are identified as to function.
11. Unless otherwise specified, furnish thermometers for walk-in units mounted above the exterior entrance door with suitable length armored capillary tubes to allow the sensing bulbs to be installed in the incoming air stream to the blower coil with runs fastened to the walk-in walls to prevent it from damage. This identical requirement applies to alarm systems when specified.

2.5 PRODUCT SPECIFICATIONS

- A. All items listed on the contract drawings under the heading "Foodservice Equipment Schedule" shall be furnished in strict accordance with the foregoing specifications and with the following detailed item specifications.
- B. Each model number includes the code *F026 as a suffix. This code is known as the Specifier Identification System. It is not to be removed by the bidders. Its purpose is to identify the specifier to the vendors providing equipment in the event it is necessary to communicate questions, clarifications, and comments, from prior to bid award through final purchase. It is to be used on all correspondence including fax and email when communicating with manufacturer representatives and factories.

Individual item specifications to be determined and provided with bid /contract documents.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Begin installing the equipment at the time the building is ready to receive the equipment and in accordance with the schedule.
- B. Provide a competent foreman or supervisor for erection of equipment and to coordinate with other trades regarding connections, installation, and inspection. Coordinate delivery schedule to ensure adequate openings in the building to receive the equipment.
- C. Install refrigeration work in an approved manner, using first quality fittings, controls, valves, etc. Refrigeration items shall be started up, tested, adjusted, and turned over to the Architect in first-class condition and left operating in accordance with the manufacturer's specifications.
- D. Set equipment that rests on masonry bases level onto a bed of silicone rubber sealant.

- E. Seal equipment that butts to a wall or against other equipment with silicone rubber sealant. Set trim strips or other items requiring fasteners in a bed of silicone rubber sealant and fastened with suitable stainless steel fasteners 48" (1200mm) or less on centers. Surfaces shall be thoroughly clean and degrease all surfaces prior to the application of sealant.
- F. Install and interconnect electrical controls, switches, or other units which are separately furnished for field installation in or on equipment provided, unless otherwise specified.
- G. Install and wire refrigeration systems in strict conformance with the manufacturers' instructions and recommendations. Ensure that all refrigeration condensing units are ventilated properly and are accessible for repair, maintenance, and inspection.
- H. Hang evaporator coils per the manufacturer's recommendation at the locations as shown on the drawings. Mount units such that the drain pans are pitched to the drain lines. Hang the coils using nylon or other approved non-conductive, non-corrosive fasteners. Furnish #12 gauge galvanized steel fish plates of suitable size and shape on the exterior ceiling of the walk-in to spread the weight of the coils adequately. Connect coils to the condensing unit and install to constitute a complete working system capable of maintaining the interior temperatures specified regardless of the heavy usage the walk-in units may receive.
- I. Furnish and install a copper or PVC drainline painted silver from each coil outlet to a point 1" (25mm) above the floor drain. Trap drainlines immediately above the floor drain. Provide continuous electrified heater tape for freezer drainlines, coordinate electrical requirements and wiring with electrical division. Insulate drainline after installation.
- J. Refrigeration tubing shall be the Type L, ACR hard drawn degreased, sealed copper and shall be installed with horizontal runs sloped 1" per 20 feet (1:240) toward the condensing units. Refrigerant piping shall be properly supported by adjustable hangers spaced and adjusted to the drop required. Where vertical runs of more than 5' (1500mm) occur in the suction line, trap the risers at the bottom. Install piping so refrigerant or oil cannot drain back into the coils from the suction line.
- K. Insulate suction and refrigerant lines with minimum 1/2" (12mm) Armstrong armaflex or equal cellular type insulation. Provide metal pipe sleeves where piping passes through a wall, ceiling, or floor. Fill space around the tubing with mastic insulating compound. Install a permanent suction line filter in each compressor suction line with pressure fitting ahead of the filter to facilitate checking of pressure drop through the filter. Fully insulate and seal penetrations through walk-in cooler or freezer structures to be vapor tight to prevent condensation within any light fixtures, switch boxes, junction boxes, or any other fittings. Fully seal refrigeration and drain lines and provide escutcheon plates.
- L. Furnish and completely install a thermostat to control the refrigeration temperatures for each individual compartment.
- M. Mount the condensing units on a welded steel rack containing all accessories and components necessary to form a complete condensing unit package. Provide each condensing unit with a factory mounted, pre-wired control panel/disconnect switch complete with circuit breakers, contactors, and time clocks as required.
- N. Furnish the refrigeration systems with a one-year refrigeration service contract, covering all parts and labor, with service available seven days per week, 24-hours per day. Provide an option for

continuation of the service contract after the first year. Warrant the refrigeration system for one year and provide the compressors with the manufacturer's extended five-year warranty.

- O. Furnish four (4) copies of complete remote refrigeration system control wiring and piping diagrams. Frame one (1) copy in Plexiglas and mount at compressor location or inside the refrigeration system enclosure as appropriate.
- P. Coordinate the equipment work with the respective work of other Sections so that electrical and mechanical components built into the equipment will conform and/or adapt to the type, materials, and characteristics of the building components.
- Q. Install heated and motor-driven equipment so as to operate efficiently. Provide additional vents, guards, deflectors, and other accessories as needed at no additional cost. Note such additions or modifications on the shop drawings and bring to Architect's attention by special accompanying letter.

3.2 FABRICATION OF METAL WORK

- A. Items of fabricated equipment shall be fabricated in the same factory and shall be similar in construction details, materials, methods, and appearance to similar types of items so fabricated under this contract.
- B. All fabrication shall conform to the latest Standards and Revisions established by the National Sanitation Foundation. Provide N.S.F. "Seal of Approval" on each manufactured item, and on items of custom works.
- C. Each fabricated item of equipment shall include necessary reinforcing, bracing, and welding with the proper number and spacing of uprights and cross members for strength. Wherever standard sheet sizes will permit, the tops of all tables, shelves, exterior panels of cabinet type fixtures, and doors and drainboards shall be constructed of a single sheet of metal. Except where required to be removable, flat surfaces shall be secured to vertical and horizontal bracing members by welding or other approved means to eliminate buckle, warp, rattle, and wobble. Equipment not braced in a rigid manner and which is subject to rattle and wobble shall be unacceptable, and the Contractor shall add additional bracing in an approved manner to achieve acceptance.
- D. Suitable pipe slots shall be provided on fabricated equipment to accommodate service and utility lines and mechanical connections. These slots shall be of proper size and shall be neatly made with turned up edges around to eliminate cutting or defacing of equipment on the job. Cabinet bases shall be provided with an inner panel duct at the ends or rear of the cabinet allowing adequate space to conceal vertical piping. Such work, when performed at the job site, shall be of the same quality as similar work performed in the shop.
- E. Exposed surfaces shall be free from bolt and screw heads. When bolts are required, they shall be of the concealed type and be of similar composition as the metal to which they are applied. Where bolt or screw threads on the interior of fixtures are visible or may come into contact with hands or wiping cloths, they shall be capped with a stainless steel acorn nut and stainless steel lock washer.
- F. Where screw threads are not visible or readily accessible, they shall be assembled with stainless steel lock washers and nuts. Wherever bolts or screws are welded to the underside of trim or tops,

the reverse side of the weld shall be finished uniformly with the adjoining surfaces. Depressions at these points shall not be acceptable.

- G. Rivets shall not be permitted in any location.
- H. Welding shall be the heliarc method with welding rod of the same composition as the sheets or parts welded. Welds shall be complete, strong, and ductile with excess metal ground off and joints finished smooth to match adjoining surfaces. Welds shall be free of mechanical imperfections such as gas holes, pits, cracks, etc., and shall be continuously welded so that the fixtures shall appear as one piece construction. Butt welds made by spot solder and finished by grinding shall not be acceptable.
 - 1. Spot welds shall have a maximum spacing of 3" (75mm). Tack welds shall be of at least 1/4" (6mm) length of welding material at a maximum space of 4" (100mm) from center to center. Weld spacing at the ends of the channel battens shall not exceed 2" (50mm) centers.
 - 2. In no case shall soldering be accepted.
 - 3. Fixtures shall be shop fabricated of one piece and shipped to the job completely assembled wherever possible. Equipment too large to transport or enter the building as one piece shall be constructed so that the field joints can be welded at the job site.
 - 4. Exposed joints shall be ground flush with adjoining material and finished to harmonize therewith. Whenever material has been depressed by a welding operation, such depression shall be suitably hammered and penned flush with the adjoining surface and, if necessary, again ground to eliminate low spots. In all cases, the grain of rough grinding shall be removed by successive fine polishing operations.
 - 5. Unexposed welded joints on undershelves of tables or counters in stainless steel construction shall be suitably coated at the factory with an approved metallic-based paint.
 - 6. After galvanized steel members have been welded, welds and areas where galvanizing has been damaged shall have a zinc dust coating applied in conformance with U.S. Government Military Specification Number MIL-P-26915.
- I. Butt joints and contact joints, wherever they occur, shall be close fitting and shall not require a filler. Wherever break bends occur, they shall be free of undue extrudence and shall not be flaky, scaly, or cracked in appearance; where such breaks do mar the uniform surface appearance of the material, such marks shall be removed by suitable grinding, polishing, and finishing. Wherever sheared edges occur, they shall be free of burrs, fins, and irregular projections and be finished to obviate danger of cutting or laceration when the hand is drawn over them. In no case shall overlapping materials be acceptable where miters or bullnosed corners occur.
- J. The grain of polishing shall run in the same direction on horizontal and on vertical surfaces of each item of fabricated equipment except in the case where the finish of the horizontal sections of each shall terminate in a mitered edge. Where sinks and adjacent drainboards are equipped with backsplash, the grain of polishing shall be consistent in direction throughout the length of the backsplash and sink compartment.

K. Component parts, whether fabricated by the Contractor or purchased for building into the fabricated equipment, shall conform to the following.

1. Bolts, screws, nuts, and washers shall be of steel, except where brass or stainless steel is fastened, in which case they shall be of brass or stainless steel, respectively. Where dissimilar metals are fastened, bolts, screws, nuts, and washers shall be of the higher grade metal. The spacing and extent of bolts and screws shall be such as to ensure suitable fastening and prevent buckling of the metals fastened.

L. Gauges: Except as otherwise indicated, fabricate the following components from the gauge of metal indicated, and other components from not less than 20 gauge metal:

1. Table and counter tops:	14 gauge (2.0 mm)
2. Table reinforcements:	12 gauge (2.0 mm)
3. Counter reinforcements:	12 gauge (2.5 mm)
4. Sinks and drainboards:	14 gauge (2.0 mm)
5. Wall shelves and overshelvess:	16 gauge (1.6 mm)
6. Front drawer and hinged door panels:	18 gauge (1.25 mm) (double pan type)
7. Single louvered door panels:	16 gauge (1.6 mm)
8. Enclosed base cabinets:	18 gauge (1.25 mm)
9. Enclosed wall cabinets:	18 gauge (1.25 mm)
10. Pan type inserts and tray slides:	16 gauge (1.6 mm)
11. Removable covers and panels:	16 gauge (1.6 mm)
12. Skirts and enclosure panels:	18 gauge (1.25 mm)
13. Closure and trim strips over 4" wide:	18 gauge (1.25 mm)
14. Hardware reinforcements:	12 gauge (2.5 mm)
15. Gusset plates:	10 gauge (3.0 mm)
16. Legs:	1-5/8" x 16 gauge (1.6 mm)
17. Crossbracings:	1-1/4" x 16 gauge (1.6 mm)

3.3 CLEAN-UP

A. At completion of the installation, clean up, lubricate, and adjust where necessary items of equipment provided and turn them over in first-class condition.

1. Where stainless steel surfaces are disturbed by the installation or fabricating process, such surface shall be finished to match adjoining undisturbed surfaces.
2. At the completion of the installation work, stainless steel shall be gone over with a portable polishing machine and buffed to perfect surfaces. Painted surfaces shall be carefully gone over and retouched as required.

3.4 START-UP AND TESTING AND COMMISSIONING

A. Startup Services: Engage factory-authorized service representatives to perform startup services and to demonstrate and train Owner's maintenance personnel as specified below.

1. Coordinate food service equipment startup with service-utility testing, balancing, and adjustments. Do not operate steam lines before they have been cleaned and sanitized.
2. Remove protective coverings and clean and sanitize equipment, both inside and out, and relamp equipment with integral lighting. Where applicable, comply with manufacturer's written cleaning instructions.
3. Test each equipment item for proper operation. Repair or replace equipment that is defective in operation, including units that operate below required capacity or that operate with excessive noise or vibration.
4. Test refrigeration equipment's ability to maintain specified operating temperature under heavy-use conditions. Repair or replace equipment that does not maintain specified operating temperature.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
6. Test motors and rotating equipment for proper rotation and lubricate moving parts according to manufacturer's written instructions.
7. Test water, drain, gas, steam, oil, refrigerant, and liquid-carrying components for leaks. Repair or replace leaking components.
8. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance for each food service equipment item.
9. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Contract Closeout."
10. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
11. Schedule training with Owner, through Architect, with at least 7 days advance notice.

3.5 SEISMIC RESTRAINTS

- A. Install equipment in these contract documents according to the "SMACNA Guidelines for Seismic Restraint of Kitchen Equipment" in any State, province, or jurisdiction that has legislated this requirement as necessary for acceptance. This shall include:
1. Identifying these items on submittal drawings, Plans, Elevations, and Sections.
 2. Showing required SMACNA methods of restraint on submittal drawings.
 3. Referencing the appropriate detail(s).
 4. Obtain regulatory approval for all seismic engineering details.

- B. If no SMACNA detail exists for a particular situation, prepare and obtain approval for a special attachment detail:
1. Detail must be prepared by an engineer licensed by the State having jurisdiction over the project and accompanied by the supporting calculations used in the design.
 2. Verify that the restraint design is appropriate to the building's structural conditions and the surfaces to which the equipment will be secured.

End of Section 114000

AQUA WAIKIKI WAVE
FOODSERVICE EQUIPMENT BROCHURE

Project Number: 14048

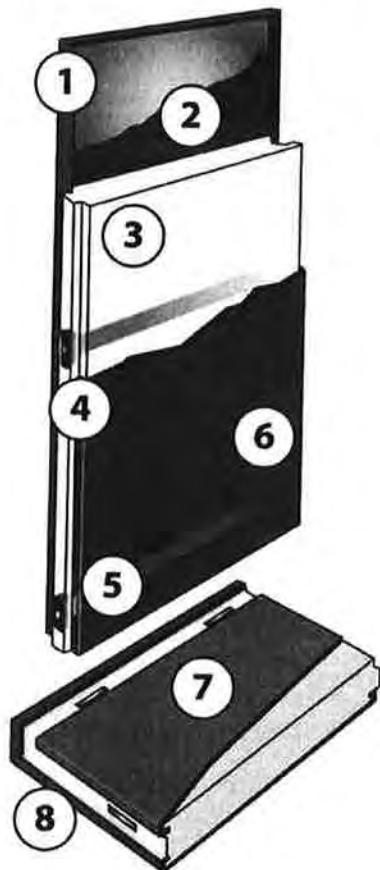


JANUARY 9, 2015

Food**Strategy**, Inc.
1300 Piccard Drive
Suite 207
Rockville, MD 20850
p-301-926-8181
f-301-926-8199

www.foodstrategy.com

GENERAL DESIGN



Smallest building size is 3'11" x 5'10". Size increases in 11½" increments.

Our panels are precisely formed in custom-designed molds then injected with foam insulation to provide dimensional stability through a wide range of temperatures.

1. Exterior metal vertical panel skins. (See below for available finishes.)
2. Bally wash primer for optimum foam adhesion.
3. Foamed-in-place, non-ozone depleting urethane insulation.
4. Accurately molded urethane creates tongue and groove edges.
5. Speed-Lok joining mechanism creates snug joints with heavy-gauge steel straps that connect locking arms with locking pins on opposite edges of each panel.
6. Interior metal vertical panel skin. (See below for available finishes.)
7. Interior metal floor panel skin. (See below for available finishes.)
8. Exterior metal floor panel skin. Edges capped with matching metal when Stainless steel or White galvanized steel is specified for vertical. (See below for available finishes.)

Size per plan
+8'-6"H

Verticals	Heights:	6'10"-10'10", 11'4"-19'4", 19'8"-27'8" In 1' increments. (May be fabricated in 2 pieces)
	Widths:	11½", 17¼", 23", 34½", or 46" Corners 12" x 12" Outside width
Ceiling & Floor	End:	23½" Widths
	Center:	11½", 17¼", 23", 34½", or 46" Widths
Hinged Entrance Doors 4" 5", or 6"	Heights:	6'10", 7'10" (For taller buildings, correctly sized panels are installed above the door panels.)
	Widths:	46" wide panels: 24", 30", 34", 36" openings 57½" wide panels: 36", 42", 48" openings 69" wide panels: 36", 42", 48", or 60" openings

Heights shown are for vertical panels only; for overall height, add thickness of appropriate floor and ceiling panels. Lengths vary. 4" and 5" thick floor and ceiling panel maximum length: 11'6" multi-span; 17'4" for single span (indoors). Beading occurs on panels greater than 130" in height to improve stability; panels shorter than 130" are not beaded.

PANEL FINISHES

Bally panels are constructed with standard metal finishes. Custom options and colors are available.

Vertical Panel Finishes

- Stainless steel** Where exposed
- Galvanized steel
- Smooth White galvanized steel
- Smooth White aluminum
- Stucco-Embossed Galvalume steel**
- Stucco-Embossed Stainless steel
- Stucco-Embossed Aluminum
- Stucco-Embossed White Aluminum
- Stucco-Embossed White galvanized steel
- Stucco-Embossed Sand-tan galvanized steel

Floor Metal and Diamond Tread Finishes

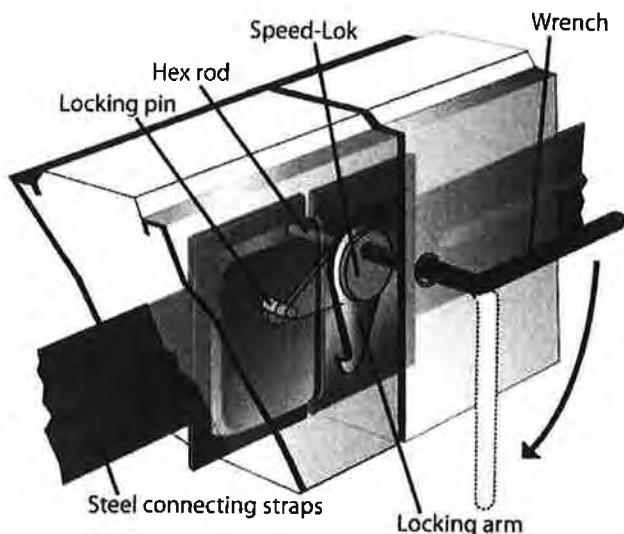
- 16 ga. Stainless Steel
- .080 Rigidized Aluminum
- .100 Smooth Aluminum
- 16 ga. Galvanized Steel
- .125 Aluminum Diamond Tread
- .060 Rigidized Stainless Steel

GENERAL DESIGN

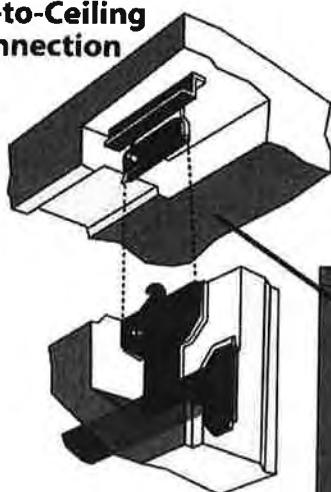
THE BALLY SPEED-LOK

Bolstered by a steel strap foamed into the panels, Bally Speed-Loks help to create strong structures. The Speed-Lok's simplicity allows a structure to be assembled in a fraction of the time compared to conventional construction and aids in the ability to expand, disassemble, or relocate a Bally structure with ease. The Bally Speed-Lok is operated solely by a hex wrench, and consists of:

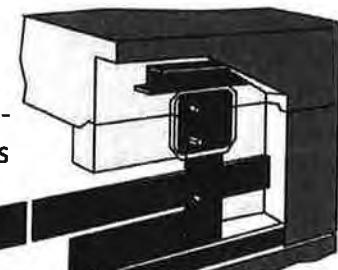
- **Locking pin:** This steel rod is precisely positioned so that the locking arm engages it tightly.
- **Locking arm:** A cam-mounted arm with a hooked end. When a hex wrench is used to turn the arm, the eccentric movement of the cam first enables the hook to engage the pin and then draws the panels tightly together.



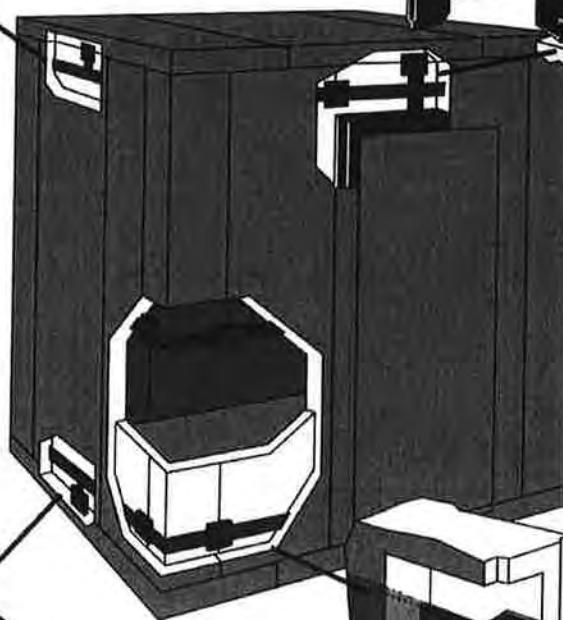
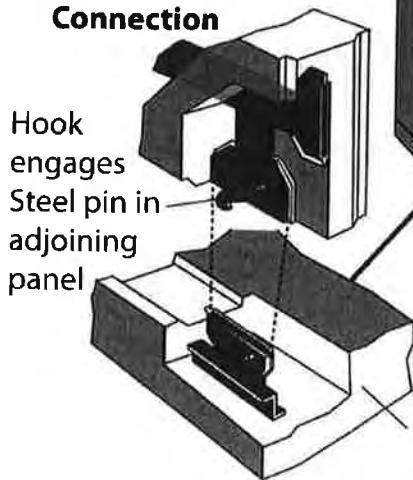
Wall-to-Ceiling Connection



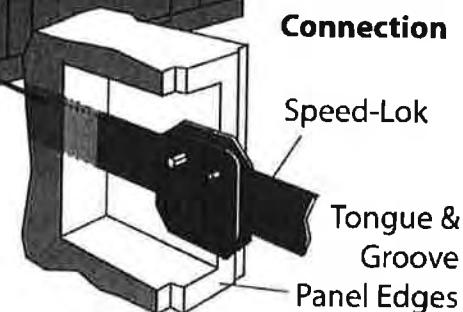
Door Frame Connection



Floor-to-Wall Connection



Wall Panel Connection



GENERAL DESIGN

BALLY PANEL INSULATION

The current insulation formula used in Bally panels relies on Hydrofluorocarbon (HFCs), specifically HFC-245fa, meeting standards for Chlorofluorocarbon (CFC) reduction, the U.S. Clean Air Act, and the EISA Act of 2007. Compared to the CFCs they replace, HFCs reduce ozone depletion by a factor of ten while creating insulation with outstanding resistance to the transfer of heat. Urethane insulation is substantially more effective at resisting the transfer of heat than other common insulating materials. Advantages of Bally Insulation:

- **Dimensional stability:** Bally's non-ozone depleting urethane uses a low pressure expanding agent that produces 98% closed-cell insulation that maintains its shape and size through a wide range of temperatures.
- **Lightweight:** Poured-foam urethane insulation makes Bally panels light in weight, so they are easy to handle during installation.
- **Energy efficiency:** The insulating superiority of a Bally structure reduces energy expenditures resulting in cost savings.

INSULATION RATINGS

Bally Insulation	K-Factor	R-Value		
		4"	5"	6"
Cooler Panels	.137	29.2	36.5	43.9
Freezer Panels	.123	32.6	40.8	48.9

In 2009, federal law went into effect requiring Walk-In Cooler and Freezer panels to contain insulation with ratings of at least R-25 for Coolers and R-32 for Freezers. R-values and K-factors measure thermal resistance and heat conductivity which are determined by ASTM c518. Coolers are tested at 55°F mean temperature with a 40° temperature difference. Freezers are tested at 20°F mean temperature with a 40° temperature difference.

LAWS, APPROVALS & LISTINGS

Our products are in compliance with the Energy Independence and Security Act of 2007, and additionally backed with approvals and listings from leading independent quality certification organizations. Buyers can be sure that Bally products live up to these stringent standards.

EISA

Bally panels and refrigeration systems are in accordance with the Energy Independence and Security Act of 2007.



Underwriters Laboratories

Flame spread and smoke developed listings appear on tags on every Bally panel; proving that the panels are UL-classified. UL listings have also been granted to electrical systems in Bally structures, including interior lights, door heaters and refrigeration systems.



Factory Mutual

Bally panels have been approved as a Class 1 building material by Factory Mutual Insurance System. This approval means that Bally wall and ceiling panels meet FM standards for Walk-Ins and Refrigerated Buildings without sprinklers. (Local codes vary)



National Sanitation Foundation

Bally installations that incorporate floor panels with a 3/8" coved offset are Certified by NSF.



New York City

Stringent tests on our insulation have earned Bally panels the Materials and Equipment Approval of the City of New York. To conform to the standards Bally makes special wiring systems and low-voltage heaters when needs dictate.



City of Houston

Tests on our panels have earned Bally the City of Houston Approval.



Miami Dade

Bally has received approval from Miami-Dade County, Florida NOA # 12-0313.02 Expires: 2.7.2018



Contact factory regarding other approvals.

DOORS

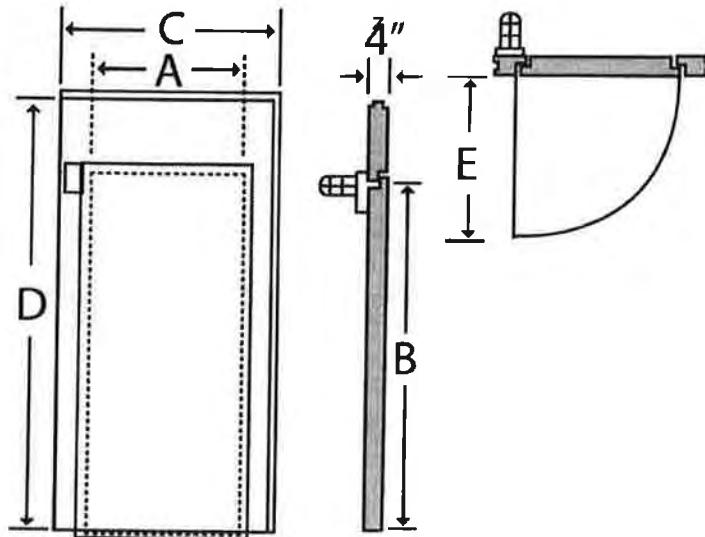
DEPEND ON BALLY FOR LONG LIFE AND RELIABLE SERVICE

Our doors use the same construction as our panels: rigid insulation foamed-in-place and securely bonded to metal skins for tremendous structural strength. A reinforced U-channel steel frame with a thermal breaker prevents twisting, sagging, and eliminates the need for structural members. The durability of this construction results in an exceptionally strong door.

- Bally doors include fingertip-touch latch with lock set. A magnetic gasket provides a snug seal.
- Heater wires concealed in the perimeter of Bally door jambs prevent the formation of condensation or frost.
- Bally offers a wide selection of sizes and options.

DIMENSIONAL DATA:

Hinged Entrance Door Panels



120V., 60Hz., 1 Phase service is required for lights and anti-condensate heaters on door panels (220V. available). Connections are made to the junction box at the light, which is always inside the Walk-In, directly opposite the top hinge.



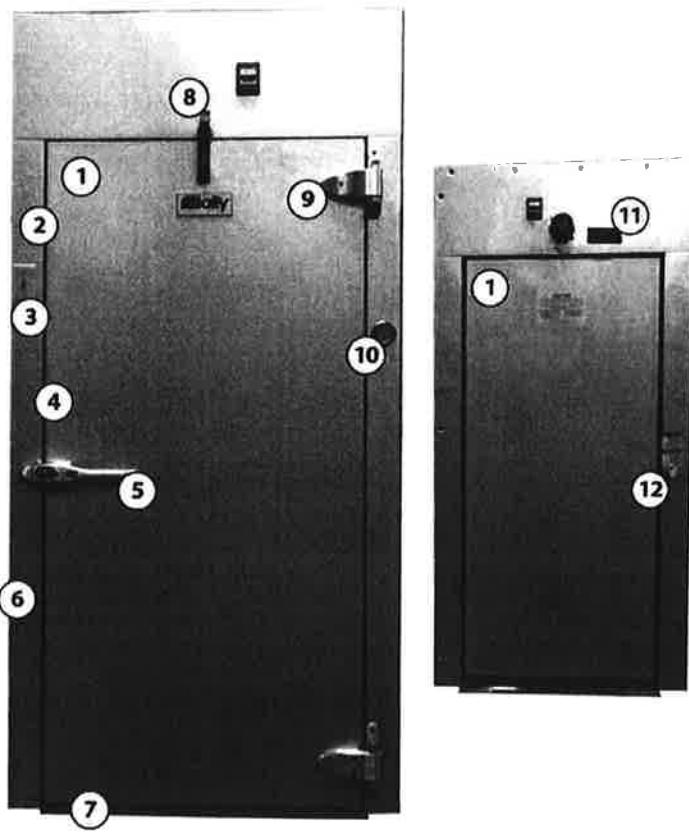
	Door Opening		Door Panels Used w/Floor Panels			Total Amps **
	A	B	C*	D	E	
7'6" High Walk-In	2'6"	6'6"	3'10"	6'10"	3'1"	3.14
	2'6"	6'6"	5'9"	6'10"	3'1"	3.14
	3'0"	6'6"	3'10"	6'10"	3'7"	3.56
	3'0"	6'6"	5'9"	6'10"	3'7"	3.56
	3'6"	6'6"	5'9"	6'10"	4'1"	3.35
	4'0"	6'6"	5'9"	6'10"	4'7"	3.18
	5'0"	6'6"	5'9"	6'10"	5'6"	3.94
	2'6"	6'6"	3'10"	7'10"	3'1"	3.14
	2'6"	6'6"	5'9"	7'10"	3'1"	3.14
	2'6"	7'0"	3'10"	7'10"	3'1"	3.65
	2'6"	7'0"	5'9"	7'10"	3'1"	3.65
	3'0"	6'6"	3'10"	7'10"	3'7"	3.65
	3'0"	6'6"	5'9"	7'10"	3'7"	3.65
	3'0"	7'0"	3'10"	7'10"	3'7"	3.46
	3'0"	7'0"	5'9"	7'10"	3'7"	3.46
8'6" High Walk-In	3'6"	6'6"	5'9"	7'10"	4'1"	3.35
	3'6"	7'0"	5'9"	7'10"	4'1"	3.26
	4'0"	6'6"	5'9"	7'10"	4'7"	3.18
	4'0"	7'0"	5'9"	7'10"	4'7"	4.24
	5'0"	7'0"	5'9"	7'10"	5'6"	3.85

**Total amps include anti-condensate heaters and one 32-watt compact fluorescent light.

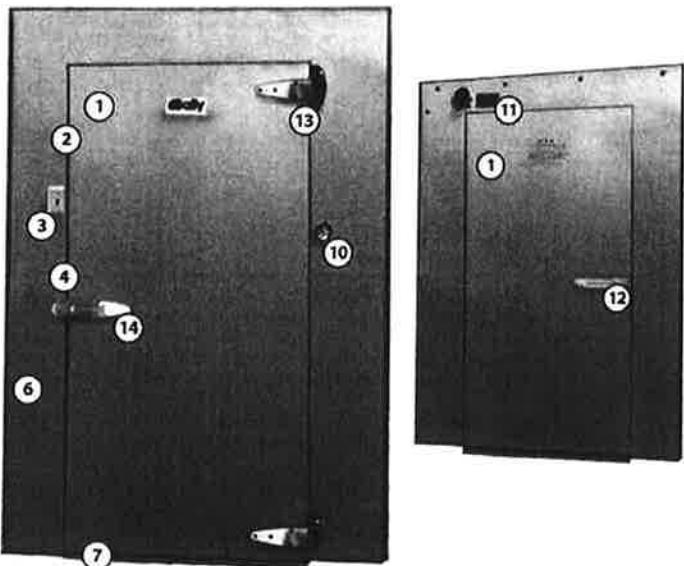
*Consult factory for details. 4'9½" door panel available for 30", 36", 42" and 48" door openings requiring special locations. For 6'6" Walk-Ins, 5'6" high door openings can be supplied. Partition door panels, when used with floor panels, are identical to exterior door panels except that the stepplate is flush. For Walk-Ins higher than 8'6", an additional filler wall panel is used above an 8'6" high door panel.

DOORS

STANDARD HINGED 30"-36" & 42" DOORS



STANDARD 48" & 60" WIDE DOORS



1. Inside and outside doorcaps are die-formed (See page 4 for available finishes).
2. Magnetic gasket of soft compression plastic with magnetic core keeps door tightly sealed.
3. Toggle switch with pilot light for interior light.
4. Heater wires are concealed around perimeter of the door frame to prevent formation of frost or condensation.
5. Fingertip-touch latch with lock set easily opens the door. Available with special provision for padlocking. *Finish matches hinges.*
6. Bally insulation in 4", 5", or 6" thickness.
7. Dual wiper-type gasket at the bottom of the door provides a tight seal.
8. Door closer.
9. Hinges with zinc-plated steel pins and Delrin bushings are cam-action, spring-loaded, and self-closing. Supplied with protective plastic caps. *Finishes: Satin, polished aluminum, or chrome-finish.*
10. Built-in, flush-face, dial type thermometer (*Field mounted in 60" doors.*)
11. Serial number tag; use as reference for future orders.
12. Inside safety release.
13. Strap-type hinges. *Finishes: Satin, polished aluminum, chrome finished cast metal.*
14. Positive door latch.

SUPER DOORS

For the most rugged applications, these hinged doors are shielded inside and outside by Diamond Tread kickplates, and are provided with extra support by an added third hinge. The Super Door is designed to take hard use with little or no damage, especially in high-traffic locations. Available in all standard sizes and with many options.



DOORS

STANDARD FEATURES

BUILT-IN THERMOMETER

Flush-face, dial-type thermometer mounted with each 30", 36", 42", and 48" wide entrance door. Dual temperature readings from -60°F (-50°C) to 80°F (30°C). (60" doors require field mounting.)



INSIDE SAFETY RELEASE

All locks are connected to a safety release mounted inside the Walk-In. Turning the handle allows for immediate release. (Supplied on 30", 34", 36", and 42" doors. Field mounted on 48" & 60" wide doors.)



SELF-CLOSING HINGES (30", 34", 36", 42" WIDE DOORS)

Bally cam-action, spring-loaded hinges are built to last with zinc-plated steel pins, Delrin bushings, and protective plastic caps. Finishes: satin or polished aluminum.



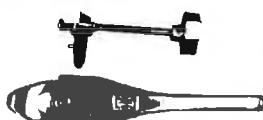
STRAP HINGES (48" AND 60" WIDE DOORS)

These heavy-duty strap-type hinges give extra support, with three supplied on each door. Finishes: satin or polished aluminum.



DOOR LATCH (30"- 36" AND 42" WIDE DOORS)

Bally's fingertip-touch latch easily opens our standard doors. The latch includes a key lock. Finishes match hinges.



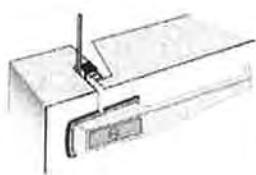
POSITIVE DOOR LATCH (48" AND 60" WIDE DOORS)

Sturdy latches are rugged for use with bigger doors. Finishes match hinges.



DOOR HEATER CIRCUIT

A heating circuit mounted in the door jamb prevents moisture buildup in Coolers and frost formation in Freezers.



OPTIONS

OBSERVATION WINDOW

Bally observation windows are made of tempered glass and electrically heated to eliminate condensation (115V, .87 amps). Windows are 14" wide x 24" long, or 14" x 14".



PRESSURE RELIEF PORTS

Pressure relief ports allow air pressure inside the building to equalize with air pressure on the outside. The difference in pressure results from temperature changes that occur immediately following coil defrost, or opening the entrance door. Without the port, wall or ceiling panels could be seriously damaged. (Required on all Freezer applications.)



DIGITAL THERMOMETERS AND ALARMS

Digital thermometers may be selected in place of the standard dial type. Each incorporates a visual signal and sounds an alarm when temperatures rise above acceptable limits. (Indoor applications only.) Electronic temperature alarms are also available.



LOCKING BARS

Locking bars are available for all Bally hinged entrance doors. The bars protect against theft especially for outdoor installations. Even if hinges are removed, the bar prevents the door from opening.

STRIP CURTAINS

Bally's NSF Certified vinyl strip curtains minimize air infiltration and temperature loss. Polyester reinforced clear vinyl strips are 8" wide with rounded edges and USDA-approved. Use for temperatures as low as -20°F. Hinged Doors: 30", 36", 42", 48", and 60" widths. Manual Sliding Doors: 36", 48", and 60" widths. Panels sized 6' x 8'.

See Section 4 for more accessories.

FLOOR CONSTRUCTION

GENERAL INFORMATION

Bally can provide design recommendations for many kinds of floor construction. For most installations we recommend Bally floor panels on a properly-prepared base or built-in insulated floors.

An engineer familiar with the circumstances of the individual installation is responsible for the review and approval of all plans because requirements vary widely with individual site conditions and local construction regulations.

INSULATION THICKNESS FOR BUILT-IN FLOORS

When temperatures within the Walk-In or Refrigerated Building are:

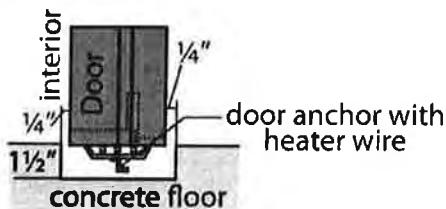
- Above 32°F (0°C): one layer of 2" thick sheet urethane required if Cooler is not on ground floor. *Recommended in all other Less Floor applications.*
- Below 32°F (0°C): two layers of 2½" thick urethane (*At least R-32 minimum as required by EISA 2007*).

In either case, joints must be staggered when urethane is incorporated with Bally built-in insulated floors.

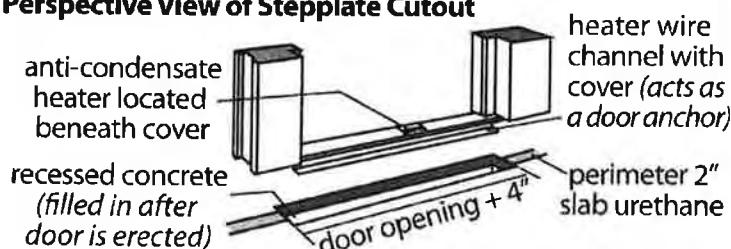
MAXIMUM LOADS ON BALLY FLOOR PANELS

Bally floor panels are designed to withstand uniformly distributed stationary floor loads up to 600 pounds per square foot (psf). Whenever loads exceed these weights, Bally will review and recommend the appropriate solution for the load. Whenever carts are used Bally recommends the use of Diamond Tread overlays or thick-set quarry tile. Reinforced floors with internal "I" Beam support and 3/16" Diamond Tread overlay are also available for higher rolling weight requirements.

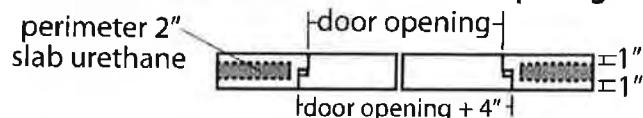
Section View of Steplate Cutout:



Perspective View of Steplate Cutout



Detail of Perimeter Insulation at Door Openings



1 800 24BALLY | www.ballyrefboxes.com

NSF CERTIFIED FLOOR

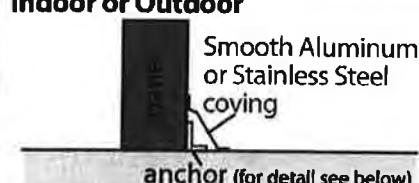
With Floor



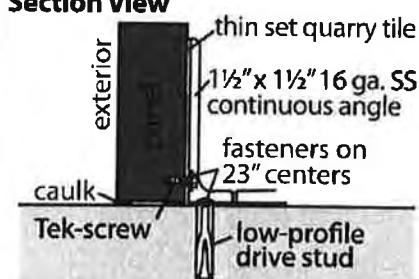
Less Floor (Indoor Only)



Indoor or Outdoor

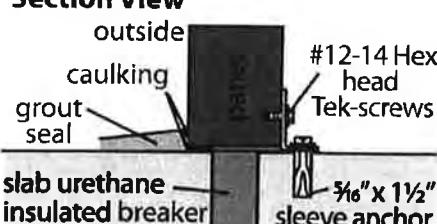


Section View

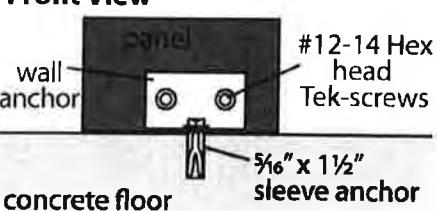


VERTICAL PANEL ANCHORING

Section View



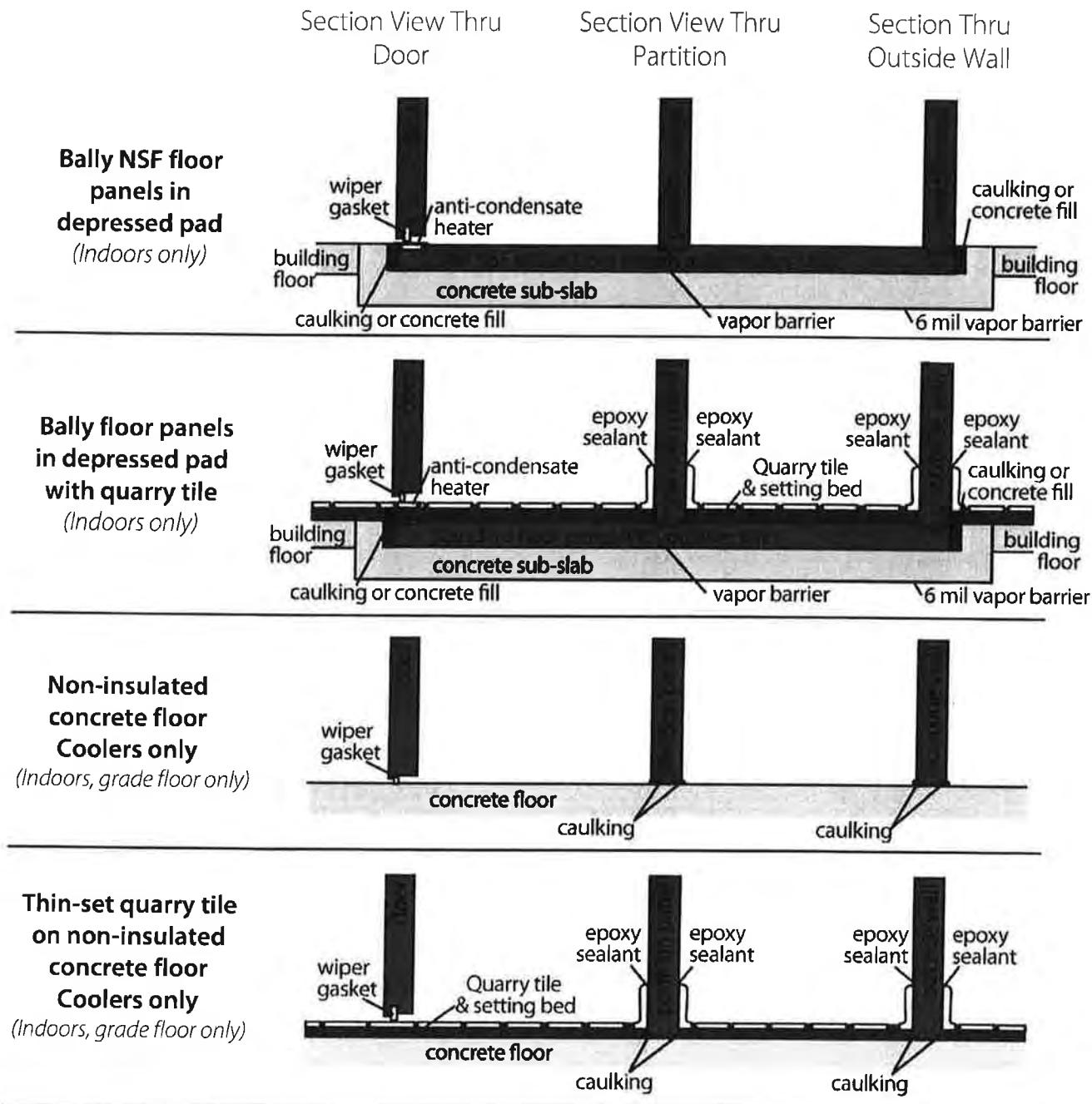
Front View



FLOORS

Additional under-floor heating and venting may be required to prevent frost heaving of the floor depending on the size, temperature of application, and location of the structure. (Dimensions shown are for 4" panels; if 5" or 6" panels are used, adapt drawings accordingly by adding 1" to inside of wall thickness.)

An engineer familiar with the circumstances of the individual installation is responsible for the review and approval of all plans because requirements vary widely with individual site conditions and local construction regulations.

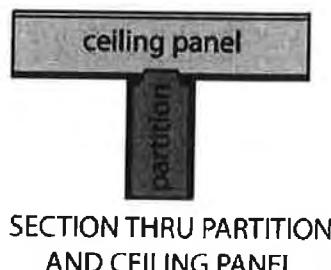
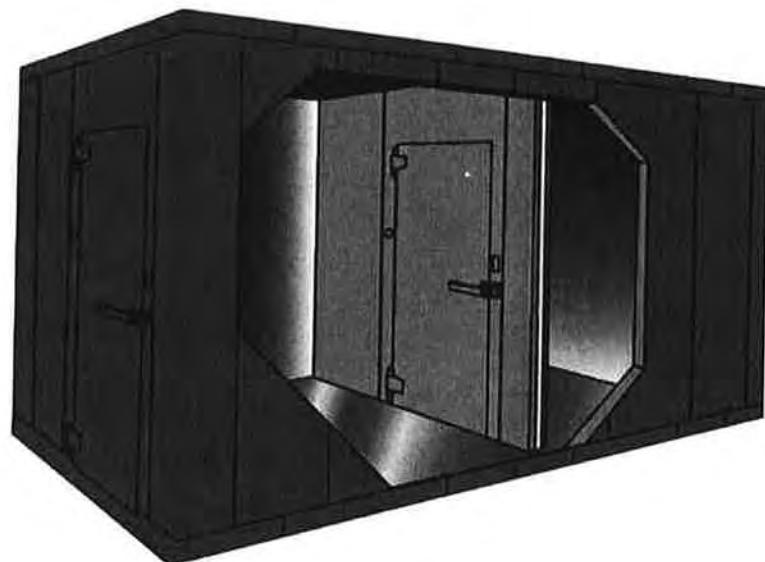


ACCESSORIES

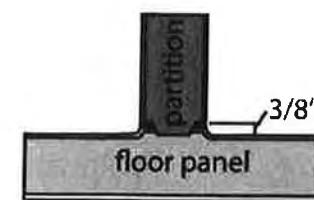
PARTITIONS

Bally's partition panels allow the creation of compartments within a Walk-In. Constructed like our standard wall panels, partition panels are fast and easy to install. Floor, ceiling and wall panels abutting the partitions contain built-in breaker strips, minimizing conductivity between compartments, and eliminating moisture or frost at partition joints. Bally recommends caulking all partition walls, ceilings, and floors when the compartments are a Cooler/Freezer combination.

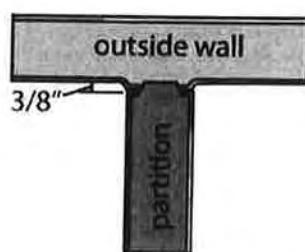
To gain full advantage of partition breaker strips, ceiling and floor panels should run in the same direction as the partitions. Standard partitions are centered on 23" or 46" wall panels making it possible to locate partitions at distances in multiples of 5 $\frac{3}{4}$ " from either end. Partitions may also be installed at right angles to other partition panels to form rooms.



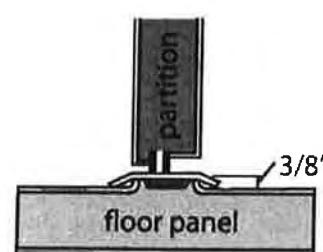
SECTION THRU PARTITION
AND CEILING PANEL



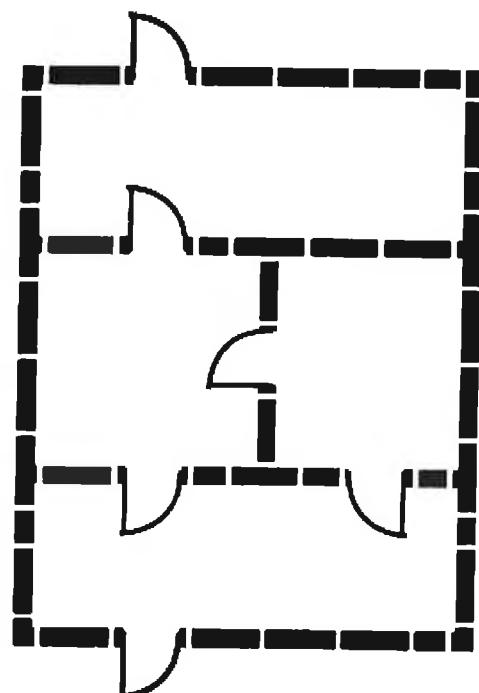
SECTION THRU PARTITION
AND FLOOR PANEL



SECTION THRU PARTITION
AND WALL PANEL



SECTION THRU PARTITION
DOOR AND FLOOR

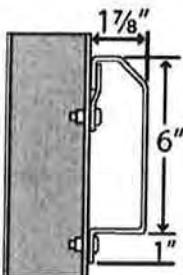


Example of partition walls within a Walk-In.

ACCESSORIES

RUB RAILS

For wall protection in heavy use areas, choose rub rails, in single rows or pairs at any height. Smooth aluminum or stainless steel finishes.



BUMPER GUARDS

Vinyl bumper guards can be installed where lighter wall impacts are expected. The guards are specially developed to be non-marking and highly resistant to impact and abrasion.



COMPACT FLUORESCENT & LED VAPORPROOF LIGHTS

Vaporproof lights (one is provided standard with each door section) are constructed with cast aluminum bodies, porcelain sockets and Lexan globes.



TEMPERATURE ALARMS

Protect stored goods with temperature alarms that use visual signals and sounds when temperatures rise above set limits. Bally offers several types, including digital and electronic varieties.



PRESSURE RELIEF PORTS

Pressure relief ports allow air pressure inside the building to equalize with air pressure on the outside. The difference in pressure results from temperature changes that occur immediately following coil defrost, or opening the entrance door. Without the port, wall or ceiling panels could be seriously damaged. (Required on all Freezer applications.)

Walk-In Freezers
less than 400ft²



Walk-In Freezers
larger than 400ft²

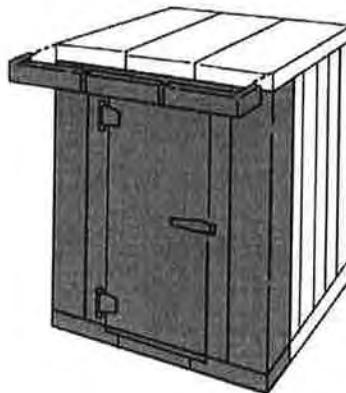
FLUORESCENT & LED LIGHTS

These fixtures provide diffused fluorescent or LED light, and remain protected from moisture and breakage to temperatures as low as -20°F (-29°C). The high-impact plastic housings are molded with plain surfaces that shed dirt and water.



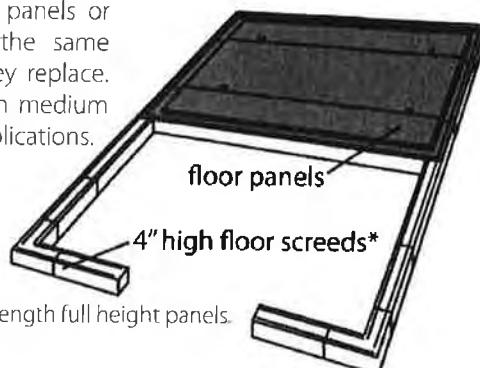
FLOOR AND CEILING EDGE CAPS

When an exterior front or side is finished with a metal different than the rest of the Walk-In, the exposed edges of the floor and ceiling panels may require edge caps.



4" FLOOR SCREEDS

Multi-compartment Walk-Ins without floors may be supplied with extended length panels or insulated screeds of the same height as the floor they replace. Screeds can be used in medium or low temperature applications.



*Or extended length full height panels.

SPECIFICATIONS

Sectional Walk-In Refrigerators and/or Freezers complete with doors shall be manufactured by Bally Refrigerated Boxes, Inc. All work and materials shall be in full accordance with local and/or state ordinances, and with any other prevailing rules and regulations. Bally is not responsible for furnishing items required by the regulations, unless specified or shown on the drawings or contained in the specifications.

Overall Walk-In Dimensions:

Lengths: 5'10", 6'9½", 7'9", 8'8½", 9'8", 10'7½", 11'7", 12'6½", 13'6", 14'5½", 15'5", 16'4½", 17'4", 18'3½", 19'3", 20'2½", 21'2", 22'1½", 23'1", 24'½", 25'0", 25'11½", 26'11", 27'10½". Longer buildings available in additional 11½" increments.

Widths: 5'10", 6'9½", 7'9", 8'8½", 9'8", 10'7½", 11'7", 12'6½", 13'6", 14'5½", 15'5", 16'4½", 17'4", 18'3½", 19'3", 20'2½", 21'2", 22'1½", 23'1", 24'½", 25'0", 25'11½", 26'11", 27'10½". Wider buildings available in additional 11½" increments.

Heights: (Heights shown are with floor; subtract 4" for less-floor units): 7'6", 8'6", 9'6", 10'6", 12', 13', 14', 15', 16', 17', 18', 19', 20'4", 21'4", 22'4", 23'4", 24'4", 25'4", 26'4", 27'4", 28'4". (Single length verticals)
Taller buildings available in 12" increments, with stacked vertical panels.

1. SPEED-LOK

Panels shall be equipped with Bally Speed-Lok diaphragmatic joining devices. Each device shall consist of a hooked locking arm, and a steel rod positioned less than 46" apart in the adjoining panel. When the arm is rotated, the hook engages the rod and draws the panels tightly together. Arms and rods are housed in individual steel pockets, and joined together by the use of 2" wide metal straps foamed into the insulation; forming lock-to-lock connections for extra strength.

2. PANELS

Foam core panels shall be UL listed as having flame spread of 25 or lower and smoke generation of 450 or lower when tested in accordance with ASTME-84. Panels shall be approved by Factory Mutual as a Class I building type. They shall be foamed using HFC expanding agents and shall comply with EISA 2007, and all current international standards.

Panels shall consist of interior and exterior metals skins precisely foamed and thoroughly checked for accuracy. The metal skins shall be placed into heated molds and liquid urethane injected between them. For extra rigidity, the exteriors of all vertical panels above 130" except corners and door panels shall have vertical grooves (*beading*) spaced on 5¾" centers. Urethane shall be foamed-in-place (*poured, not frothed*) and, when completely heat cured, shall bind tenaciously to the metal skins to form an insulated panel. Panels shall have no internal wood or structural members between the skins. Panel edges have foamed-in-place tongues and grooves with a flexible vinyl gasket on the interior and exterior of all tongue edges. Gaskets shall be resistant to damage from oil, fats, water and detergents and must be NSF Certified.

Panel Sizes: Thicknesses 4", 5", 6"

Widths Vertical, Ceiling, Floor panels: 23", 46", (11½", 17¼", or 34½" if required)
Corner panels: 12" x 12" exterior right-angle configurations

Heights Vertical panels: single lengths up to 28' high (16' for Aluminum or Stainless steel).
Outdoor applications: single-height panels above 19' (16' for aluminum) or multi-tiered vertical panels are secured to horizontal girts mounted between building columns.

Exterior Finishes: Stucco-Embossed Galvalume steel, Stucco-Embossed Aluminum, Stucco-Embossed White galvanized steel, Smooth White galvanized steel, Stainless steel, Stucco-Embossed White Aluminum, Smooth White aluminum, Stucco-Embossed Stainless steel, Stucco-Embossed Sand-tan galvanized steel, Galvanized steel

Interior Finishes: Stucco-Embossed Galvalume steel, Stucco-Embossed Aluminum, Stucco-Embossed White Galvanized steel, Smooth White Galvanized steel, Stainless steel, Stucco-Embossed White aluminum, Smooth White Aluminum

3. FLOORS

Floor Construction: Bally furnishes floor panels only. All construction and preparation for Bally floor panels must be provided by others. Floor panel construction similar to panels but with a heavier-gauge interior skin. 4" thick floor panels have the option of being NSF Certified; trim is available for 5", and 6" floors allowing them to be NSF Certified.

Light-usage Floor

Floor panels placed on a concrete (*depressed concrete if needed*) pad and leveled.

Heavy-usage Floor

Floor panels shall be placed on a depressed concrete pad and leveled. Supporting steel assembled, and a 4" concrete wearing floor is poured.

**Built-in, Insulated Floor
(constructed at job site)**

Depressed, reinforced concrete sub-slab, with built-in slab urethane. Tile floor or 4" concrete wearing floor installed above and fastened to wall panels. (*Drainage, ventilation, or other heat sources must be provided.*)

Reinforced Floor Panels

4" insulated floor panels contain non-conductive structural imbeds for maximum strength without freezing. Panel overlays add strength.

Floor Panel Finishes

16 ga. Stainless steel, .080 Rigidized Aluminum, .100 Smooth Aluminum, 16 ga. Galvanized Steel, .125 Aluminum Diamond Tread, .060 Rigidized Stainless Steel

4. DOORS

Hinged Entrance Door Panels (*Number of doors, location and direction of swing is specified on the plans*) Thermoplastic gaskets with magnetic cores installed on the top edge and both sides of the door keep the door in a closed position, forming a tight seal. A flexible, dual blade wiper gasket is installed at the bottom of the door. NSF Certified gaskets are replaceable and resistant to damage from oil, fats, water and detergent. A heavy U-channel structural steel frame around the perimeter of the door opening prevents racking or twisting; and reinforced for hardware attachment. Anti-condensate heater wire is concealed behind metal edge of the doorjambs. The door panel includes a vapor-proof interior lamp; junction box for 120v., 60 cycle, 1 phase, a.c. service (*15 amp maximum*); 2" dia. flush-face dial thermometer (*field mounted on 60" wide doors*); and weather hoods for outdoor installations.

Widths 30" 36" 42" 48" 60"

Heights 78" 84"

Hardware 24", 30", 34", 36", 42" wide openings 2 spring-loaded, self-closing hinges; cylinder latch (*includes safety release and provision for padlock*); door closer.

48", 60" wide openings Uplift-type hinges at least 9" long; latch (*includes safety release and provision for padlock*)

Hardware Finishes Polished aluminum (*Stainless steel Walk-Ins*)
Satin aluminum (*non Stainless steel Walk-Ins*)

Door Options Super Entrance Door Construction identical to standard doors with added third hinge and interior/exterior Diamond Tread kick-plates.

Observation Window Constructed of tempered glass, and electrically heated to eliminate condensation (*115V, .87 amps*). 14" x 24" or 14" x 14".

Deadbolt Handle Latch Security latch with sliding deadbolt using cylinder or padlock.
Strip Curtain Sturdy, NSF Certified, clear-vinyl strip curtains permit easy passage while minimizing air infiltration

Double-swing Cart Door Single or double leaf models minimize heat entry, and are mounted on sturdy steel frames for easy field installation.

Reach-in Doors 18½" x 30" or 30" x 30" Single or Double

Glass Display Doors Provide maximum display and easy accessibility.

5. OPTIONS

Pressure Relief Ports (*required for all Freezers*) Equalizes inside and outside air pressure

Partition Walls Constructed like our wall panels, partition panels allow creation of compartments within a Walk-In. Floor, ceiling, and wall panels abutting the partitions contain built-in breaker strips, minimizing conductivity between compartments, and eliminating moisture or frost at partition joints.

Roof Options (*One of the following types must be used for any outdoor installation*):

Sectional prefab metal roof: Panels for outdoor structures 34'7" wide x any length.

Single-piece, pre-sized membrane roof system; maximum dimensions: 34'7" x 34'7"

Built-up type by others

Alarm Systems Audio-Visual Alarm System

Audio-Visual Alarm with digital temperature readout, Hi set point only

Audio-Visual Alarm with digital temperature readout, Hi/Low set point with dry contact

Shelving Cantilevered or Freestanding

Lengths: 36", 48", 60" (*Custom lengths available*.)

Widths: 14", 21"

Finishes: Chrome, Epoxy, Stainless Steel, Flat & Louvered Stainless

Other options available, consult factory for details.

6. REFRIGERATION

Mechanical Refrigeration (*For multi-compartment units, provide plan view with compartment temperatures*)

- Hermetic
- Semi-hermetic
- Scroll
- Water Cooled
- Preassembled Remote
- Self-contained

Condensing units: located indoor or outdoor with optional Low-ambient kits for winter controls

7. WARRANTIES

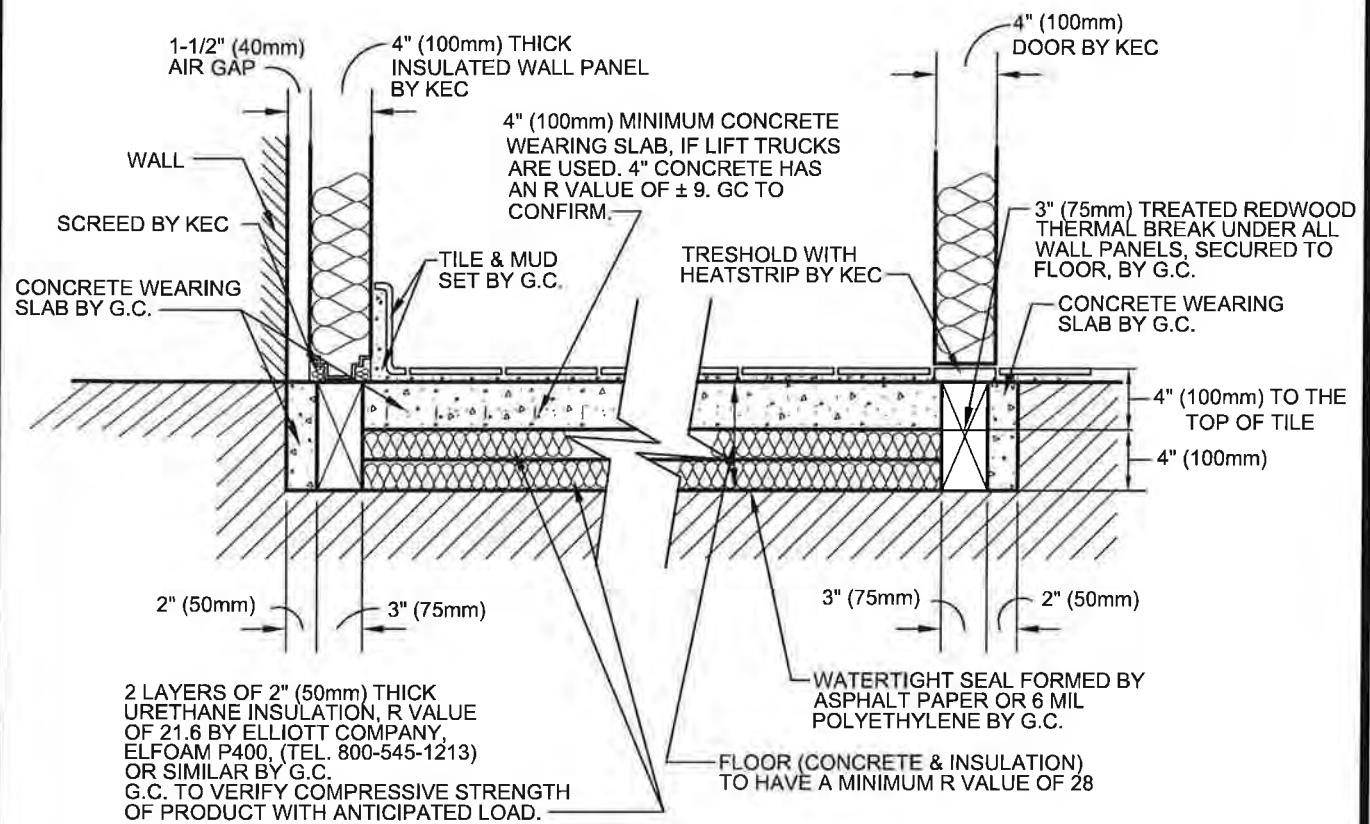
Bally shall warrant that any part of the structure it supplies (*except the refrigeration system and its related accessories*) is free from defects in materials or workmanship under normal use and service as follows:

Panels The insulated panel portion of the structure is warranted free from defects under normal use and service for a period of 10 years from date of installation (*but in no event shall the warranty be in force for more than 10 years and 6 months from the date the product was first shipped by Bally*).

Finish Panel surface condition is warranted free from defects under normal use and service for 1 year from installation, provided the panel is stored and installed according to Bally's instructions.

Components Mechanical (*including hardware, gasketing, Speed-Lok assemblies, aluminum weather roofs*) and electrical components, except refrigeration systems (*which are covered by a separate warranty*) are warranted to be free from defects under normal use and service for one year from date of installation. (*In no case shall this portion of the warranty be in force for more than 1 year and 6 months from the date the product was first shipped by Bally*.)

The warranty shall not include any labor charges for replacement or repair of defective parts or refrigeration. Full warranty information is to be provided with the Walk-In.



NOTE:

FOR FREEZER OF OVER 400 SQUARE FEET ($36m^2$), G.C. TO PROVIDE HEATING ELEMENT AND/OR VENTING SYSTEM UNDER SLAB AS DIRECTED BY WALK-IN MANUFACTURER

 NATIONAL REFRIGERATION AND AIR CONDITIONING CANADA CORP. 159 ROY BLVD, PO BOX 2020 BRANTFORD, ON CANADA N3T 5Y6				BLP211MA-S1B_ECM LOW PROFILE EVAPORATOR																																																																																																																			
PURCHASER : PROJECT : ORDER # : 03658.42894.00095P-A00 QUOTE # : Q07ANBSA-A PURCHASER'S PO # :				SUBMITTED BY : BILL STOMPF DATE : 07 Jan 2015 ITEM # : 1 ID # : TAGGING : COOLER																																																																																																																			
MODEL FEATURES																																																																																																																							
<ul style="list-style-type: none"> • 3/8" Tubing coil construction (reduces refrigerant operating charge) • Factory installed solenoid valve wire harness • Heavy gauge textured aluminum cabinet construction resists scratches/corrosion • Spacious piping end compartment allows for easy assembly 				<ul style="list-style-type: none"> • Hinged drain pan with central universal drain connection (3/4" drain) • Front access to spacious electrical and header compartments • Schrader connection on suction header • Attractive and durable high density polyethylene fan guards • Ultra efficient Electronically Commutated Motor (ECM) • ** ECM with SmartSpeed Technology • High efficiency enhanced copper tube and aluminium fin coil design • 6 FPI 																																																																																																																			
MODEL OPTIONS (* = Shipped Loose)																																																																																																																							
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VOLTAGE 115/1/60		SYSTEM REFRIGERANT R404A		AIR FLOW 1910 CFM		EVAP. TEMP 25 °F		BOX TEMP 35 °F		CAPACITY 11000 BTUH																																																																																																													
FANS			HEATERS			CIRCUIT TOTAL																																																																																																																	
QTY	POWER	FLA/FAN	TYPE	QTY	AMPS		AMPS	WATTS	MCA†	MOP‡																																																																																																													
2	0.07HP	1					2	120	2.3	15																																																																																																													
							2	120	2.3	15																																																																																																													
DISTRIBUTOR SUCTION		1/2 in 7/8 in	SOUND WEIGHT	- 74 lb	REC CAPACITY REF CHARGE	2 lb																																																																																																																	
NOTES: † MCA.. Minimum Circuit Ampacity, ‡ MOP.. Maximum Overcurrent Protection											APPROVALS																																																																																																												
  																																																																																																																							
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NATIONAL REFRIGERATION AND
AIR CONDITIONING CANADA CORP.
159 ROY BLVD, PO BOX 2020
BRANTFORD, ON
CANADA N3T 5Y6

Order Item No: 1

BLP211MA-S1B_ECM

LOW PROFILE
EVAPORATOR

NATIONAL REFRIGERATION will furnish equipment in accordance with this drawing and specifications, and subject to its published warranty. Approval of this drawing signifies that the equipment is acceptable under the provision of the job specifications. Any change made hereon by any person whomsoever subject to acceptance by NATIONAL REFRIGERATION at its home office.

Dimensions shown are for standard unit less options.

DIMENSIONS	
DIMENSION A	46 1/4 in
DIMENSION B	33 1/4 in
DIMENSION C	
DIMENSION D	
DIMENSION E	
DIMENSION F	
DIMENSION G	0 in
DIMENSION H	

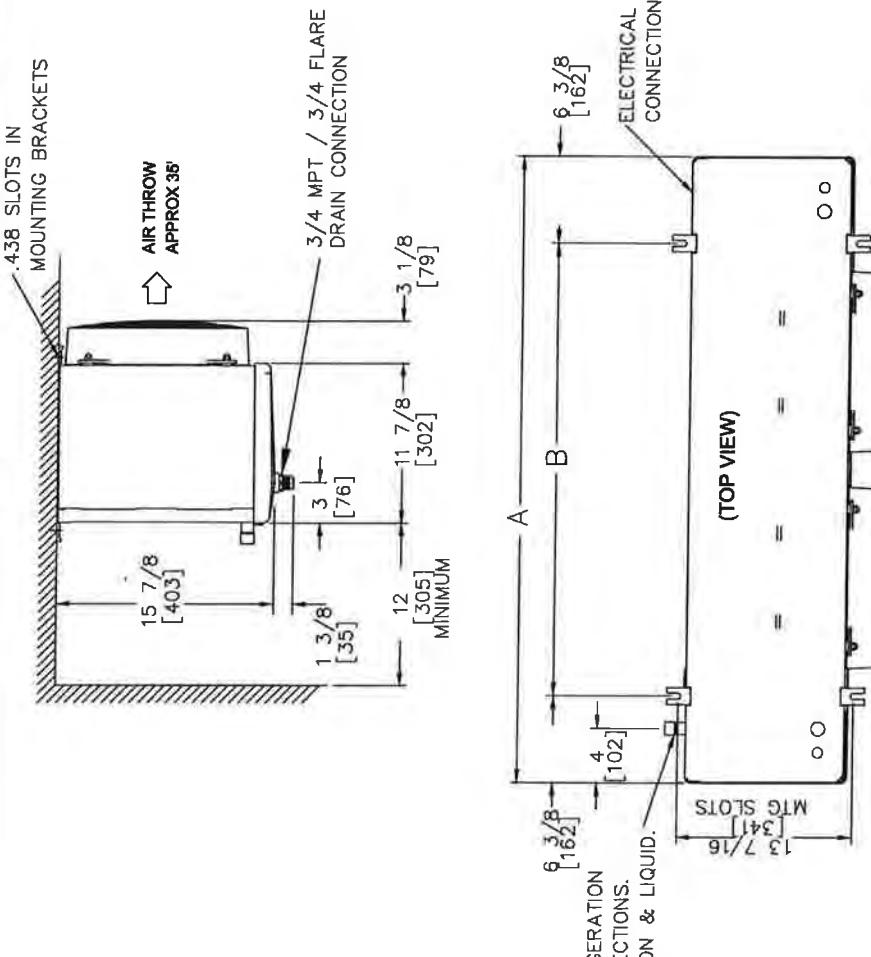
CONNECTIONS

DISTRIBUTOR	1/2 in
SUCTION	7/8 in
DRAIN	3/4 in
WATER	
DISCHARGE	
PAN LOOP	
HOT GAS SIDE PORT	
HOT GAS INLET	
HOT GAS OUTLET	
OTHER	
SHIPPING WEIGHT	74 lb
REFRIGERANT CHARGE	2 lb
RECEIVER CAPACITY	

APPROVALS



NOTES:



 NATIONAL REFRIGERATION AND AIR CONDITIONING CANADA CORP. 159 ROY BLVD, PO BOX 2020 BRANTFORD, ON CANADA N3T 5Y6		BXHA010E6-IT3A COAX WATER-COOLED HERMETIC CONDENSING UNITS-WTR							
PURCHASER : PROJECT : ORDER # : 03658.42894.00095P-A00 QUOTE # : Q07ANBSA-A PURCHASER'S PO # :		SUBMITTED BY : BILL STOMPF DATE : 07 Jan 2015 ITEM # : 2 ID # : TAGGING : COOLER							
<ul style="list-style-type: none"> • Adjustable dual high / low pressure control • Copper tubing secured with cushion clamps • Pre-formed piping 		MODEL FEATURES <ul style="list-style-type: none"> • Receiver with fusible plug and liquid shut off valve • Suction Service valve • Units are shipped with Helium holding charge • Co-Axial Water-Cooled Condenser • Water regulating valve shipped loose • Electrical control box with compressor contactor and fused control circuit 							
PRE-ENGINEERED OPTION PACKAGE <input type="checkbox"/> A - STD <input checked="" type="checkbox"/> 1 <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> F <input type="checkbox"/> H DEFROST FUSING - SHOW SET QTY <input type="checkbox"/> Up to 30 Amps <input type="checkbox"/> 35 Amps to 60 Amps		MODEL OPTIONS (* = Shipped Loose) BALL VALVE <input type="checkbox"/> *Liquid Line CAPACITY CONTROL - HOT GAS BYPASS <input type="checkbox"/> To Inlet of Evaporator <input type="checkbox"/> To Suction Line Compressor Circuit Breaker <input type="checkbox"/> Compressor Time Delay Relay Crankcase Heater CUPRONICKEL (CUNI) CONDENSER <input type="checkbox"/> Standard Configuration DISCONNECT SWITCH <input type="checkbox"/> Fused <input type="checkbox"/> Non-Fused Export Crating Extended 4-Year Compressor Warranty <input type="checkbox"/> Extended Leg Kit LIQUID LINE FILTER + SIGHT GLASS <input checked="" type="checkbox"/> Sealed Liquid Line Lock-Out Relay LIQUID LINE SOLENOID VALVE <input type="checkbox"/> *Standard 230V Coil <input type="checkbox"/> *Standard 115V Coil							
ELECTRIC DEFROST KIT (TIMECLOCK INCL.) <input type="checkbox"/> Up to 40A Htrs, 30A Fans 1 Evap <input type="checkbox"/> Up to 60A Htrs, 30A Fans 1 Evap <input type="checkbox"/> Up to 40A Htrs, 30A Fans 2 Evap <input type="checkbox"/> Up to 60A Htrs, 30A Fans 2 Evap 115V Control Circuit 30A Contactor 40A Contactor 60A Contactor ADJUSTABLE PRESSURE CONTROLS <input type="checkbox"/> Johnson Dual with flex hose		<input type="checkbox"/> Oversized Receiver PHASE / VOLTAGE MONITOR <input type="checkbox"/> 3-Lead <input type="checkbox"/> 6-Lead (MotorSaver455) Pump Down Toggle Switch Receiver Inlet Ball Valve Single Point Electrical SUCTION ACCUMULATOR <input type="checkbox"/> With Heat Exchanger <input type="checkbox"/> Without Heat Exchanger SUCTION FILTER <input type="checkbox"/> Sealed Type TIME CLOCK <input type="checkbox"/> Paragon 8145 Style <input type="checkbox"/> *230V Paragon 8145 Style <input type="checkbox"/> *115V Paragon 8145 Style WATER REGULATING VALVE <input checked="" type="checkbox"/> *Standard Duty <input type="checkbox"/> QuickVac Valves							
ADJUSTABLE T-STATS <input type="checkbox"/> *Danfoss									
VOLTAGE 208-230/3/60		SYSTEM REFRIGERANT R404A							
FANS		SUCTION TEMP 25 °F							
		COND TEMP 105 °F							
		CAPACITY 9740 BTUH							
		CIRCUIT TOTAL							
QTY	POWER	FLA/FAN	AMPS						
		0	RST70C1E-TA5-202	1	4.2	31	4.2	5.3	15
	3/8 in	SOUND	-	REC CAPACITY	5 lb			APPROVALS	
SUCTION	5/8 in	WEIGHT	140 lb	REF CHARGE					
NOTES: † MCA.. Minimum Circuit Ampacity, ‡ MOP.. Maximum Overcurrent Protection									
APPROVED BY :							DATE :		
Approval of this drawing signifies that the equipment is acceptable under the provision of the job specifications. Any change made hereon by any person whomsoever subject to acceptance by NATIONAL REFRIGERATION at its home office.									

Bally

NATIONAL REFRIGERATION AND
AIR CONDITIONING CANADA CORP.
159 ROY BLVD, PO BOX 2020
BRANTFORD, ON
CANADA N3T 5Y6

Order Item No: 2	
BXHA010E6-IT3A	
COAX WATER-COOLED HERMETIC CONDENSING UNITS-WTR	
DATE : 07 Jan 2015	
PURCHASER :	
PROJECT :	
SUBMITTED BY : BILL STOMPF	

NATIONAL REFRIGERATION will furnish equipment in accordance with this drawing and specifications, and subject to its published warranty. Approval of this drawing signifies that the equipment is acceptable under the provision of the job specifications. Any change made hereon by any person whomsoever subject to acceptance by NATIONAL REFRIGERATION at its home office.

Dimensions shown are for standard unit less options.

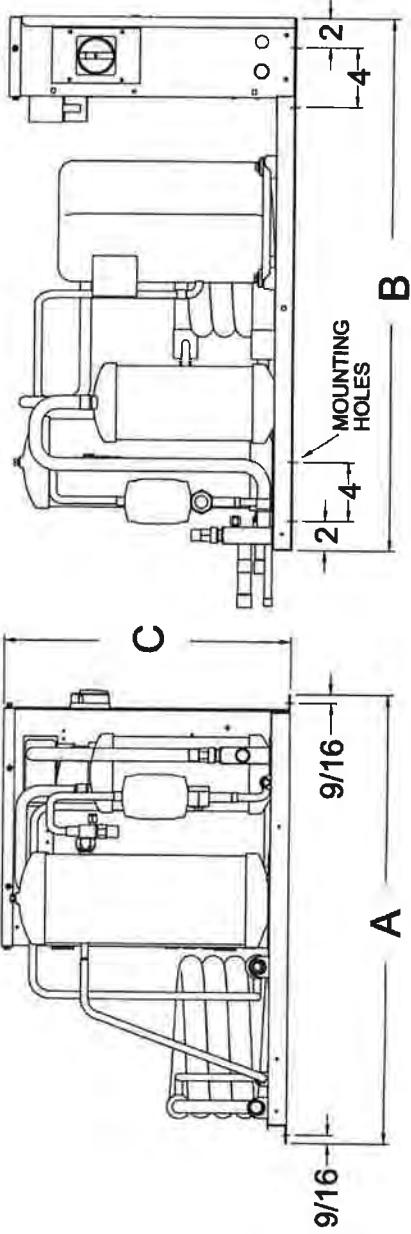
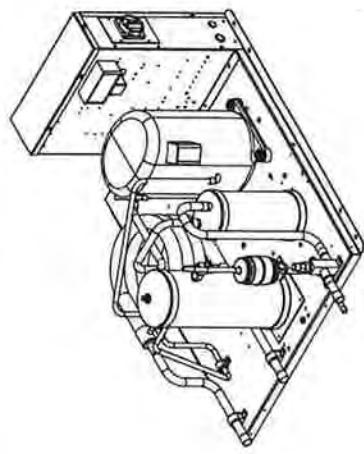
DIMENSIONS	30	3/8 in
DIMENSION A	30	3/8 in
DIMENSION B	24	7/8 in
DIMENSION C	16	1/2 in
DIMENSION D		
DIMENSION E		
DIMENSION F		
DIMENSION G	0	in
DIMENSION H		

CONNECTIONS

SUCTION	3/8 in
DRAIN	5/8 in
WATER	1/2 in
DISCHARGE	
PAN LOOP	
HOT GAS SIDE PORT	
HOT GAS INLET	
HOT GAS OUTLET	
OTHER	
SHIPPING WEIGHT	140 lb
REFRIGERANT CHARGE	
RECEIVER CAPACITY	5 lb

APPROVALS

NOTES:



 NATIONAL REFRIGERATION AND AIR CONDITIONING CANADA CORP. 159 ROY BLVD, PO BOX 2020 BRANTFORD, ON CANADA N3T 5Y6		BLP106LE-S2B_ECM LOW PROFILE EVAPORATOR	
PURCHASER : PROJECT : ORDER # : 03658.42894.00095P-A00 QUOTE # : Q07ANBSA-A PURCHASER'S PO # :		SUBMITTED BY : BILL STOMPF DATE : 07 Jan 2015 ITEM # : 4 ID # : TAGGING : FREEZER	
<p>MODEL FEATURES</p> <ul style="list-style-type: none"> • 3/8" Tubing coil construction (reduces refrigerant operating charge) • Factory installed solenoid valve wire harness • Heavy gauge textured aluminum cabinet construction resists scratches/corrosion • Spacious piping end compartment allows for easy assembly • Hinged drain pan with central universal drain connection (3/4" drain) • Front access to spacious electrical and header compartments • Schrader connection on suction header • Attractive and durable high density polyethylene fan guards • Ultra efficient Electronically Commutated Motor (ECM) • ** ECM with SmartSpeed Technology • High efficiency enhanced copper tube and aluminium fin coil design • 6 FPI 			
PRE-ASSEMBLED EVAP <input type="checkbox"/> Sporlan TXV, LLSV, T-stat <input type="checkbox"/> SmartVapII with Sporlan TXV & Solvly <input type="checkbox"/> Danfoss TXV, LLSV, T-stat <input type="checkbox"/> EEV Kit - Sporlan EEV + Kelvin II <input type="checkbox"/> EEV Kit - Emerson EEV + EX48 <input checked="" type="checkbox"/> KE2 Demand Defrost w/Sporlan TXV <input checked="" type="checkbox"/> KE2 Demand Defrost w/Sporlan EEV <input type="checkbox"/> *KE2 Demand Defrost w/Sporlan TXV <input type="checkbox"/> *KE2 Demand Defrost w/Sporlan EEV <input type="checkbox"/> KE2 Demand Defrost w/KE2 EEV <input type="checkbox"/> *KE2 Demand Defrost w/KE2 EEV		MODEL OPTIONS (* = Shipped Loose) <p>DEMAND DEFROST ELECTRONIC CONTROLLER</p> <p>1 KE2 Therm - Demand Defrost <input type="checkbox"/> *KE2 Therm - Demand Defrost</p> <p>Dual Circuit ELECTRONIC CONTROLLER</p> <p><input type="checkbox"/> KE2 LowTemp+Defrost</p> <p>EXPANSION VALVE</p> <p><input type="checkbox"/> Sporlan TXV <input type="checkbox"/> Emerson TXV 1 Sporlan EEV <input type="checkbox"/> Emerson EEV <input type="checkbox"/> Danfoss TXV</p> <p>EEV SENSOR/TRANSDUCER BRAND</p> <p><input type="checkbox"/> CPC/Emerson <input type="checkbox"/> Other - Specify in Notes</p> <p>ELECTRONIC CONTROLLER</p> <p><input type="checkbox"/> SmartVapII</p> <p>ELECTRONIC SH CONTROLLER FOR EEV</p> <p><input type="checkbox"/> *Sporlan Kelvin II EEV Controller <input type="checkbox"/> *Emerson EEV Controller <input type="checkbox"/> *Other EEV Controller- Specify MFR Model in Notes</p> <p>EVAPORATOR PRISON PACKAGE</p> <p><input type="checkbox"/> Tamper Proof Screws <input type="checkbox"/> Export Crating</p> <p>COIL COATING</p> <p><input type="checkbox"/> ElectroFin Coating <input type="checkbox"/> Heresite Coating</p> <p>FIN AND MATERIAL</p> <p><input type="checkbox"/> Gold Coat Fins <input type="checkbox"/> Copper Fins</p> <p>Insulated Drain Pan</p> <p>KE2 THERM</p> <p><input type="checkbox"/> *SmartGate Router #20695 <input type="checkbox"/> *8 Port Switch #20166 <input type="checkbox"/> *CAT5e Shielded Cable - 50ft w/connectors <input type="checkbox"/> *Contactor Kit - 50A #20217</p> <p>Liquid / Suction Heat Exchanger</p> <p>LIQUID LINE SOLENOID VALVE</p> <p><input type="checkbox"/> Danfoss 1 Sporlan <input type="checkbox"/> Emerson <input type="checkbox"/> By Others Field Supplied</p> <p>Dual Voltage Coil 120-230V Field Wired</p> <p>Nitrogen Charged and Sealed Room Thermostat</p> <p>*Room Thermostat</p> <p>Wire Fan Guards</p>	
ADJUSTABLE T-STATS <input type="checkbox"/> *Johnson A19ABC <input type="checkbox"/> *Johnson A419ABC-1C <input type="checkbox"/> *Danfoss <input type="checkbox"/> Ranco F25 - Adjustable DT, Fixed FD			
Aux Sideport Connector			
CABINET FINISH <input type="checkbox"/> Painted White <input type="checkbox"/> Painted Black <input type="checkbox"/> Stainless Steel			
CPC I/O BOARD SENSORS <input type="checkbox"/> Coil Temp Sensor <input type="checkbox"/> Return Air Temp Sensor <input type="checkbox"/> Suction Pressure Transducer			
VOLTAGE 208-230/1/60		SYSTEM REFRIGERANT R404A	
		AIR FLOW 900 CFM	
		EVAP. TEMP -20 °F	
		BOX TEMP -10 °F	
		CAPACITY 5800 BTUH	
FANS		HEATERS	
QTY	POWER	FLA/FAN	TYPE
1	0.07HP	0.6	
		DEFROST HTRS	
		4.6	
		REC CAPACITY	
		AMPS	
		0.6	
		WATTS	
		60	
		MCA†	
		0.8	
		MOP‡	
		1060	
		5.8	
		15	
DISTRIBUTOR		1/2 in	
SUCTION		5/8 in	
SOUND		-	
WEIGHT		53 lb	
REC CHARGE		1 lb	
APPROVALS			
 			
			
NOTES: † MCA.. Minimum Circuit Ampacity, ‡ MOP.. Maximum Overcurrent Protection			
Approval of this drawing signifies that the equipment is acceptable under the provision of the job specifications. Any change made hereon by any person whomsoever subject to acceptance by NATIONAL REFRIGERATION at its home office.			
APPROVED BY :		DATE :	
PAGE 5 OF 8			



NATIONAL REFRIGERATION AND
AIR CONDITIONING CANADA CORP.

159 ROY BLVD, PO BOX 2020
BRANTFORD, ON
CANADA N3T 5Y6

NATIONAL REFRIGERATION will furnish equipment in accordance with this drawing and specifications, and subject to its published warranty. Approval of this drawing signifies that the equipment is acceptable under the provision of the job specifications. Any change made hereon by any person whomsoever subject to acceptance by NATIONAL REFRIGERATION at its home office.

Dimensions shown are for standard unit less options.

CONNECTIONS	DIMENSIONS
DISTRIBUTOR	30 1/4 in
SUCTION	17 1/4 in
DRAIN	3/4 in
WATER	0 in
DISCHARGE	0 in
PAN LOOP	1/2 in
HOT GAS SIDE PORT	5/8 in
HOT GAS INLET	3/4 in
HOT GAS OUTLET	0 in
OTHER	0 in
SHIPPING WEIGHT	53 lb
REFRIGERANT CHARGE	1 lb
RECEIVER CAPACITY	0 in

Order Item No: 4

BLP106LE-S2B_ECM

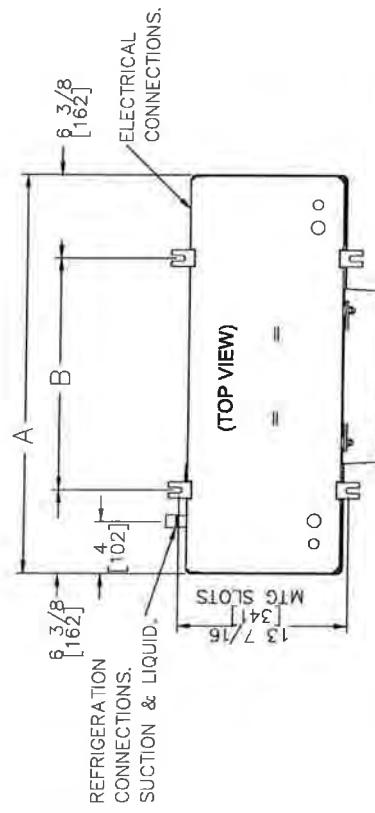
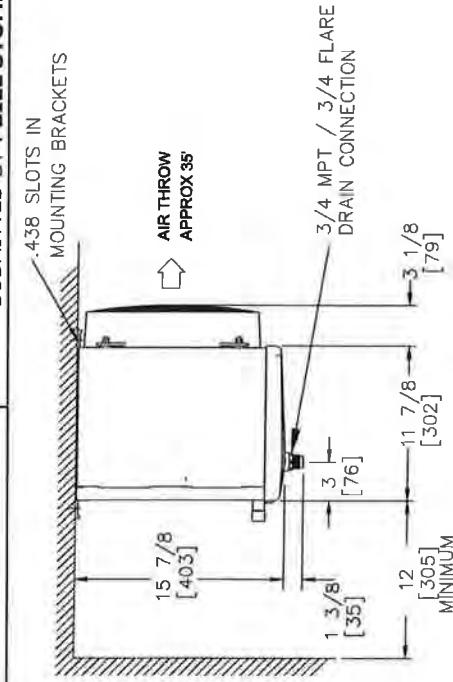
**LOW PROFILE
EVAPORATOR**

DATE : 07 Jan 2015

PURCHASER :

PROJECT :

SUBMITTED BY : BILL STOMPF



APPROVALS	
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NOTES:

 NATIONAL REFRIGERATION AND AIR CONDITIONING CANADA CORP. 159 ROY BLVD, PO BOX 2020 BRANTFORD, ON CANADA N3T 5Y6		BXHA020L6-IT3A COAX WATER-COOLED HERMETIC CONDENSING UNITS-WTR																																																																																																															
PURCHASER : PROJECT : ORDER # : 03658.42894.00095P-A00 QUOTE # : Q07ANBSA-A PURCHASER'S PO # :		SUBMITTED BY : BILL STOMPF DATE : 07 Jan 2015 ITEM # : 5 ID # : TAGGING : FREEZER																																																																																																															
<ul style="list-style-type: none"> • Adjustable dual high / low pressure control • Copper tubing secured with cushion clamps • Pre-formed piping 		MODEL FEATURES <ul style="list-style-type: none"> • Receiver with fusible plug and liquid shut off valve • Suction Service valve • Units are shipped with Helium holding charge • Co-Axial Water-Cooled Condenser • Water regulating valve shipped loose • Electrical control box with compressor contactor and fused control circuit 																																																																																																															
PRE-ENGINEERED OPTION PACKAGE <input type="checkbox"/> A - STD <input type="checkbox"/> B <input type="checkbox"/> C 1 <input checked="" type="checkbox"/> F <input type="checkbox"/> H DEFROST FUSING - SHOW SET QTY <input type="checkbox"/> Up to 30 Amps <input type="checkbox"/> 35 Amps to 60 Amps ELECTRIC DEFROST KIT (TIMECLOCK INCL.) 1 Up to 40A Htrs, 30A Fans 1 Evap <input type="checkbox"/> Up to 60A Htrs, 30A Fans 1 Evap <input type="checkbox"/> Up to 40A Htrs, 30A Fans 2 Evap <input type="checkbox"/> Up to 60A Htrs, 30A Fans 2 Evap 115V Control Circuit <input type="checkbox"/> 30A Contactor <input type="checkbox"/> 40A Contactor <input type="checkbox"/> 60A Contactor ADJUSTABLE PRESSURE CONTROLS <input type="checkbox"/> Johnson Dual with flex hose ADJUSTABLE T-STATS <input type="checkbox"/> *Danfoss		MODEL OPTIONS (* = Shipped Loose) BALL VALVE <input type="checkbox"/> *Liquid Line CAPACITY CONTROL - HOT GAS BYPASS <input type="checkbox"/> To Inlet of Evaporator <input type="checkbox"/> To Suction Line Compressor Circuit Breaker <input type="checkbox"/> Compressor Time Delay Relay Crankcase Heater CUPRONICKEL (CUNI) CONDENSER <input type="checkbox"/> Standard Configuration DISCONNECT SWITCH <input type="checkbox"/> Fused <input type="checkbox"/> Non-Fused Export Crating Extended 4-Year Compressor Warranty <input type="checkbox"/> Extended Leg Kit LIQUID LINE FILTER + SIGHT GLASS 1 Sealed <input type="checkbox"/> Liquid Line Lock-Out Relay LIQUID LINE SOLENOID VALVE <input type="checkbox"/> *Standard 230V Coil <input type="checkbox"/> *Standard 115V Coil																																																																																																															
		<input type="checkbox"/> Oversized Receiver PHASE / VOLTAGE MONITOR <input type="checkbox"/> 3-Lead <input type="checkbox"/> 6-Lead (MotorSaver455) Pump Down Toggle Switch Receiver Inlet Ball Valve Single Point Electrical SUCTION ACCUMULATOR <input type="checkbox"/> With Heat Exchanger <input type="checkbox"/> Without Heat Exchanger SUCTION FILTER <input type="checkbox"/> Sealed Type TIME CLOCK <input type="checkbox"/> Paragon 8145 Style <input type="checkbox"/> *230V Paragon 8145 Style <input type="checkbox"/> *115V Paragon 8145 Style WATER REGULATING VALVE 1 *Standard Duty <input type="checkbox"/> QuickVac Valves																																																																																																															
		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: left;">VOLTAGE</th> <th colspan="3" style="text-align: center;">SYSTEM REFRIGERANT</th> <th colspan="2" style="text-align: center;">SUCTION TEMP</th> <th colspan="2" style="text-align: center;">COND TEMP</th> <th colspan="2" style="text-align: center;">CAPACITY</th> </tr> <tr> <th colspan="2" style="text-align: left;">208-230/3/60</th> <th colspan="3" style="text-align: center;">R404A</th> <th colspan="2" style="text-align: center;">-20 °F</th> <th colspan="2" style="text-align: center;">105 °F</th> <th colspan="2" style="text-align: center;">5720 BTUH</th> </tr> <tr> <th colspan="3" style="text-align: center;">FANS</th> <th colspan="6"></th> <th colspan="3" style="text-align: center;">CIRCUIT TOTAL</th> </tr> <tr> <th>QTY</th> <th>POWER</th> <th>FLA/FAN</th> <th>TYPE</th> <th>QTY</th> <th></th> <th></th> <th>AMPS</th> <th>WATTS</th> <th>MCA†</th> <th>MOP‡</th> </tr> <tr> <td></td> <td></td> <td>0</td> <td>CF06K6E-TF5-247</td> <td>1</td> <td>6.3</td> <td>52</td> <td>6.3</td> <td></td> <td>7.9</td> <td>15</td> </tr> <tr> <td></td> <td></td> <td>3/8 in</td> <td>SOUND</td> <td>-</td> <td>REC CAPACITY</td> <td></td> <td>5 lb</td> <td></td> <td colspan="2" style="text-align: center;">APPROVALS</td> </tr> <tr> <td>SUCTION</td> <td></td> <td>7/8 in</td> <td>WEIGHT</td> <td>160 lb</td> <td>REF CHARGE</td> <td></td> <td></td> <td></td> <td colspan="2" rowspan="2">  </td> </tr> <tr> <td colspan="10">NOTES: † MCA.. Minimum Circuit Ampacity, ‡ MOP.. Maximum Overcurrent Protection</td> </tr> <tr> <td colspan="7">APPROVED BY :</td> <td colspan="4">DATE :</td> </tr> <tr> <td colspan="11">Approval of this drawing signifies that the equipment is acceptable under the provision of the job specifications. Any change made hereon by any person whomsoever subject to acceptance by NATIONAL REFRIGERATION at its home office.</td> </tr> </thead></table>		VOLTAGE		SYSTEM REFRIGERANT			SUCTION TEMP		COND TEMP		CAPACITY		208-230/3/60		R404A			-20 °F		105 °F		5720 BTUH		FANS									CIRCUIT TOTAL			QTY	POWER	FLA/FAN	TYPE	QTY			AMPS	WATTS	MCA†	MOP‡			0	CF06K6E-TF5-247	1	6.3	52	6.3		7.9	15			3/8 in	SOUND	-	REC CAPACITY		5 lb		APPROVALS		SUCTION		7/8 in	WEIGHT	160 lb	REF CHARGE						NOTES: † MCA.. Minimum Circuit Ampacity, ‡ MOP.. Maximum Overcurrent Protection										APPROVED BY :							DATE :				Approval of this drawing signifies that the equipment is acceptable under the provision of the job specifications. Any change made hereon by any person whomsoever subject to acceptance by NATIONAL REFRIGERATION at its home office.										
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NATIONAL REFRIGERATION AND
AIR CONDITIONING CANADA CORP.
159 ROY BLVD, PO BOX 2020
BRANTFORD, ON
CANADA N3T 5Y6

Order Item No: 5	
BXHAO20L6-IT3A	
COAX WATER-COOLED HERMETIC CONDENSING UNITS-WTR	
DATE : 07 Jan 2015	
PURCHASER :	
PROJECT :	
SUBMITTED BY : BILL STOMPF	

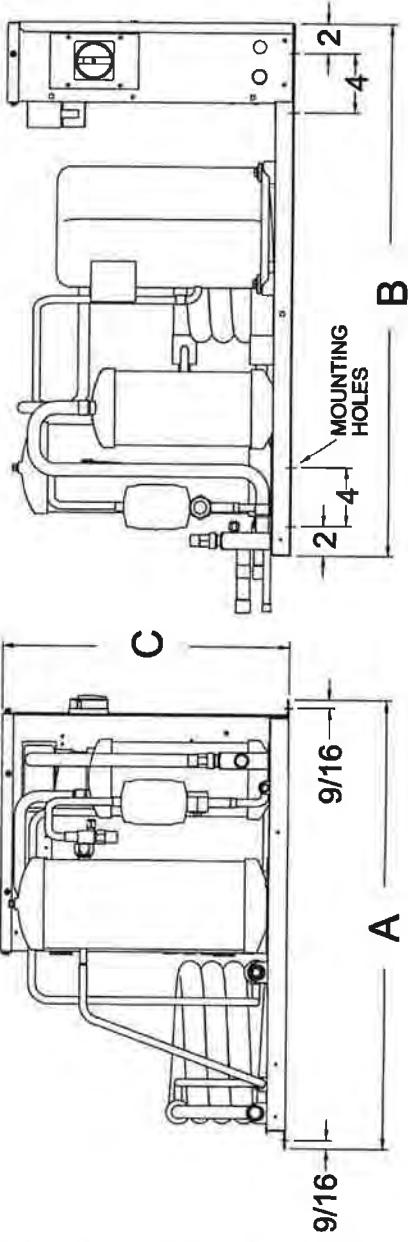
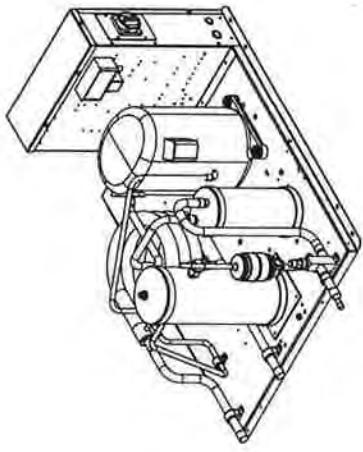
NATIONAL REFRIGERATION will furnish equipment in accordance with this drawing and specifications, and subject to its published warranty. Approval of this drawing signifies that the equipment is acceptable under the provision of the job specifications. Any change made hereon by any person whomsoever subject to acceptance by NATIONAL REFRIGERATION at its home office.

Dimensions shown are for standard unit less options.

CONNECTIONS	DIMENSIONS
SUCTION	3/8 in
DRAIN	7/8 in
WATER	1/2 in
DISCHARGE	
PAN LOOP	
HOT GAS SIDE PORT	
HOT GAS INLET	
HOT GAS OUTLET	
OTHER	
SHIPPING WEIGHT	160 lb
REFRIGERANT CHARGE	
RECEIVER CAPACITY	5 lb

APPROVALS	
UL us	

NOTES:	





Length as shown on plan
Each unit to consist of four shelves, four MX63UP posts,
two 5MPX casters, and two MPBX casters

METROMAX Q™ SHELVING

with *Microban Antimicrobial Product Protection

Part of the innovative MetroMax iQ™ Storage System, MetroMax Q™ is a longer life storage solution than conventional wire shelving. The product offers durable polymer mats that remove for easy cleaning and protect stored items from damage. Quick adjust shelves and MetroMax iQ accessories provides a very efficient use of storage space. MetroMax Q™ is integrated with online space planning tools and tutorials. www.metro.com/iQ

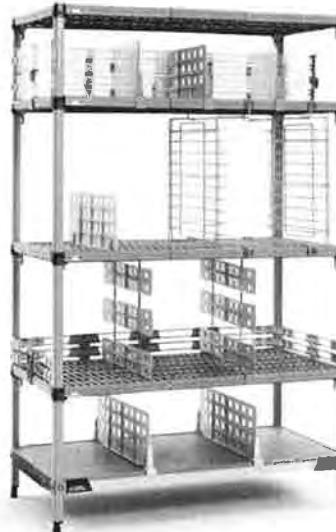
- Longer-life performance:** Durable, corrosion proof polymer mats protect the shelves from normal wear and tear. Robust epoxy coated steel frames and posts hold as much weight as Metro's wire shelving. Weight capacity for evenly distributed loads:
800 lbs. (363kg) per shelf for lengths of 24" to 48" (610 to 1220mm)
600 lbs. (275kg) per shelf for lengths of 54" (1370mm) or longer
2,000 lbs. (907kg) maximum per stationary unit.
- Interchangeable:** MetroMax Q and MetroMax i™ shelves, posts, and most accessories are compatible on the same unit. Use MetroMax Q shelves with MetroMax i™ polymer posts for increased corrosion protection. Use MetroMax i™ solid shelves when spill containment is required or as a bottom shelf to protect supplies from dirt or backsplashes from mops.
- Easier to clean and maintain:** Polymer mats can be easily removed and cleaned in a sink or dish machine. Microban antimicrobial product protection is built into the high contact areas of the shelf including the mats, frames, and posts to protect the product from bacteria, mold, mildew, and fungus that cause odors and product degradation. Microban protection keeps the product "cleaner between cleanings".
- Quick to Adjust:** Patented corner release allows shelves to be unlocked without tools. Simply flip each corner release, relocate the wedge connectors on the posts, and reposition the shelf. Quickly adjust shelves to reclaim wasted vertical space.
- Smooth, Protective Surfaces:** Smooth shelf mats protect packaged items from unwanted rips, tears, or damage.
- Open Grid and Solid Mat Options:** MetroMax Q is available with open grid mats as standard. Open grid shelves promote air circulation and light penetration.
MetroMax i™ solid shelves can be used with MetroMax Q grid shelves on the same unit and are available in 18" and 24" (457 and 610mm) depths. For 21" (530mm) deep MetroMax Q, solid mat overlays are available.
- Efficient, Organized Storage:** Premium MetroMax iQ™ accessories efficiently organize, contain, and compartmentalize **all** space between shelves.
- Quick to Assemble:** MetroMax Q assembles easily in minutes, without tools. Shelves can be adjusted at 1" (25mm) increments along the post. Shelf wedges have a window to locate your desired position.



MetroMax Q Mobile Unit



NSF



*MetroMax Q with Accessories and
MetroMax i Solid Bottom Shelf*

*MICROBAN® and the MICROBAN® symbol are registered trademarks of the Microban Products Company, Huntersville, NC.



InterMetro Industries Corporation
North Washington Street
Wilkes-Barre, PA 18705
www.metro.com





METROMAX Q™ POLYMER AND STEEL SHELVING

Specifications

- Shelf frames and posts:** Steel with electroplated substrate and highly durable, abrasion-resistant epoxy finish. Epoxy finish has built-in Microban antimicrobial product protection. The adjustable foot is reinforced nylon.
- Shelf Mats:** Injection molded polypropylene with exclusive built-in Microban® antimicrobial product protection.
- Shelf Wedge Connector:** Reinforced nylon.
- Temperature range:** -20°F (-29°C) to 125°F (52°C) continuous use, with intermittent exposure to 200°F (93°C) for cleaning.

Standard Interchangeable Shelves

- Part number includes shelf with removable mats and one bag of wedges.
- MetroMax Q grid shelves, MetroMax i™ grid and solid shelves are all compatible on the same unit.

Nominal Width (in.) (mm)	Nominal Length (in.) (mm)	MetroMax Q Shelf with Grid Mat Model No.	Approx. Pkd. Wt. (lbs.) (kg)	MetroMax i™ Shelf with Solid Mat Model No.	Approx. Pkd. Wt. (lbs.) (kg)
18 457	24 610	MQ1824G	6.2 2.8	MX1824F	12.7 5.8
18 457	30 760	MQ1830G	8.0 3.6	MX1830F	14.5 6.6
18 457	36 914	MQ1836G	9.7 4.4	MX1836F	17.2 7.8
18 457	42 1060	MQ1842G	11.4 5.2	MX1842F	20.1 9.1
18 457	48 1220	MQ1848G	13.2 6.0	MX1848F	23.1 10.5
18 457	54 1372	MQ1854G	15.0 6.8	MX1854F	21.5 9.7
18 457	60 1524	MQ1860G	16.7 7.6	MX1860F	23.2 10.5
18 457	72 1829	MQ1872G	20.0 9.1	MX1872F	27.5 12.5
21 530	24 610	MQ2124G	8.0 3.6	—	—
21 530	30 760	MQ2130G	9.7 4.4	—	—
21 530	36 914	MQ2136G	11.4 5.2	—	—
21 530	42 1060	MQ2142G	12.8 5.8	—	—
21 530	48 1220	MQ2148G	14.5 6.6	—	—
21 530	54 1372	MQ2154G	16.7 7.6	—	—
21 530	60 1524	MQ2160G	18.5 8.4	—	—
21 530	72 1829	MQ2172G	21.7 9.9	—	—
24 610	24 610	MQ2424G	9.7 4.4	MX2424F	14.2 6.4
24 610	30 760	MQ2430G	11.4 5.2	MX2430F	15.9 7.2
24 610	36 914	MQ2436G	13.1 6.0	MX2436F	19.6 8.9
24 610	42 1060	MQ2442G	14.1 6.4	MX2442F	21.5 9.8
24 610	48 1220	MQ2448G	15.8 7.1	MX2448F	25.3 11.5
24 610	54 1372	MQ2454G	18.5 8.4	MX2454F	25.0 11.3
24 610	60 1524	MQ2460G	20.3 9.2	MX2460F	26.8 12.1
24 610	72 1829	MQ2472G	23.5 10.7	MX2472F	31.0 14.1

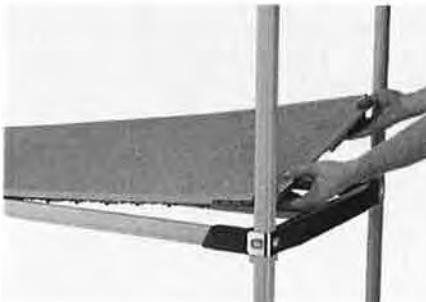
Actual Dimensions:

Width: Add $\frac{3}{16}$ " (10mm) to nominal size.

Length: Subtract $\frac{3}{16}$ " (5mm) from nominal size.



MetroMax Q Open Grid Shelf



MetroMax i™ Solid Shelf

Heavy-Duty Dunnage Shelves

- Corrosion proof MetroMax i™ dunnage shelf is compatible with MetroMax Q.
- Open grid and solid version available.
- Weight capacity per shelf evenly distributed: 1,200 lbs. (544kg) on shelves up to and including 48" (1220mm) long; 900 lbs. (408kg) for shelves 60" (1524mm) long.
- Dunnage shelves are recommended for use on units with four posts.

Nominal Width (in.) (mm)	Nominal Length (in.) (mm)	Shelf with Grid Mat Model No.	Approx. Pkd. Wt. (lbs.) (kg)	Shelf with Solid Mat Model No.	Approx. Pkd. Wt. (lbs.) (kg)
18 457	36 914	MHP1836G	18 8.2	MHP1836F	22 10.0
18 457	48 1220	MHP1848G	22 10.0	MHP1848F	26 11.8
18 457	60 1524	MHP1860G	26 11.8	MHP1860F	30 13.6
24 610	36 914	MHP2436G	21 9.5	MHP2436F	25 11.3
24 610	48 1220	MHP2448G	27 12.2	MHP2448F	31 14.1
24 610	60 1524	MHP2460G	33 15.0	MHP2460F	37 16.8

Solid Mat Overlays

- Overlays snap onto the open grid mats to create a solid surface.
- Available for 21" (530mm) deep MetroMax Q shelves.

Fits Shelf (in.) (mm)	Model No.	Approx. Pkd. Wt. (lbs.) (kg)
21x24 530x610	Q2124SM	0.35 0.16
21x30 530x760	Q2130SM	0.45 0.20
21x36 530x914	Q2136SM	0.50 0.23
21x42 530x1060	Q2142SM	0.60 0.27
21x48 530x1220	Q2148SM	0.70 0.32
21x54 530x1372	Q2154SM	0.80 0.36
21x60 530x1524	Q2160SM	0.90 0.41
21x72 530x1829	Q2172SM	1.00 0.45

METROMAX Q™ POLYMER AND STEEL SHELVING



Standard Interchangeable Posts

- MetroMax Q: Epoxy coated steel with Microban antimicrobial product protection.
- MetroMax i: Polymer with Microban antimicrobial product protection.
- Stationary posts include an adjustable leveling foot to compensate for uneven floors. Leveling foot can be adjusted 1" (25mm).
- When mounting a shelving unit to a dolly base, stationary posts are used.
- Special height cut posts are available. Consult your Metro representative.

Nominal Height (in.) (mm)	Actual Height* (in.) (mm)	MetroMax Q Steel Model No.	STATIONARY POST WITH LEVELING FOOT			Approx. Pkd. Wt. (lbs.) (kg)	MetroMax i Polymer Model No.	Approx. Pkd. Wt. (lbs.) (kg)
			Approx. Pkd. Wt. (lbs.) (kg)	MetroMax i Polymer Model No.	Approx. Pkd. Wt. (lbs.) (kg)			
13 370	14 ¹ / ₄ 375	MQ13PE	1.0 0.5	MX13P	0.5 0.2			
27 685	28 ³ / ₄ 730	MQ27PE	2.0 0.9	MX27P	0.9 0.4			
33 875	34 ¹ / ₄ 883	MQ33PE	2.5 1.1	MX33P	1.0 0.5			
54 1370	54 ¹ / ₄ 1391	MQ54PE	4.0 1.8	MX54P	1.6 0.7			
63 1585	62 ¹ / ₄ 1594	MQ63PE	4.5 2.0	MX63P	1.8 0.8			
74 1690	74 ¹ / ₄ 1899	MQ74PE	5.5 2.5	MX74P	2.2 1.0			
86 2195	86 ¹ / ₄ 2203	MQ86PE	6.5 2.9	MX86P	2.5 1.1			

Nominal Height (in.) (mm)	Actual Height* (in.) (mm)	MetroMax Q Steel Model No.	POST FOR STEM CASTER			Approx. Pkd. Wt. (lbs.) (kg)
			Approx. Pkd. Wt. (lbs.) (kg)	MetroMax i Polymer Model No.	Approx. Pkd. Wt. (lbs.) (kg)	
13 370	13 ³ / ₄ 349	MQ13UPE	1.0 0.5	MX13UP	0.5 0.2	
27 685	27 ³ / ₄ 705	MQ27UPE	2.0 0.9	MX27UP	0.9 0.4	
33 875	33 ³ / ₄ 857	MQ33UPE	2.5 1.1	MX33UP	1.0 0.5	
54 1370	53 ³ / ₄ 1365	MQ54UPE	4.0 1.8	MX54UP	1.6 0.7	
63 1585	61 ¹ / ₄ 1568	MQ63UPE	4.5 2.0	MX63UP	1.8 0.8	
70 1778	69 ¹ / ₄ 1765	MQ70UPE	5.0 2.3			
74 1690	73 ³ / ₄ 1873	MQ74UPE	5.5 2.5	MX74UP	2.3 1.0	
86 2195	85 ¹ / ₄ 2178	MQ86UPE	6.5 2.9	MX86UP	2.5 1.4	

NOTE: Compatibility with existing Metro polymer mat shelving systems

- MQ9985 wedges are compatible with original MetroMax Q shelves and posts.
- The post centers on MetroMax Q have been changed to allow interchangeability with MetroMax i™ shelves. MetroMax Q shelves manufactured within or after April 2009 are not compatible with Q shelves made prior to April 2009.
- MetroMax Q is not compatible with original MetroMax manufactured prior to April 2009.
- Posts listed in above table (ex. MQ74PE, MX74PE) can be used with original MetroMax Q shelves made prior to April 2009.

Post Clamp

Adds stability by joining posts of two separate units together. With it, each unit is supported by four posts and buttressed by the adjacent unit.

Model No. 9994X



Foot Plate

Use to add stability to the shelving unit or to bolt units to the floor.

Model No. Zinc 9993Z

Model No. Stainless Steel 9993S



Stem Casters

A variety of stem casters are offered for MetroMax i™ mobile applications.

Stem caster models include bumpers.

See Catalog Sheet 11.20 for stem casters.

Load Rating: 3 x Stem Caster Load Rating, maximum — 900 lbs. (363kg) per stem caster cart.



Replacement Bumper
M9992DBX



METROMAX iQ™ ACCESSORIES



Stem Casters

Stem casters are used with stem caster posts to create transport carts or to enable fully loaded stationary storage units to be easily repositioned when cleaning floors or walls.

Consider stem casters with polymer horns and stainless axles (5PCX, 5PCBX, 5PCRX) for greater corrosion protection.

- MetroMax iQ Stem Casters:** Use with polymer or steel stem caster posts to create a storage and transport unit to meet your needs.

Model No.	Wheel Tread	Type	Wheel Diameter (in.) (mm)	Face (in.) (mm)	Load Rating (lbs.) (kg)	Approx. Pkd. Wt. (lbs.) (kg)
5MX	Resilient	Stem/Swivel	5 127	1 1/4 32	200 90	2 1/4 1.2
5MBX	Resilient	Stem/Brake	5 127	1 1/4 32	200 90	3 1.4
5MRX	Resilient	Stem/Rigid	5 127	1 1/4 32	200 90	3 1/4 1.7
5MPX	Polyurethane	Stem/Swivel	5 127	1 1/4 32	300 135	2 1/4 1.0
5MPBX	Polyurethane	Stem/Brake	5 127	1 1/4 32	300 135	2 1/2 1.1
5MPRX	Polyurethane	Stem/Rigid	5 127	1 1/4 32	300 135	2 1/4 1.0
5MDXA	Resilient	Stem/Swivel Donut	5 127	1 1/4 32	250 110	2 1/2 1.1
5MDBXA	Resilient	Stem/Brake Donut	5 127	1 1/4 32	250 110	2 1/2 1.1
5MDRXA	Resilient	Stem/Rigid Donut	5 127	1 1/4 32	250 110	2 1/2 1.1

Donut bumpers included.



- Polymer Casters:** Corrosion-resistant design.

Model No.	Wheel Tread	Type	Wheel Diameter (in.) (mm)	Face (in.) (mm)	Load Rating (lbs.) (kg)	Approx. Pkd. Wt. (lbs.) (kg)	Temperature Range (continuous)
5PCX	Polyurethane	Swivel	5 127	1 1/4 32	300 135	2 .9	-20°F to 120°F
5PCBX	Polyurethane	Brake	5 127	1 1/4 32	300 135	2 .9	-20°F to 120°F
5PCRX	Polyurethane	Rigid	5 127	1 1/4 32	300 135	2 .9	-20°F to 120°F

Specific Models with Antimicrobial Protection

Cat. No.	Wheel Tread	Type	Wheel Diameter (in.) (mm)	Face (in.) (mm)	Load Rating (lbs.) (kg)	Approx. Pkd. Wt. (lbs.) (kg)	Temperature Range (continuous)
5PCXM	Polyurethane	Swivel	5 127	1 1/4 32	300 135	2 .9	-20°F to 120°F
5PCBXM	Polyurethane	Brake	5 127	1 1/4 32	300 135	2 .9	-20°F to 120°F

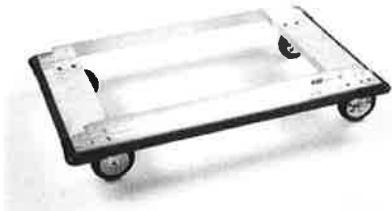
NOTE 1: Optional thread guards (blue) may be ordered by adding "-TG" to the desired model number (e.g. 5PC-TG, 5PCB-TG, 5PCR-TG).

NOTE 2: Stem casters are shipped with donut bumpers at no extra charge.

NOTE 3: Rigid casters are held in place by a connecting channel. When ordering, shell depth must be provided.



Replacement Bumper
Model No. M9992DBX



Truck Dolly Bases

For heavy duty mobile applications. Truck dollies are available in aluminum or stainless construction with corner bumpers or wrap-around bumpers.

For more information, refer to Spec Sheet 11.37

Mounting Bolt Kit

When ordering a dolly frame for use with MetroMax i™ or MetroMax Q, include mounting bolt kit **DMK-2X** on order.

Order one mounting bolt kit per dolly.



Item # _____

Job _____

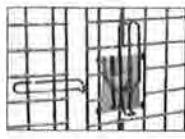
SECURITY UNITS

Features:

- Safe Storage:** Protects valuable materials and sensitive items from loss or pilferage.
- Microban® Antimicrobial Product Protection***: Metroseal 3 and MetroMax Q models feature Microban Antimicrobial Product Protection, designed to stay "cleaner between cleanings."
- Ready View of Contents:** Heavy-gauge open wire construction keeps the entire contents of the truck visible at all times, making it easy to check inventory.
- Adjustable, Optional Intermediate Shelves:** Patented, easily adjustable shelf designs — Super Adjustable Super Erecta, MetroMax Q, and qwikSLOT — allow flexibility to meet changing needs. Can be positioned in 1" (25 mm) increments along the entire height of post.
- Patented, Ergonomic, 1/4-Turn Door Handle:** Makes opening and closing the unit easier than conventional security unit designs.
- Double Door:** Each door opens 270 degrees and can be secured along the sides of the unit.
- Time Saving Assembly:** Metro security units assemble quickly — right out of the box.
- Shipped Knocked-Down:** Saves on freight costs. Easily assembled.

Choose from Stationary or Mobile Standard and Heavy-Duty Configurations:

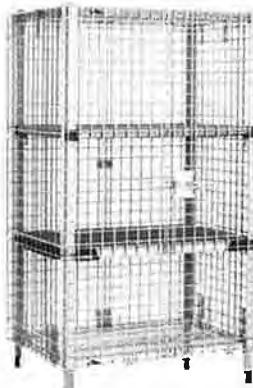
- Safe Transportation:** Mobile, security trucks provide the advantage of quick, protective transportation.
- Easy Cleaning of Storage Areas:** Mobile units move easily from walls to allow thorough cleaning of floors and walls.
- Mobile Units:** Available in Standard and Heavy-Duty models. Heavy-Duty units offer increased rigidity and durability for applications such as crossing thresholds.
- Stationary Units:** Posts have leveling feet to compensate for uneven surfaces.



Handle (open position)



Handle (closed position)

Super Erecta Shelf (HD Mobile)
with optional Super Adjustable
Super Erecta® Intermediate shelvesMetroMax Q (Stationary) with
optional Intermediate shelvesqwikSLOT (Mobile) with
optional Intermediate shelves

*MICROBAN® and the MICROBAN® symbol are registered trademarks of the Microban Products Company, Huntersville, NC.



InterMetro Industries Corporation
North Washington Street
Wilkes-Barre, PA 18705
www.metro.com





SECURITY UNITS

Specifications

Super Erecta Shelf Stationary Security

Model No. Chrome	Model No. Metroseal 3	Model No. Stainless Steel	Width (in.) (mm)	Length (in.) (mm)	Height (in.) (mm)	Fits Shelf (in.) (mm)	Approx. Pkd. Wt. (lbs.) (kg)
SEC33C	SEC33K3	SEC33S	21½ 546	38½ 980	66¹³/₁₆ 1695	18x36 457x914	138 63
SEC35C	SEC35K3	SEC35S	21½ 546	50½ 1295	66¹³/₁₆ 1695	18x48 457x1219	157 71
SEC53C	SEC53K3	SEC53S	27¼ 692	38½ 980	66¹³/₁₆ 1695	24x36 610x914	154 70
SEC55C	SEC55K3	SEC55S	27¼ 692	50½ 1295	66¹³/₁₆ 1695	24x48 610x1219	174 79
SEC56C	SEC56K3	SEC56S	27¼ 692	62½ 1587	66¹³/₁₆ 1695	24x60 610x1524	195 89
SEC63C		SEC63S	33½ 851	38½ 980	66¹³/₁₆ 1695	30x36 760x914	167 76
SEC65C		SEC65S	33½ 851	50½ 1295	66¹³/₁₆ 1695	30x48 760x1219	193 88
SEC66C		SEC66S	33½ 851	62½ 1587	66¹³/₁₆ 1695	30x60 760x1524	215 98

Super Erecta Shelf Mobile Security

Standard-Duty Stem Caster Models: feature 5" (127mm) swivel casters. Please note model numbers for specific caster types.

Model No. Chrome	Model No. Metroseal 3	Caster Type	Width (in.) (mm)	Length (in.) (mm)	Height (in.) (mm)	Fits Shelf (in.) (mm)	Approx. Pkd. Wt. (lbs.) (kg)
SEC33EC	SEC33EK3	(2) 5MP/(2) 5MPB	21½ 546	40¾ 1035	68½ 1740	18x36 457x914	146 66
SEC35EC	SEC35EK3	(2) 5MP/(2) 5MPB	21½ 546	52¾ 1340	68½ 1740	18x48 457x1219	165 75
SEC53DC	SEC53DK3	(4) 5MP	27¼ 692	40¾ 1035	68½ 1740	24x36 610x914	162 74
SEC55DC	SEC55DK3	(4) 5MP	27¼ 692	52¾ 1340	68½ 1740	24x48 610x1219	182 83
SEC56DC	SEC56DK3	(4) 5MP	27¼ 692	65 1651	68½ 1740	24x60 610x1524	203 92
SEC53EC	SEC53EK3	(2) 5MP/5MPB	27¼ 692	40¾ 1035	68½ 1740	24x36 610x914	162 74
SEC55EC	SEC55EK3	(2) 5MP/5MPB	27¼ 692	52¾ 1340	68½ 1740	24x48 610x1219	182 83
SEC56EC	SEC56EK3	(2) 5MP/5MPB	27¼ 692	65 1651	68½ 1740	24x60 610x1524	203 92
	SEC53VK3	(2) 5PC/5PCB	27¼ 692	40¾ 1035	68½ 1740	24x36 610x914	162 74
	SEC55VK3	(2) 5PC/5PCB	27¼ 692	52¾ 1340	68½ 1740	24x48 610x1219	182 83
	SEC56VK3	(2) 5PC/5PCB	27¼ 692	65 1651	68½ 1740	24x60 610x1524	203 92
SEC63EC		(2) 5MP/(2) 5MPB	33½ 851	40¾ 1035	68½ 1740	30x36 760x914	175 80
SEC65EC		(2) 5MP/(2) 5MPB	33½ 851	52¾ 1340	68½ 1740	30x48 760x1219	202 92
SEC66EC		(2) 5MP/(2) 5MPB	33½ 851	65 1651	68½ 1740	30x60 760x1524	223 101

Casters: 5MP and 5MPB (with locking brake) feature a polyurethane tread

5PC and 5PCB (with locking brake) casters feature a polymer horn and resist rusting. They are recommended for high-moisture environments.

Heavy-Duty Models: feature aluminum dollies with wraparound bumpers and 5" (127mm) diameter casters.

Model No. Chrome	Model No. Metroseal 3	Caster Type	Width (in.) (mm)	Length (in.) (mm)	Height (in.) (mm)	Fits Shelf (in.) (mm)	Approx. Pkd. Wt. (lbs.) (kg)
SEC53LC	SEC53LK3	(2) B5P/B5PB	28⅓ 713	38½ 980	68½ 1740	24x36 610x914	187 85
SEC55LC	SEC55LK3	(2) B5P/B5PB	28⅓ 713	50½ 1285	68½ 1740	24x48 610x1219	210 95
SEC56LC	SEC56LK3	(2) B5P/B5PB	28⅓ 713	63⅓ 1600	68½ 1740	24x60 610x1524	235 107

Stainless Steel: Casters must be ordered separately on "SD" models. Dollies and casters must be ordered separately on "HD" models.

Model No.	Description	Width (in.) (mm)	Length (in.) (mm)	Height (in.) (mm)	Fits Shelf (in.) (mm)	Approx. Pkd. Wt. (lbs.) (kg)
SEC33S-SD	Standard Duty	21½ 546	40¾ 1035	62 1575	18x36 457x914	138 63
SEC35S-SD	Standard Duty	21½ 546	52¾ 1340	62 1575	18x48 457x1219	157 71
SEC53S-SD	Standard Duty	27¼ 692	40¾ 1035	62 1575	24x36 610x914	154 70
SEC55S-SD	Standard Duty	27¼ 692	52¾ 1340	62 1575	24x48 610x1219	174 79
SEC56S-SD	Standard Duty	27¼ 692	65 1651	62 1575	24x60 610x1524	195 89
SEC63S-SD	Standard Duty	33½ 851	40¾ 1035	62 1575	30x36 760x914	167 76
SEC65S-SD	Standard Duty	33½ 851	52¾ 1340	62 1575	30x48 760x1219	193 88
SEC66S-SD	Standard Duty	33½ 851	65 1651	62 1575	30x60 760x1524	215 98
SEC53S-HD	Heavy Duty	28⅓ 713	38½ 980	62 1575	24x36 610x914	154 70
SEC55S-HD	Heavy Duty	28⅓ 713	50½ 1285	62 1575	24x48 610x1219	174 79
SEC56S-HD	Heavy Duty	28⅓ 713	63⅓ 1600	62 1575	24x60 610x1524	195 89

NOTE: Given height is for unit without dolly or casters (depending on model chosen). For approximate overall unit height add chosen caster diameter plus 1" (25mm).

CAUTION: Large casters can create a tipping hazard. On 18" (457mm) security units, do not use casters larger than 5" (127mm) in diameter.

Intermediate Super Adjustable Shelves for Super Erecta Shelf Security Units

Model No.- Chrome	Model No. Metroseal 3	Model No. Stainless Steel	Width (in.) (mm)	Length (in.) (mm)	Fits Shelf (in.) (mm)	Approx. Pkd. Wt. (lbs.) (kg)
A1836NC	A1836NK3	A1836NS	18 457	36 914	9½ 4.3	
A1848NC	A1848NK3	A1848NS	18 457	48 1219	12 5.4	
A2436NC	A2436NK3	A2436NS	24 610	36 914	13 6	
A2448NC	A2448NK3	A2448NS	24 610	48 1219	16 7	
A2460NC	A2460NK3	A2460NS	24 610	60 1524	21 9.5	
A3036NC		A3036NS	30 760	36 914	15 6.8	
A3048NC		A3048NS	30 760	48 1219	21 9.5	
A3060NC		A3060NS	30 760	60 1524	26½ 11.8	

NOTE: Standard Super Erecta shelves can also be used as intermediate shelves. Refer to catalog sheet 10-01 for more information.



Length as shown on plan
Each unit to consist of five shelves and four MX74P posts

METROMAX Q™ SHELVING

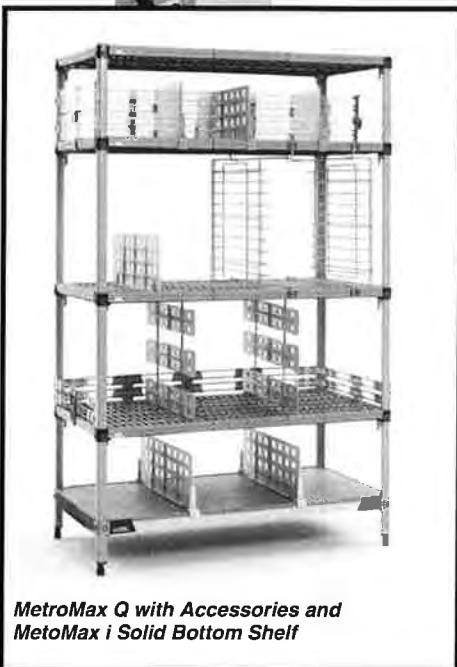
with *Microban Antimicrobial Product Protection

Part of the innovative MetroMax iQ™ Storage System, MetroMax Q™ is a longer life storage solution than conventional wire shelving. The product offers durable polymer mats that remove for easy cleaning and protect stored items from damage. Quick adjust shelves and MetroMax iQ accessories provides a very efficient use of storage space. MetroMax Q™ is integrated with online space planning tools and tutorials. www.metro.com/iQ

- **Longer-life performance:** Durable, corrosion proof polymer mats protect the shelves from normal wear and tear. Robust epoxy coated steel frames and posts hold as much weight as Metro's wire shelving. Weight capacity for evenly distributed loads:
800 lbs. (363kg) per shelf for lengths of 24" to 48" (610 to 1220mm)
600 lbs. (275kg) per shelf for lengths of 54" (1370mm) or longer
2,000 lbs. (907kg) maximum per stationary unit.
- **Interchangeable:** MetroMax Q and MetroMax i™ shelves, posts, and most accessories are compatible on the same unit. Use MetroMax Q shelves with MetroMax i™ polymer posts for increased corrosion protection. Use MetroMax i™ solid shelves when spill containment is required or as a bottom shelf to protect supplies from dirt or backsplashes from mops.
- **Easier to clean and maintain:** Polymer mats can be easily removed and cleaned in a sink or dish machine. Microban antimicrobial product protection is built into the high contact areas of the shelf including the mats, frames, and posts to protect the product from bacteria, mold, mildew, and fungus that cause odors and product degradation. Microban protection keeps the product "cleaner between cleanings".
- **Quick to Adjust:** Patented corner release allows shelves to be unlocked without tools. Simply flip each corner release, relocate the wedge connectors on the posts, and reposition the shelf. Quickly adjust shelves to reclaim wasted vertical space.
- **Smooth, Protective Surfaces:** Smooth shelf mats protect packaged items from unwanted rips, tears, or damage.
- **Open Grid and Solid Mat Options:** MetroMax Q is available with open grid mats as standard. Open grid shelves promote air circulation and light penetration.
MetroMax i™ solid shelves can be used with MetroMax Q grid shelves on the same unit and are available in 18" and 24" (457 and 610mm) depths. For 21" (530mm) deep MetroMax Q, solid mat overlays are available.
- **Efficient, Organized Storage:** Premium MetroMax iQ™ accessories efficiently organize, contain, and compartmentalize **all** space between shelves.
- **Quick to Assemble:** MetroMax Q assembles easily in minutes, without tools. Shelves can be adjusted at 1" (25mm) increments along the post. Shelf wedges have a window to locate your desired position.



MetroMax Q Mobile Unit



*MetroMax Q with Accessories and
MetroMax i Solid Bottom Shelf*

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InterMetro Industries Corporation
North Washington Street
Wilkes-Barre, PA 18705
www.metro.com





METROMAX Q™ POLYMER AND STEEL SHELVING

Specifications

- Shelf frames and posts:** Steel with electroplated substrate and highly durable, abrasion-resistant epoxy finish. Epoxy finish has built-in Microban antimicrobial product protection. The adjustable foot is reinforced nylon.
- Shelf Mats:** Injection molded polypropylene with exclusive built-in Microban® antimicrobial product protection.
- Shelf Wedge Connector:** Reinforced nylon.
- Temperature range:** -20°F (-29°C) to 125°F (52°C) continuous use, with intermittent exposure to 200°F (93°C) for cleaning.

Standard Interchangeable Shelves

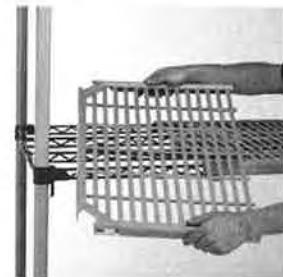
- Part number includes shelf with removable mats and one bag of wedges.
- MetroMax Q grid shelves, MetroMax i™ grid and solid shelves are all compatible on the same unit.

Nominal Width (in.) (mm)	Nominal Length (in.) (mm)	MetroMax Q Shelf with Grid Mat Model No.	Approx. Pkd. Wt. (lbs.) (kg)	MetroMax i™ Shelf with Solid Mat Model No.	Approx. Pkd. Wt. (lbs.) (kg)
18 457	24 610	MQ1824G	6.2 2.8	MX1824F	12.7 5.8
18 457	30 760	MQ1830G	8.0 3.6	MX1830F	14.5 6.6
18 457	36 914	MQ1836G	9.7 4.4	MX1836F	17.2 7.8
18 457	42 1060	MQ1842G	11.4 5.2	MX1842F	20.1 9.1
18 457	48 1220	MQ1848G	13.2 6.0	MX1848F	23.1 10.5
18 457	54 1372	MQ1854G	15.0 6.8	MX1854F	21.5 9.7
18 457	60 1524	MQ1860G	16.7 7.6	MX1860F	23.2 10.5
18 457	72 1829	MQ1872G	20.0 9.1	MX1872F	27.5 12.5
21 530	24 610	MQ2124G	8.0 3.6	—	—
21 530	30 760	MQ2130G	9.7 4.4	—	—
21 530	36 914	MQ2136G	11.4 5.2	—	—
21 530	42 1060	MQ2142G	12.8 5.8	—	—
21 530	48 1220	MQ2148G	14.5 6.6	—	—
21 530	54 1372	MQ2154G	16.7 7.6	—	—
21 530	60 1524	MQ2160G	18.5 8.4	—	—
21 530	72 1829	MQ2172G	21.7 9.9	—	—
24 610	24 610	MQ2424G	9.7 4.4	MX2424F	14.2 6.4
24 610	30 760	MQ2430G	11.4 5.2	MX2430F	15.9 7.2
24 610	36 914	MQ2436G	13.1 6.0	MX2436F	19.6 8.9
24 610	42 1060	MQ2442G	14.1 6.4	MX2442F	21.5 9.8
24 610	48 1220	MQ2448G	15.8 7.1	MX2448F	25.3 11.5
24 610	54 1372	MQ2454G	18.5 8.4	MX2454F	25.0 11.3
24 610	60 1524	MQ2460G	20.3 9.2	MX2460F	26.8 12.1
24 610	72 1829	MQ2472G	23.5 10.7	MX2472F	31.0 14.1

Actual Dimensions:

Width: Add $\frac{3}{16}$ " (10mm) to nominal size.

Length: Subtract $\frac{3}{16}$ " (5mm) from nominal size.



MetroMax Q Open Grid Shelf



MetroMax i™ Solid Shelf

Heavy-Duty Dunnage Shelves

- Corrosion proof MetroMax i™ dunnage shelf is compatible with MetroMax Q.
- Open grid and solid version available.
- Weight capacity per shelf evenly distributed: 1,200 lbs. (544kg) on shelves up to and including 48" (1220mm) long; 900 lbs. (408kg) for shelves 60" (1524mm) long.
- Dunnage shelves are recommended for use on units with four posts.

Nominal Width (in.) (mm)	Nominal Length (in.) (mm)	Shelf with Grid Mat Model No.	Approx. Pkd. Wt. (lbs.) (kg)	Shelf with Solid Mat Model No.	Approx. Pkd. Wt. (lbs.) (kg)
18 457	36 914	MHP1836G	18 8.2	MHP1836F	22 10.0
18 457	48 1220	MHP1848G	22 10.0	MHP1848F	26 11.8
18 457	60 1524	MHP1860G	26 11.8	MHP1860F	30 13.6
24 610	36 914	MHP2436G	21 9.5	MHP2436F	25 11.3
24 610	48 1220	MHP2448G	27 12.2	MHP2448F	31 14.1
24 610	60 1524	MHP2460G	33 15.0	MHP2460F	37 16.8

Solid Mat Overlays

- Overlays snap onto the open grid mats to create a solid surface.
- Available for 21" (530mm) deep MetroMax Q shelves.

Fits Shelf (in.) (mm)	Model No.	Approx. Pkd. Wt. (lbs.) (kg)
21x24	Q2124SM	0.35 0.16
21x30	Q2130SM	0.45 0.20
21x36	Q2136SM	0.50 0.23
21x42	Q2142SM	0.60 0.27
21x48	Q2148SM	0.70 0.32
21x54	Q2154SM	0.80 0.36
21x60	Q2160SM	0.90 0.41
21x72	Q2172SM	1.00 0.45

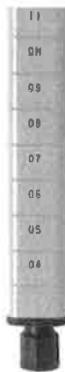
METROMAX Q™ POLYMER AND STEEL SHELVING



Standard Interchangeable Posts

- MetroMax Q: Epoxy coated steel with Microban antimicrobial product protection.
- MetroMax i: Polymer with Microban antimicrobial product protection.
- Stationary posts include an adjustable leveling foot to compensate for uneven floors. Leveling foot can be adjusted 1" (25mm).
- When mounting a shelving unit to a dolly base, stationary posts are used.
- Special height cut posts are available. Consult your Metro representative.

Nominal Height (in.) (mm)	Actual Height* (in.) (mm)	MetroMax Q Steel Model No.	STATIONARY POST WITH LEVELING FOOT			Approx. Pkd. Wt. (lbs.) (kg)
			Approx. Pkd. Wt. (lbs.) (kg)	MetroMax i Polymer Model No.	Approx. Pkd. Wt. (lbs.) (kg)	
13 370	14 ¹ / ₄ 375	MQ13PE	1.0	0.5	MX13P	0.5 0.2
27 685	28 ¹ / ₄ 730	MQ27PE	2.0	0.9	MX27P	0.9 0.4
33 875	34 ¹ / ₄ 883	MQ33PE	2.5	1.1	MX33P	1.0 0.5
54 1370	54 ¹ / ₄ 1391	MQ54PE	4.0	1.8	MX54P	1.6 0.7
63 1585	62 ¹ / ₄ 1594	MQ63PE	4.5	2.0	MX63P	1.8 0.8
74 1690	74 ¹ / ₄ 1899	MQ74PE	5.5	2.5	MX74P	2.2 1.0
86 2195	86 ¹ / ₄ 2203	MQ86PE	6.5	2.9	MX86P	2.5 1.1



MetroMax Q Steel Post



MetroMax i Polymer Post

Replacement Leveling Foot:
Model No. RPM3-FOOT

Replacement Post Cap for Steel Post:
Model No. RPMQS-POSTCAP

Replacement Post Cap for Polymer Post:
Model No. RPMXS-POSTCAP

Replacement MetroMax Q Wedges
Model No. MQ9985 Bag of 4

Nominal Height (in.) (mm)	Actual Height* (in.) (mm)	MetroMax Q Steel Model No.	POST FOR STEM CASTER			Approx. Pkd. Wt. (lbs.) (kg)
			Approx. Pkd. Wt. (lbs.) (kg)	MetroMax i Polymer Model No.	Approx. Pkd. Wt. (lbs.) (kg)	
13 370	13 ³ / ₄ 349	MQ13UPE	1.0	0.5	MX13UP	0.5 0.2
27 685	27 ³ / ₄ 705	MQ27UPE	2.0	0.9	MX27UP	0.9 0.4
33 875	33 ³ / ₄ 857	MQ33UPE	2.5	1.1	MX33UP	1.0 0.5
54 1370	53 ³ / ₄ 1365	MQ54UPE	4.0	1.8	MX54UP	1.6 0.7
63 1585	61 ³ / ₄ 1568	MQ63UPE	4.5	2.0	MX63UP	1.8 0.8
70 1778	69 ³ / ₄ 1765	MQ70UPE	5.0	2.3		
74 1690	73 ³ / ₄ 1873	MQ74UPE	5.5	2.5	MX74UP	2.3 1.0
86 2195	85 ³ / ₄ 2178	MQ86UPE	6.5	2.9	MX86UP	2.5 1.4



Replacement MetroMax Q Wedges MQ9985

NOTE: Compatibility with existing Metro polymer mat shelving systems

- MQ9985 wedges are compatible with original MetroMax Q shelves and posts.
- The post centers on MetroMax Q have been changed to allow interchangeability with MetroMax i™ shelves. MetroMax Q shelves manufactured within or after April 2009 are not compatible with Q shelves made prior to April 2009.
- MetroMax Q is not compatible with original MetroMax manufactured prior to April 2009.
- Posts listed in above table (ex. MQ74PE, MX74PE) can be used with original MetroMax Q shelves made prior to April 2009.

Post Clamp

Adds stability by joining posts of two separate units together. With it, each unit is supported by four posts and buttressed by the adjacent unit.

Model No. 9994X



Foot Plate

Use to add stability to the shelving unit or to bolt units to the floor.

Model No. Zinc 9993Z

Model No. Stainless Steel 9993S



Stem Casters

A variety of stem casters are offered for MetroMax i™ mobile applications.

Stem caster models include bumpers.

See Catalog Sheet 11.20 for stem casters.

Load Rating: 3 x Stem Caster Load Rating, maximum — 900 lbs. (363kg) per stem caster cart.



Replacement Bumper M9992DBX





STAINLESS STEEL WORK TABLES

PREMIUM Series - 5" Backsplash - Undershelf Style

Length as shown on plan
5" high side splashes as shown on plan
TA-93 Wall clips
TA-95 Upgrade legs to 16 ga. S/S
TA-11B Sink located as shown on plan
T&S Brass B-1121 Faucet

**NEW**

Rolled Rim Edges on
Front & Splash on
Back and Square
Side Edges

Featuring as Standard:
"THE PROVEN"

ORIGINAL ADVANCE TABCO
Adjustable Undershelf
with Die Cast Leg Clamp

MATERIAL:**KSS-SERIES: Stainless Steel Legs & Undershelf**

TOP: 14 gauge stainless steel type "304" series.
SHELF: 18 gauge stainless steel.
LEGS: 1 5/8" diameter tubular stainless steel.
1" adjustable stainless steel bullet feet.
Stainless steel gussets.

KLG-SERIES: Galvanized Legs & Undershelf

TOP: 14 gauge stainless steel type "304" series.
SHELF: 18 gauge galvanized steel.
LEGS: 1 5/8" diameter tubular galvanized steel.
1" adjustable plastic bullet feet.
Galvanized steel gussets.

KLG-Series:**Galvanized Steel Legs & Undershelf**

L	24" Wide	30" Wide	36" Wide
30"	KSS-240	KSS-300	
24"	KSS-242	KSS-302	
36"	KSS-243	KSS-303	KSS-363
48"	KSS-244	KSS-304	KSS-364
60"	KSS-245	KSS-305	KSS-365
72"	KSS-246	KSS-306	KSS-366
84"	KSS-247	KSS-307	KSS-367
96"	KSS-248	KSS-308	KSS-368
108"	KSS-249	KSS-309	KSS-369
120"	KSS-2410	KSS-3010	KSS-3610
132"	KSS-2411	KSS-3011	KSS-3611
144"	KSS-2412	KSS-3012	KSS-3612



KSS-Series:
Stainless Steel Legs & Undershelf

L	24" Wide	30" Wide	36" Wide
30"	KSS-240	KSS-300	
24"	KSS-242	KSS-302	
36"	KSS-243	KSS-303	KSS-363
48"	KSS-244	KSS-304	KSS-364
60"	KSS-245	KSS-305	KSS-365
72"	KSS-246	KSS-306	KSS-366
84"	KSS-247	KSS-307	KSS-367
96"	KSS-248	KSS-308	KSS-368
108"	KSS-249	KSS-309	KSS-369
120"	KSS-2410	KSS-3010	KSS-3610
132"	KSS-2411	KSS-3011	KSS-3611
144"	KSS-2412	KSS-3012	KSS-3612

Create Your Own Efficient Workstation with the Available Standard Accessories (Visit Section K)



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Fax: (972) 932-4795

NEVADA
Fax: (775) 972-1578

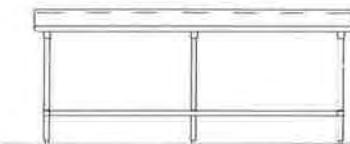
DETAILS and SPECIFICATIONS

ALL DIMENSIONS ARE TYPICAL TOL $\pm .500"$

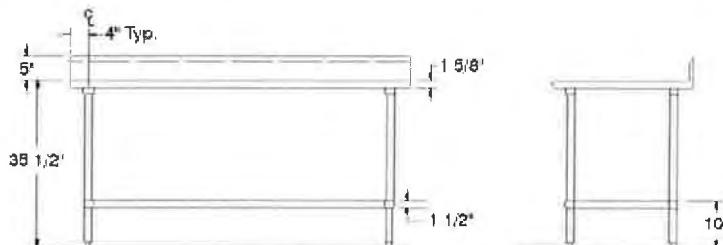
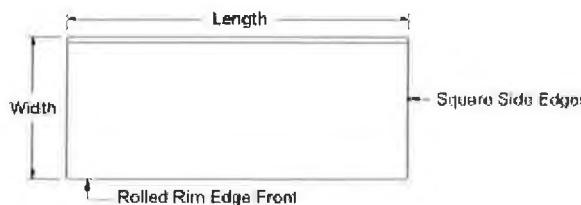
All Units Shipped Unassembled (KD) for Reduced Shipping Costs.

**KSS & KLG Series
Undershelf Style
5" Backsplash**

Finished size of undershelf = Length minus 5 3/4"
Width minus 5 3/4"



Units 8ft. and larger are furnished with six (6) legs



KSS-Series: Stainless Steel Legs & Undershelf

L	24" Wide	Wt.	30" Wide	Wt.	36" Wide	Wt.
30"	KSS-240	55 lbs.	KSS-300	70 lbs.		
24"	KSS-242	50 lbs.	KSS-302	56 lbs.		
36"	KSS-243	66 lbs.	KSS-303	77 lbs.	KSS-363	92 lbs.
48"	KSS-244	81 lbs.	KSS-304	92 lbs.	KSS-364	101 lbs.
60"	KSS-245	95 lbs.	KSS-305	111 lbs.	KSS-365	121 lbs.
72"	KSS-246	113 lbs.	KSS-306	129 lbs.	KSS-366	142 lbs.
84"	KSS-247	135 lbs.	KSS-307	153 lbs.	KSS-367	169 lbs.
96"	KSS-248	150 lbs.	KSS-308	171 lbs.	KSS-368	189 lbs.
108"	KSS-249	165 lbs.	KSS-309	195 lbs.	KSS-369	260 lbs.
120"	KSS-2410	268 lbs.	KSS-3010	294 lbs.	KSS-3610	315 lbs.
132"	KSS-2411	301 lbs.	KSS-3011	331 lbs.	KSS-3611	358 lbs.
144"	KSS-2412	316 lbs.	KSS-3012	346 lbs.	KSS-3612	373 lbs.

KLG-Series: Galvanized Steel Legs & Undershelf

L	24" Wide	Wt.	30" Wide	Wt.	36" Wide	Wt.
30"	KLG-240	55 lbs.	KLG-300	70 lbs.		
24"	KLG-242	50 lbs.	KLG-302	56 lbs.		
36"	KLG-243	66 lbs.	KLG-303	77 lbs.	KLG-363	92 lbs.
48"	KLG-244	81 lbs.	KLG-304	92 lbs.	KLG-364	101 lbs.
60"	KLG-245	95 lbs.	KLG-305	111 lbs.	KLG-365	121 lbs.
72"	KLG-246	113 lbs.	KLG-306	129 lbs.	KLG-366	142 lbs.
84"	KLG-247	135 lbs.	KLG-307	153 lbs.	KLG-367	169 lbs.
96"	KLG-248	150 lbs.	KLG-308	171 lbs.	KLG-368	189 lbs.
108"	KLG-249	165 lbs.	KLG-309	195 lbs.	KLG-369	260 lbs.
120"	KLG-2410	268 lbs.	KLG-3010	294 lbs.	KLG-3610	315 lbs.
132"	KLG-2411	301 lbs.	KLG-3011	331 lbs.	KLG-3611	358 lbs.
144"	KLG-2412	316 lbs.	KLG-3012	346 lbs.	KLG-3612	373 lbs.



ADVANCE TABCO is constantly engaged in a program of improving our products. Therefore, we reserve the right to change specifications without prior notice.



T&S BRASS AND BRONZE WORKS, INC.

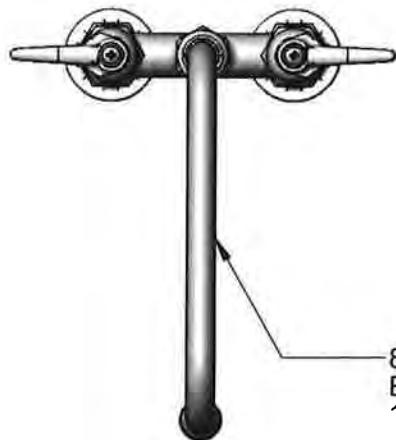
2 Saddleback Cove / P.O. Box 1088
Travelers Rest, SC 29690

Model No.

B-0227-CR-WS

Item No.

Travelers Rest, SC: 800-476-4103 • Simi Valley, CA: 800-423-0150 • Fax: 864-834-3518 • www.tsbrass.com

**ADA Compliant**

8" Swing Nozzle w/
B-0199-01-W/S
1.5 GPM Aerator

This Space for Architect/Engineer Approval

Job Name _____ Date _____

Model Specified _____ Quantity _____

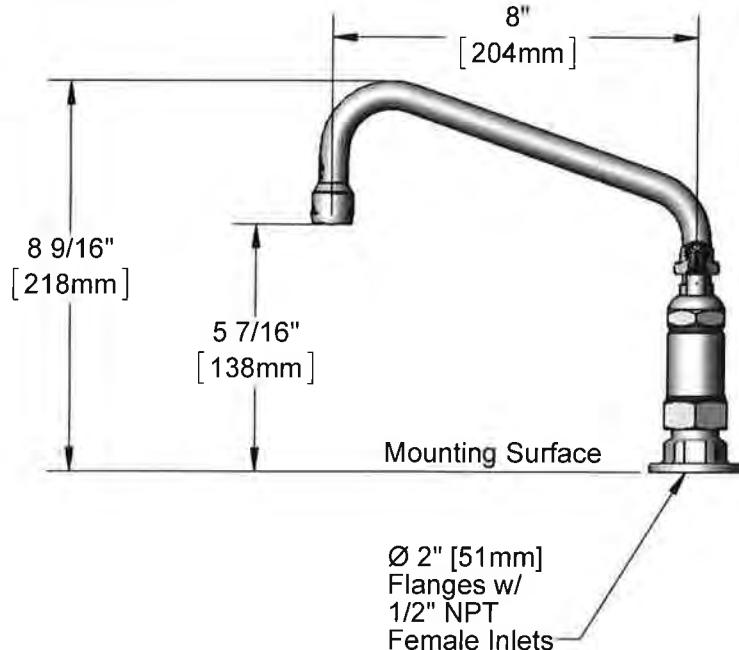
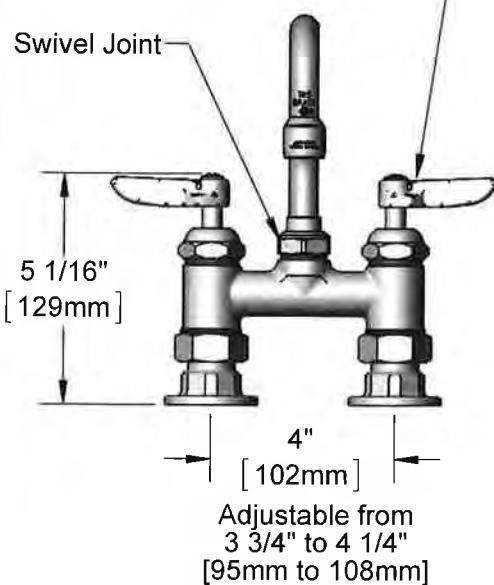
Customer/Wholesaler _____

Contractor _____

Architect/Engineer _____



Cerama Cartridges &
Lever Handles w/
Color Coded Indexes



Product Specifications:

4" Deck Mount Mixing Faucet, Cerama Cartridges, Lever Handles,
8" Swing Nozzle, 1.5 GPM Aerator & 1/2" NPT Female Inlets

Product Compliance:

ASME A112.18.1 / CSA B125.1
NSF 61 - Section 9
NSF 372 (Low Lead Content)
ANSI A117.1 (ADA)

Drawn: DHL Checked: DMH Approved: JHB Date: 11/10/14 Scale: 1:4 Sheet: 1 of 2


T&S BRASS AND BRONZE WORKS, INC.

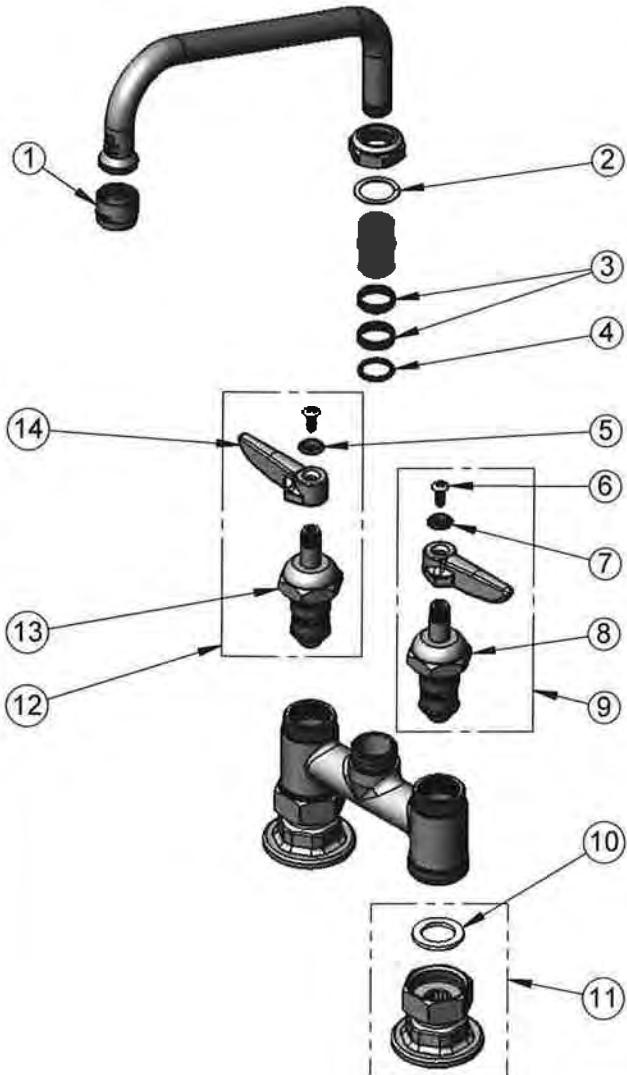
 2 Saddleback Cove / P.O. Box 1088
 Travelers Rest, SC 29690

Model No.

B-0227-CR-WS

Item No.

Travelers Rest, SC: 800-476-4103 • Simi Valley, CA: 800-423-0150 • Fax: 864-834-3518 • www.tsbrass.com



ITEM NO.	SALES NO.	DESCRIPTION
1	B-0199-01-WS	1.5 GPM Aerator, 55/64-27 Female
2	009538-45	Swivel Washer
3	011429-45	Swivel Sleeves (2)
4	001074-45	O-Ring
5	001661-45	Red Index-HW
6	000922-45	Lever Handle Screw
7	001660-45	Blue Index-CW
8	011279-25	Cerama Cartridge, LTC
9	012445-25	Cerama Cartridge, LTC w/ Handle, Index & Screw
10	001019-45	Coupling Nut Washer
11	00AA	1/2" NPT Female Eccentric Flange
12	012444-25	Cerama Cartridge, RTC w/ Handle, Index & Screw
13	011278-25	Cerama Cartridge, RTC
14	001638-45	Lever Handle

Product Specifications:

 4" Deck Mount Mixing Faucet, Cerama Cartridges, Lever Handles,
 8" Swing Nozzle, 1.5 GPM Aerator & 1/2" NPT Female Inlets

Product Compliance:

 ASME A112.18.1 / CSA B125.1
 NSF 61 - Section 9
 NSF 372 (Low Lead Content)
 ANSI A117.1 (ADA)



**STAINLESS STEEL & ALUMINUM
WALL SHELVES**



KD Wall Shelf



Item #: _____ **Qty #:** _____

Model #: _____

Project #: _____

FEATURES:

Furnished with a 1-5/8" Bullnose edge with a 1-1/4" turn-up edge on sides and rear.

Unit is easily assembled employing the slip-fit TAB-LOK design.

CONSTRUCTION:

Shelf and brackets are die stamped and die formed.

MATERIAL:

WS-KD Series - 18 gauge stainless steel polished to a satin finish.

AWS-KD Series - Heavy gauge aluminum.

S/S	ALUMINUM	length
WS-KD-24	AWS-KD-24	24"
WS-KD-36	AWS-KD-36	36"
WS-KD-48	AWS-KD-48	48"
WS-KD-60	AWS-KD-60	60"

Standard Wall Shelf

FEATURES:

Brackets can be positioned to accomodate wall studs.

Furnished with a 1-5/8" Bullnose edge with a 1-1/2" turn-up edge at rear. Ends are turned down square.

CONSTRUCTION:

Secured to wall by means of bolts through support brackets.

Units 7 ft. and larger are furnished with 3 brackets.

MATERIAL:

16 Gauge Series - 304 stainless steel polished to a satin finish.

18 Gauge Series - 430 stainless steel polished to a satin finish.

Weld support brackets to
wall shelf



10" Wide		12" Wide		15" Wide		18" Wide		Approx. Wt.	Approx. Cubes
16 Ga.	18 Ga.								
WS-10-24-16	WS-10-24	WS-12-24-16	WS-12-24	WS-15-24-16	WS-15-24	WS-18-24-16	WS-18-24	10 lbs.	3
WS-10-36-16	WS-10-36	WS-12-36-16	WS-12-36	WS-15-36-16	WS-15-36	WS-18-36-16	WS-18-36	12 lbs.	4
WS-10-48-16	WS-10-48	WS-12-48-16	WS-12-48	WS-15-48-16	WS-15-48	WS-18-48-16	WS-18-48	14 lbs.	5
WS-10-60-16	WS-10-60	WS-12-60-16	WS-12-60	WS-15-60-16	WS-15-60	WS-18-60-16	WS-18-60	17 lbs.	6
WS-10-72-16	WS-10-72	WS-12-72-16	WS-12-72	WS-15-72-16	WS-15-72	WS-18-72-16	WS-18-72	19 lbs.	7
WS-10-84-16	WS-10-84	WS-12-84-16	WS-12-84	WS-15-84-16	WS-15-84	WS-18-84-16	WS-18-84	22 lbs.	8
WS-10-96-16	WS-10-96	WS-12-96-16	WS-12-96	WS-15-96-16	WS-15-96	WS-18-96-16	WS-18-96	26 lbs.	10
WS-10-108-16	WS-10-108	WS-12-108-16	WS-12-108	WS-15-108-16	WS-15-108	WS-18-108-16	WS-18-108	28 lbs.	11
WS-10-120-16	WS-10-120	WS-12-120-16	WS-12-120	WS-15-120-16	WS-15-120	WS-18-120-16	WS-18-120	31 lbs.	12
WS-10-132-16	WS-10-132	WS-12-132-16	WS-12-132	WS-15-132-16	WS-15-132	WS-18-132-16	WS-18-132	35 lbs.	13
WS-10-144-16	WS-10-144	WS-12-144-16	WS-12-144	WS-15-144-16	WS-15-144	WS-18-144-16	WS-18-144	38 lbs.	14

Length = 24" to 144" in 12" increments.



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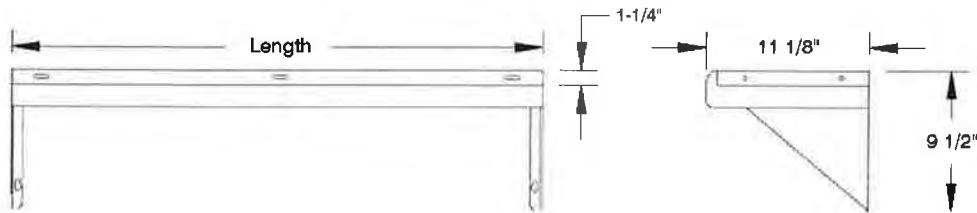
NEVADA
Fax: (775) 972-1578

DETAILS and SPECIFICATIONS

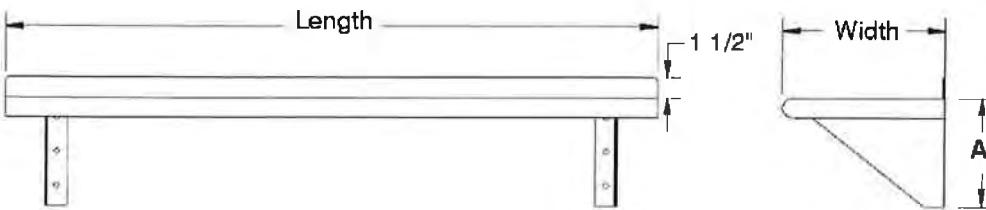
TOL $\pm .500"$

ALL DIMENSIONS ARE TYPICAL

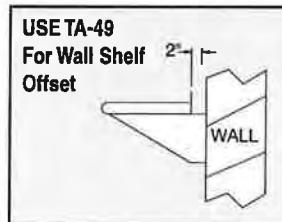
KD WALL SHELF



STANDARD WALL SHELF



Width	A
10"	8"
12"	10"
15"	10"
18"	10"



Requirements for NSF Installations

1. Install at least 60" above floor.
2. Limit to dry storage.
3. Avoid contact with liquids.
4. For "Ganging-Up" installation, allow at least 2" between units or mount units side by side and seal joints with an approved sealant.



ADVANCE TABCO is constantly engaged in a program of improving our products. Therefore, we reserve the right to change specifications without prior notice.



ITEM NO.

COMBITHERM® CTC6-10E ELECTRIC BOILER-FREE

CAPACITY

- Six (6) full-size or GN 1/1 pans, six (6) half-size sheet pans; one row deep
- Two (2) side racks with six (6) non-tilt support rails; 13" (330mm) horizontal width between rails, 2-3/4" (70mm) vertical spacing between rails

CONSTRUCTION

- Stainless steel exterior, bright annealed interior
- Seamless welded interior stainless steel cavity
- CoolTouch3™ triple pane window door with hinged inner glass prevents additional heat loss and increases cooking efficiency
- Door is hinged right with a 130° swing
- High efficiency LED lighting integrated in the door
- Door mounted self-draining drip tray
- Hands free positive catch door handle with lighted visual alerts [PATENT PENDING]
- PROrinse™ ergonomic retractable hand shower includes a safety shutoff interlock that shuts off water to the hose [PATENT PENDING] and a built-in back flow preventer
- SafeVent™ provides automatic steam venting at the end of the cooking cycle [PATENT #7,282,674]
- Zero Clearance system maximizes floor space utilization with features that carefully protect temperature sensitive components and controls [PATENT PENDING]
- Adjustable stainless steel legs provide stability

CT CLASSIC™ STANDARD FEATURES

- Oven with state-of-the-art innovative solutions that meld together perfectly to deliver high performance standards, consistent food quality, and production efficiency.
- Classic control provides a simple and intuitive push button operation that commands all the oven functions with icons that are easy to identify.

- LED display indicates cooking mode, temperature settings, time remaining, and various instructions.
- Three cooking modes:
Steam - 85°F to 250°F (30°C to 120°C)
Convection - 85°F to 575°F (30°C to 300°C)
Combination - 212°F to 575°F (100°C to 300°C)
- Cook time is displayed in hours : minutes.

- Two different fan speeds expands cooking capabilities for products affected by a high velocity of air movement.
- Cool down feature provides the operator with the ability to lower the temperature of the oven compartment at an accelerated pace.
- CombiClean® fully automated cleaning with one heavy-duty cleaning cycle.

SHORT FORM SPEC

Provide Alto-Shaam Combitherm® CT Classic™ counter-top model CTC6-10E boiler-free electric CombiOven designed with EcoSmart® technology for reduced energy and water consumption. Includes operational modes for steam, convection, and a combination of steam and convection heat. Oven is to be constructed of 18 gauge stainless steel interior cavity. Oven includes an attached retractable hand shower spray hose with safety shutoff interlock

system and a back flow preventer. Classic control includes a cool-down function, automatic cleaning function, fan with two (2) fan speeds. Oven includes four (4) adjustable stainless steel legs. Each oven is to accommodate up to six (6) half-size sheet pans or six (6) full-size hotel pans (GN 1/1), include standard right-hand door hinging, six (6) non-tilt support rails, and three (3) stainless steel shelves.

FACTORY INSTALLED OPTIONS

Boiler Version

Electrical Choices

208-240V 3ph 380-415V 3ph
 440-480V 3ph

Door Swing

Right-hand Door Hinging, standard
 Recessed Door, optional; increases oven width by 4" (102mm), slides out of the way for safety and frees up aisle space

CombiHood PLUS™ Ventless Hood
(not available on stacked combinations)

Extended One-year Warranty

Installation Start-Up Check - AVAILABLE THROUGH AN ALTO-SHAAM AUTHORIZED SERVICE AGENCY

Probe Choices

Removable, single-point, quick-connect core temperature probe, optional
 Removable, single-point, quick-connect sous vide temperature probe, optional

Security Devices for correctional facility use

- Optional base package:
includes tamper-proof screw package, excludes temperature probe
- Anti entrapment device, optional
- Control panel security cover, optional
- Hasp door lock (padlock not included), optional
- Removable, single-point, quick-connect core temperature probe, optional
- Seismic feet package, optional

Stacking Hardware (not available with CombiHood PLUS Ventless Hood)



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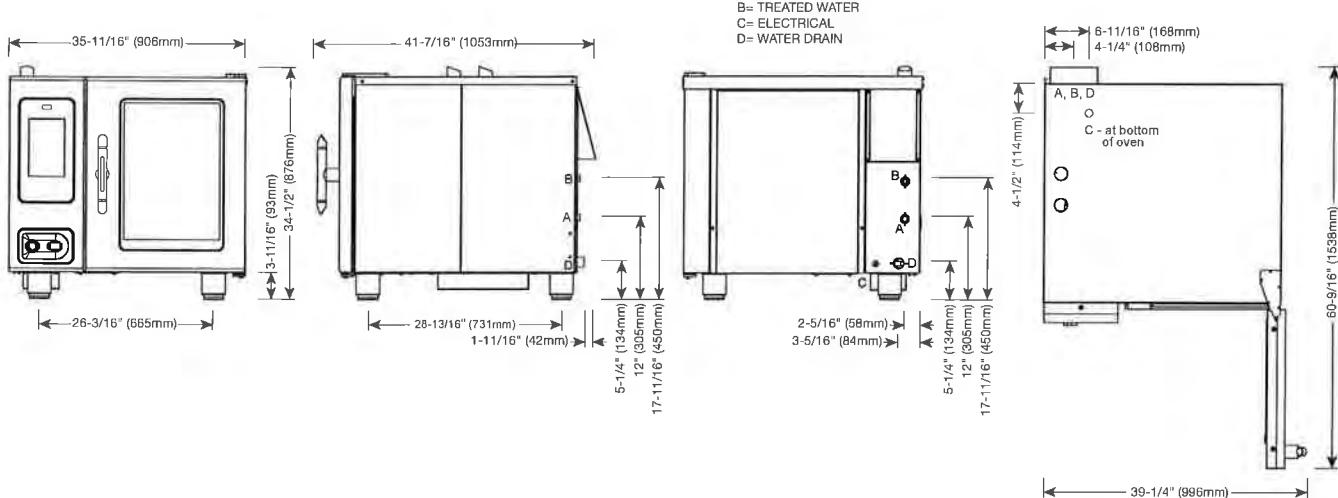
DUE TO ONGOING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.



COMBITHERM[®]

CTC6-10E

ELECTRIC BOILER-FREE



IP X5

**WATER REQUIREMENTS**

TWO (2) COLD WATER INLETS - DRINKING QUALITY
ONE (1) TREATED WATER INLET: 3/4" NPT* * Can manifold off of one
ONE (1) UNTREATED WATER INLET: 3/4" NPT* 3/4" line.
LINE PRESSURE: 30 to 90 psi 2.1 to 6.3 bar
WATER DRAIN: 1-1/2" (40mm) CONNECTION WITH A 2" MINIMUM AIR GAP INSTALLED AS CLOSE TO THE OVEN AS POSSIBLE. MATERIALS MUST WITHSTAND TEMPERATURES UP TO 200°F (93°C).

CLEARANCE REQUIREMENTS

LEFT:	0" (0mm)	18" (457mm)	FOR SERVICE ACCESS
RIGHT:	0" (0mm)	NON-COMBUSTIBLE SURFACES	2" (51mm) COMBUSTIBLE SURFACES
TOP:	20" (508mm)	FOR AIR MOVEMENT	
BACK:	4" (102mm)	BOTTOM:	5-1/8" (130mm) FOR LEGS, AIR INTAKE

INSTALLATION REQUIREMENTS

- Oven must be installed level.
- Hood installation is required.
- Water supply shut-off valve and back-flow preventer when required by local code.

ELECTRICAL (NO CORD, NO PLUG - DEDICATED CIRCUIT REQUIRED) DO NOT CONNECT TO A G.F.C.I. OUTLET

MODEL	VOLTAGE	PH	HZ	AMPS	KW	BREAKER	AWG	CONNECTION
CTC6-10E	208 - 240	3	50/60	21.9 - 25.3	7.9 - 10.5	25 - 30	8	L1, L2, L3, G
	380 - 415	3	50	13.4 - 14.6	9.0 - 10.5	16	8	L1, L2, L3, N, G
	440 - 480	3*	60	11.6 - 12.6	9.0 - 10.5	15	10 - 8	L1, L2, L3, G

*ELECTRICAL SERVICE CHARGE APPLIES

WEIGHT	SHIP DIMENSIONS	PAN CAPACITY		
NET 524 lbs est 238 kg	(L x W x H) 56" x 45" x 51** (1422 x 1143 x 1295mm)*	FULL-SIZE: GN 1/1: *HALF-SIZE SHEET: ON WIRE SHELVES ONLY	20" x 12" x 2-1/2" 530 x 325 x 65mm 18" x 13" x 1"	Six (6) Six (6) Six (6)
SHIP 574 lbs* 260 kg*				PRODUCT MAXIMUM: 72 lb (33 kg) VOLUME MAXIMUM: 45 quarts (57 liters)
*DOMESTIC GROUND SHIPPING INFORMATION: CONTACT FACTORY FOR EXPORT WEIGHT AND DIMENSIONS.				*ADDITIONAL WIRE SHELVES REQUIRED FOR MAXIMUM CAPACITY



ITEM NO. _____

COMBIhoodPLUS™



10-10EVH SHOWN



- Operate an Alto-Shaam® Combitherm® CombiOven without an expensive oven hood or costly hood installation.

- Keep costly heating and air conditioning from being vented out through your hood.

- Self-contained oven venting system fully tested and listed by Underwriters Laboratories for both safety and sanitation.

- Using EPA method 202 testing, grease laden vapors emitted by the Combi Ventless hood are 0.58 mg/m³ – far less than U.L.'s established standard of 5 mg/m³.

- Alto-Shaam's factory installed Ventless Hood is placed directly on the top of a Combitherm oven.

- A high-power fan captures all steam and fumes from the oven cavity into the hood intake and out the back surface exhaust vent, trapping grease as the air moves through the filter system.

- As fumes and vapors are circulated through the hood, condensed steam drains from an opening at the rear.

- CombihoodPLUS™ performance is "smart"; engaging the fan during the last minute of the cook mode which provides quiet operation and consumes less power.

- Power requirements to the ventless hood operate directly from the power supplied to the Combi oven.

20 gauge, non-corrosive stainless steel construction ventless hood is factory installed directly on the top of the electric Alto-Shaam® Combitherm® oven. The hood is designed to vent clean air back into the kitchen, filtering vapors and grease. A high-power fan draws fumes and steam into the hood intake and out the back exhaust vent. Fumes and vapors are circulated through filters draining the condensation through a drain at the rear of the hood. An activated charcoal filter cleans the air before venting it out the top of the hood. One (1) grease and one (1) charcoal filter is included, and access from the front of the oven simplifies replacement.

NOT AVAILABLE FOR COMBI MODELS EQUIPPED THE SMOKING OPTION, STACKED CONFIGURATIONS, OR GAS MODELS.



EPA 202 CAPTURE TEST

COMBIHOOD FILTERS

Charcoal, Class I (REQUIRED FOR NEW YORK CITY AND LOS ANGELES)

FI-36620

Charcoal, Class II

FI-25866

Grease

FI-25867



W164 N9221 Water Street • P.O. Box 450 • Menomonee Falls, Wisconsin 53052-0450 • U.S.A.

PHONE: 262.251.3800 800.558.8744 U.S.A./CANADA FAX: 262.251.7067 800.329.8744 U.S.A. ONLY

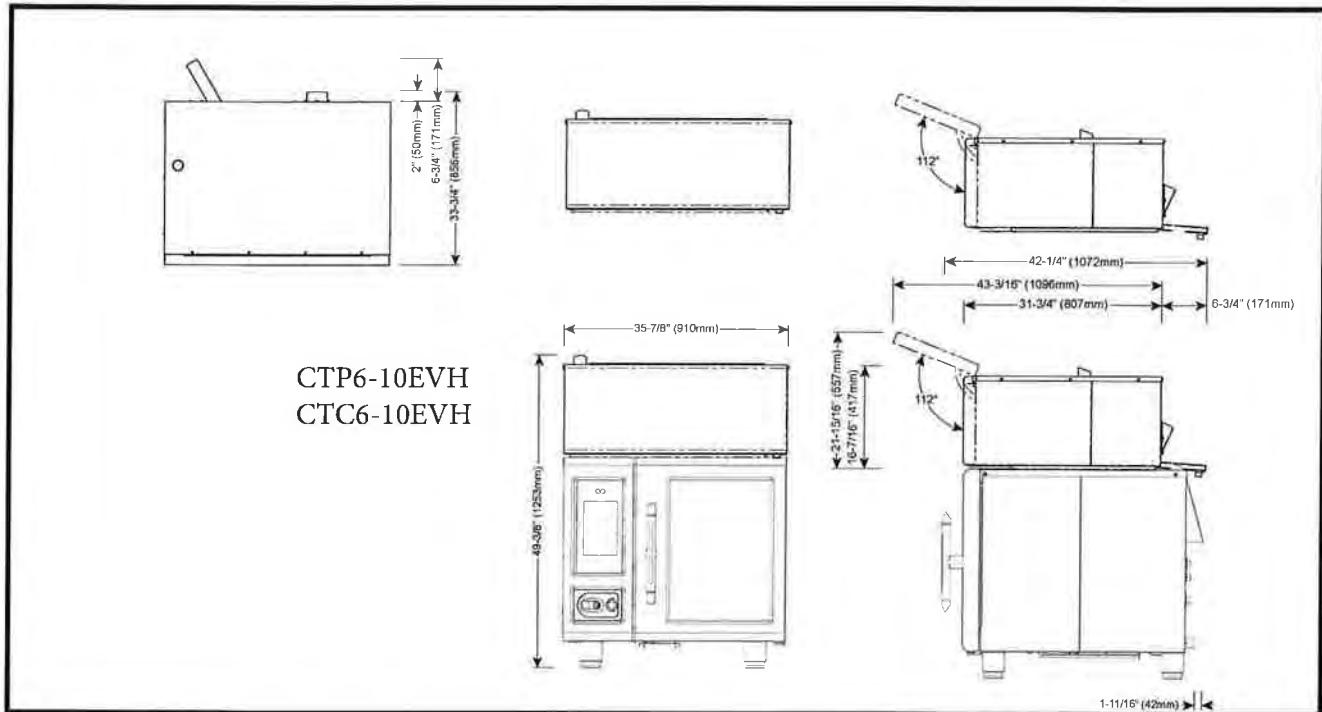
www.alto-shaam.com

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DUE TO ONGOING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

#457 - 01/14

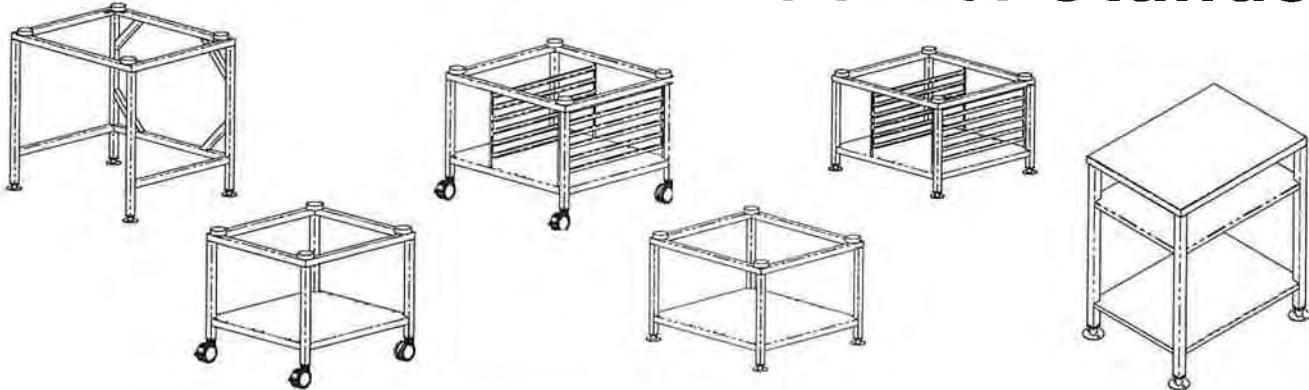

COMBIhoodPLUS™

INSTALLATION REQUIREMENTS

Water drain outlet is 3/4" NPT

SPECIFICATIONS		6-10EVH	10-10EVH
HOOD DIMENSIONS	H x W x D	16-7/16" x 35-7/8" x 38-1/2" (417mm x 910mm x 978mm)	16-7/16" x 35-7/8" x 38-1/2" (417mm x 910mm x 978mm)
HOOD WITH OVEN DIMENSIONS	H x W x D	49-3/8" x 35-7/8" x 42-1/4" (1253mm x 910mm x 1072mm)	60-5/8" x 35-7/8" x 42-1/4" (1539mm x 910mm x 1072mm)
AIR MOVEMENT		756 CFM	756 CFM
ADDITIONAL ELECTRICAL REQUIREMENTS			
AMPS		1.1A	1.1A
KW		.25	.25
SHIP WEIGHT		CONTACT FACTORY	CONTACT FACTORY
CRATE DIMENSIONS	L x W x H	CONTACT FACTORY	CONTACT FACTORY



COMBITHERM® COMBIoven Combi Stands



OVENS

STANDS, STAINLESS STEEL (H X W X D)

	4-10	6-10	10-10	7-20	10-20
5015711 MOBILE WITH PAN SLIDES & SHELF SPACING: 2-11/16" (68MM)				✓	✓
	28-15/16" x 38-3/4" x 38-5/16" (734mm x 983mm x 972mm)				
5016083 STATIONARY WITH SHELF				✓	✓
	25-7/16" x 39-13/16 x 36-5/16" (645mm x 1010mm x 922mm)				
5016084 STATIONARY WITH PAN SLIDES & SHELF SPACING: 2-11/16" (68MM)				✓	✓
	25-7/16" x 39-13/16" x 36-5/16" (645mm x 1010mm x 922mm)				
5016085 MOBILE WITH SHELF				✓	✓
	28-15/16" x 38-3/4" x 38-5/16" (734mm x 983mm x 972mm)				
5016087 STATIONARY				✓	✓
	38-3/4" x 42" x 36-5/16" (984mm x 1067mm x 922mm)				
5016088 STATIONARY WITH SHELF		✓	✓		
	25-3/8" x 31-3/4" x 34-5/16" (645mm x 805mm x 870mm)				
5016089 STATIONARY WITH PAN SLIDES & SHELF SPACING: 2-11/16" (68MM)		✓	✓		
	25-7/16" x 31-3/4" x 34-5/16" (645mm x 805mm x 870mm)				
5016090 MOBILE WITH SHELF		✓	✓		
	28-15/16" x 30-5/8" x 36-1/4" (734mm x 779mm x 920mm)				
5016091 MOBILE WITH PAN SLIDES & SHELF SPACING: 2-11/16" (68MM)		✓	✓		
	28-15/16" x 30-11/16" x 36-1/4" (734mm x 779mm x 920mm)				
5016092 STATIONARY		✓	✓		
	38-3/4" x 34" x 34-1/4" (984mm x 864mm x 870mm)				
5014737 STATIONARY WITH SINGLE SHELF	✓				
	15-1/4" x 22-5/16" x 31-5/8" (386mm x 565mm x 802mm)				
5014738 MOBILE WITH SINGLE SHELF	✓				
	18-5/16" x 21-13/16" x 31-1/8" (464mm x 552mm x 789mm)				
5014985 STATIONARY WITH DOUBLE SHELF	✓				
	36-1/4" x 22-5/16" x 31-5/8" (919mm x 565mm x 802mm)				
5014986 STATIONARY WITH DOUBLE SHELF	✓				
	36-3/16" x 23-3/4" x 31-9/16" (919mm x 603mm x 802mm)				



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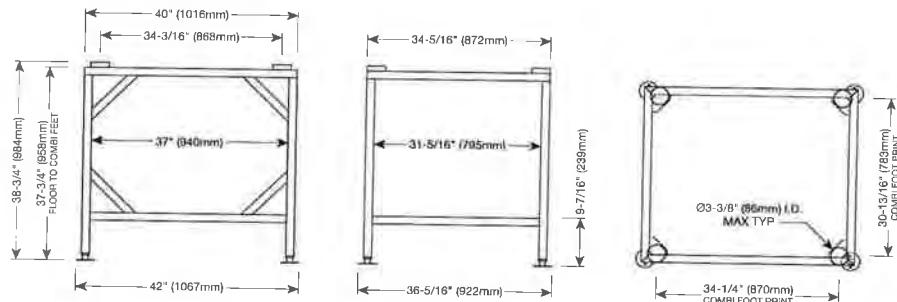
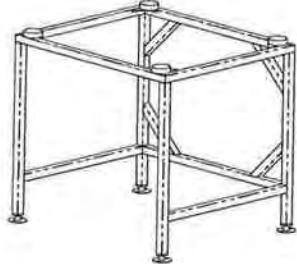


DUE TO ONGOING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

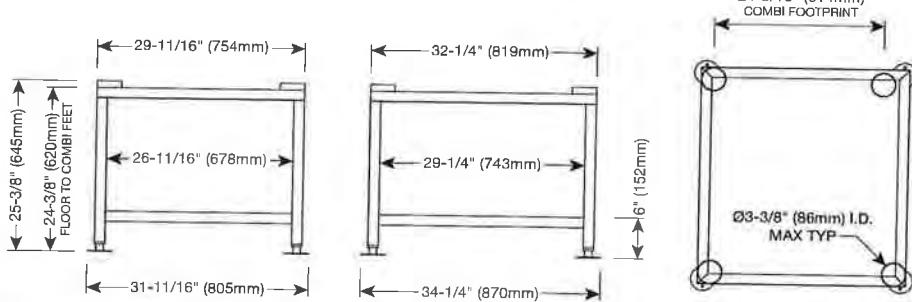
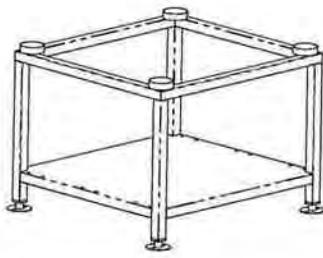
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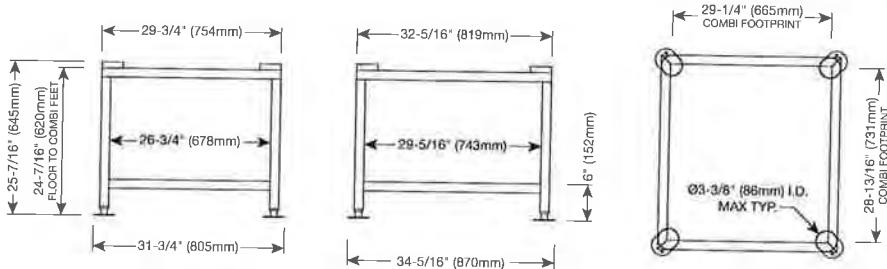
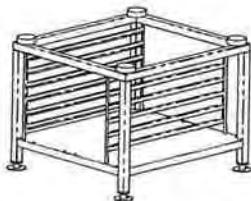
5016087
Stationary



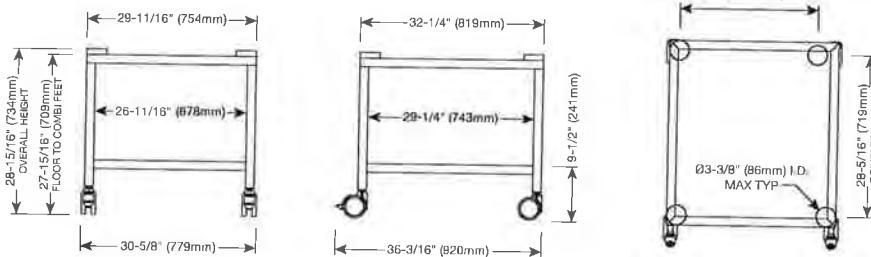
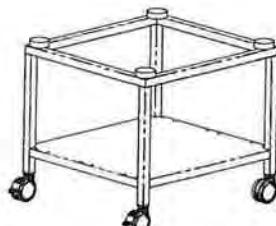
5016088
Stationary with Shelf



5016089
Stationary with Pan Slides & Shelf



5016090
Mobile with Shelf





EV9797-22

Kleensteam II Twin System

Everpure's second generation of total water treatment system for steam applications

CONNECT TO CW ON ITEM K11



Kleensteam II Twin System: EV9797-22

7CB5 Replacement Cartridge: EV9618-11

SS-10 Cartridge: EV9799-02

BENEFITS

A total system delivering high quality filtered water with scale inhibition and deliming capabilities

New dual cartridge design provides enhanced performance for low or high flow capacity steamers

Fine filters incoming water to improve the performance, maximize energy efficiency and increase the life of steam equipment

Reduces chlorine-induced corrosion

System is simple to install, operate and maintain

Easy deliming with Everpure's ScaleKleen, which is fed directly into the boiler through the SR-X bowl without use of hazardous chemicals or special piping

Long lasting SS-10 cartridge is more effective in higher alkalinity/hardness/TDS/temperature installations.

Sophisticated Hydroblend compound prevents limescale formation in high temperature steam applications

INSTALLATION TIPS

Choose a mounting location suitable to support the full weight of the system when operating

Use minimum 1/2" inlet water line (3/4" preferred)

Connect the system to the boiler feed water line only! Do not connect to the condenser water line!

Install vertically with cartridges hanging down

Allow 2-1/2" clearance below the cartridge for easy cartridge replacement

Flush cartridges by running water through filter for five minutes at full flow

OPERATION TIPS

Change 7CB5 cartridge on a regular 6 month preventative maintenance program, when capacity is reached or when pressure falls below 10 psi

Change SS-10 cartridge before Hydroblend™ compound is completely used up

Service flow rate must not exceed 2.5 gpm for single cartridge systems or 5.0 for dual cartridge systems

Always flush the filter cartridge at time of installation and cartridge change

Use for periodic deliming as needed by installing the dip tube assembly in place of the SS-10 and dissolving Scale Kleen in SR-X housing. Full deliming instructions are provided with the system

APPLICATION/SIZING

For commercial steam applications

For use with foodservice steamer and combi-oven applications

The Kleensteam II Twin System is shipped with two 7CB5 cartridges and no filter head plug

S P E C I F I C A T I O N S

Overall Dimensions:
25.5" H x 20.5" W x 7" D

Inlet connection: 3/4" FNPT

Outlet connection: 3/4" FNPT

Service Flow Rate:
Maximum 5.0 gpm (18.9 Lpm) - twin
cartridges

Pressure Requirements:
10 - 125 psi (0.7 – 8.6 bar), non-shock

Maximum water temperature at inlet:
100°F (38°C)

Alkalinity range:
2 to 12 grains per gallon

No electrical connection required

Shipping Weight: 28 lbs.

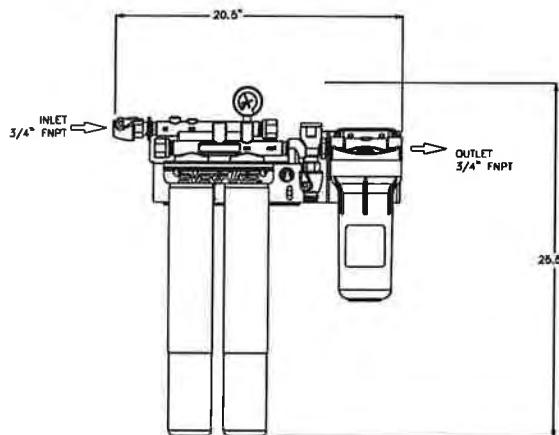
Operating Weight: 35 lbs.

The contaminants or other substances removed or reduced by this drinking water system are not necessarily in your water. Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system. Systems certified for cyst reduction may be used with disinfected water that may contain filterable cysts.

ScaleStick is NSF Certified under NSF/ANSI Standard 42 for materials

Kleensteam II Twin System

KleenSteam II - Twin Cartridge

**W A R R A N T Y**

Everpure water treatment systems (excluding replaceable elements) are covered by a limited warranty against defects in material and workmanship for a period of five years after date of purchase. Everpure replaceable elements (filter cartridges and water treatment cartridges) are covered by a limited warranty against defects in material and workmanship for a period of one year after date of purchase. See printed warranty for details. Everpure will provide a copy of the warranty upon request.

EVERPURE

EVERPURE, LLC
1040 Muirfield Drive
Hanover Park, Illinois 60133
Toll free (800) 323-7873
Tel (630) 307-3000
Fax (630) 307-3030
<http://www.everpure.com>

In Europe:
N.V. EVERPURE (EUROPE) S.A.
INDUSTRIEPARK WOLFSTEE
TOEKOMSTLAAN 30
B-2200 HERENTALS
BELGIUM
TEL 32-14-283500
FAX 32-14-283505

In Japan:
EVERPURE JAPAN LLC
HASHIMOTO MN BLDG. 7F
3-25-1 HASHIMOTO SAGAMIHARA-SHI
KANAGAWA 229-1103
JAPAN
TEL 81-(0)42-775-3011
FAX 81-(0)42-775-3015

Everpure, LLC
1040 Muirfield Drive
Hanover Park, IL 60133
Ph: 630-307-3000 Fax: 630-307-3030

DESCRIPTION: OPEN NO.

OPEN NUMBER

CUSTOM FABRICATED BY KEC

- Stainless Steel**
- Millwork**

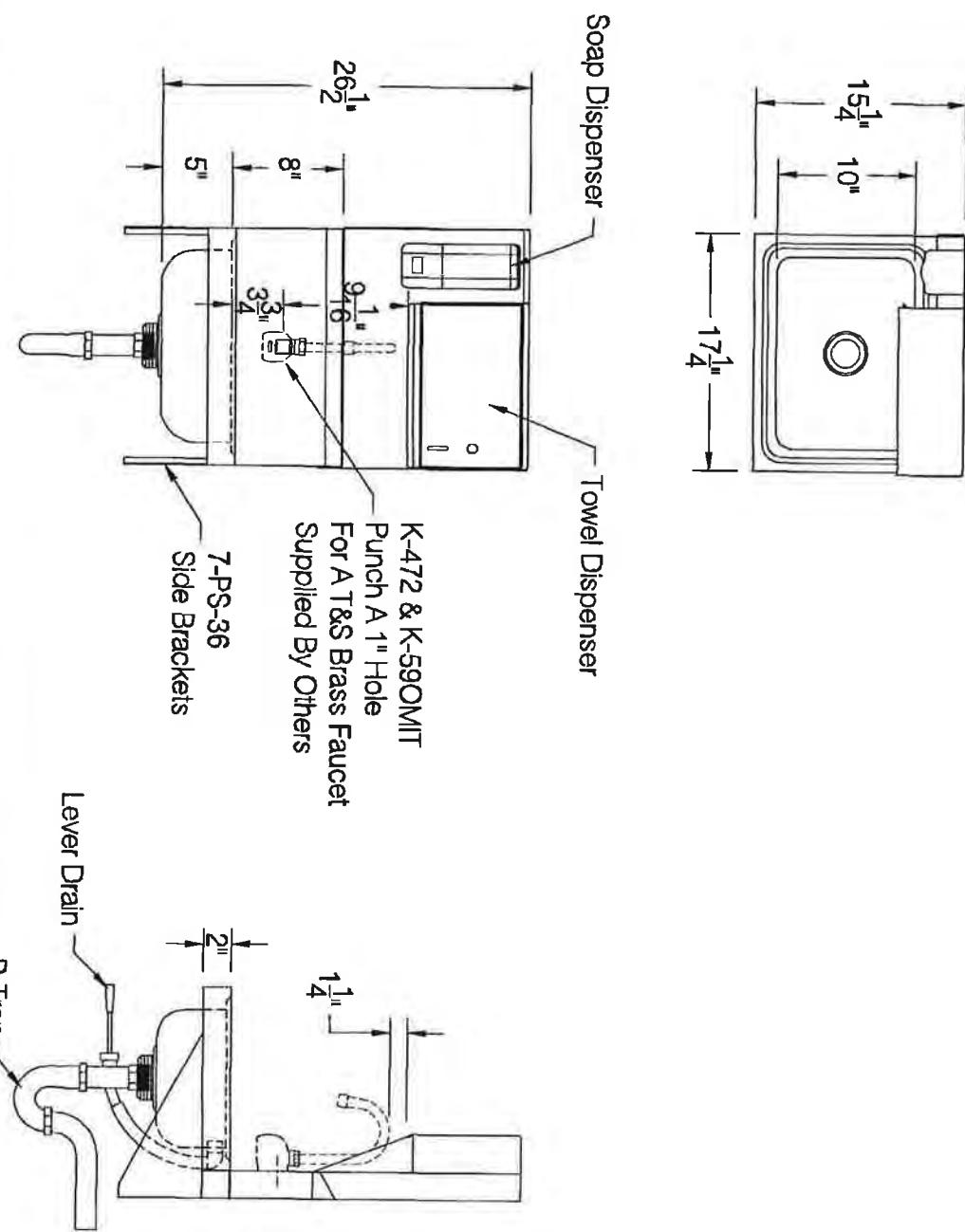
EXISTING EQUIPMENT

- Relocated by KEC**
- Remain In Place**

NOT IN KITCHEN EQUIPMENT CONTRACT (NIKEC)

- Equipment By Owner/Operator**
- Equipment By Vendor**
- Millwork By Architect/Interior Designer**
- Equipment by Others** _____.

REMARKS: _____



ADVANCE TABCO	
200 HEARTLAND BLVD EDGEMOOR, NY 11717-4380 TEL: 800-945-3186 FAX: 831-242-4689	
JOB NAME: 7-PS-80	PO# N/A
MODEL #: 7-PS-80	Order/Drawing # Typical Dwg
CUSTOMER: FoodStrategy Inc	MATERIAL: 20 Ga. 304 S/S DRAWN BY: T. Anderson

NSF logo is present in the middle row.

DATE: 08/25/10	NO. 1	REVISIONS: BY:	Print Approval
Scale: 1=12	2		Accessory Locations MUST Be Verified Prior To Unit Being Fabricated
	3		
	4		
	5		
	6		
	7		
	8		
Locations Verified By _____	Date _____		
Print Approved By _____	Date _____		

This Space For Architect/Engineer Approval
 Job Name _____ Date _____
 Model Specified _____ Quantity _____
 Customer/Wholesaler _____
 Contractor _____
 Architect/Engineer _____



FURNISHED w/ RIGID
 GOOSENECK AND 2.2 GPM
 AERATOR. REMOVE LOCK
 WASHER BELOW SWIVEL
 PIECE TO CONVERT TO
 SWIVEL ACTION

REQUIRES 1"
 DIA.
 MOUNTING
 HOLE

1"
 [25mm]

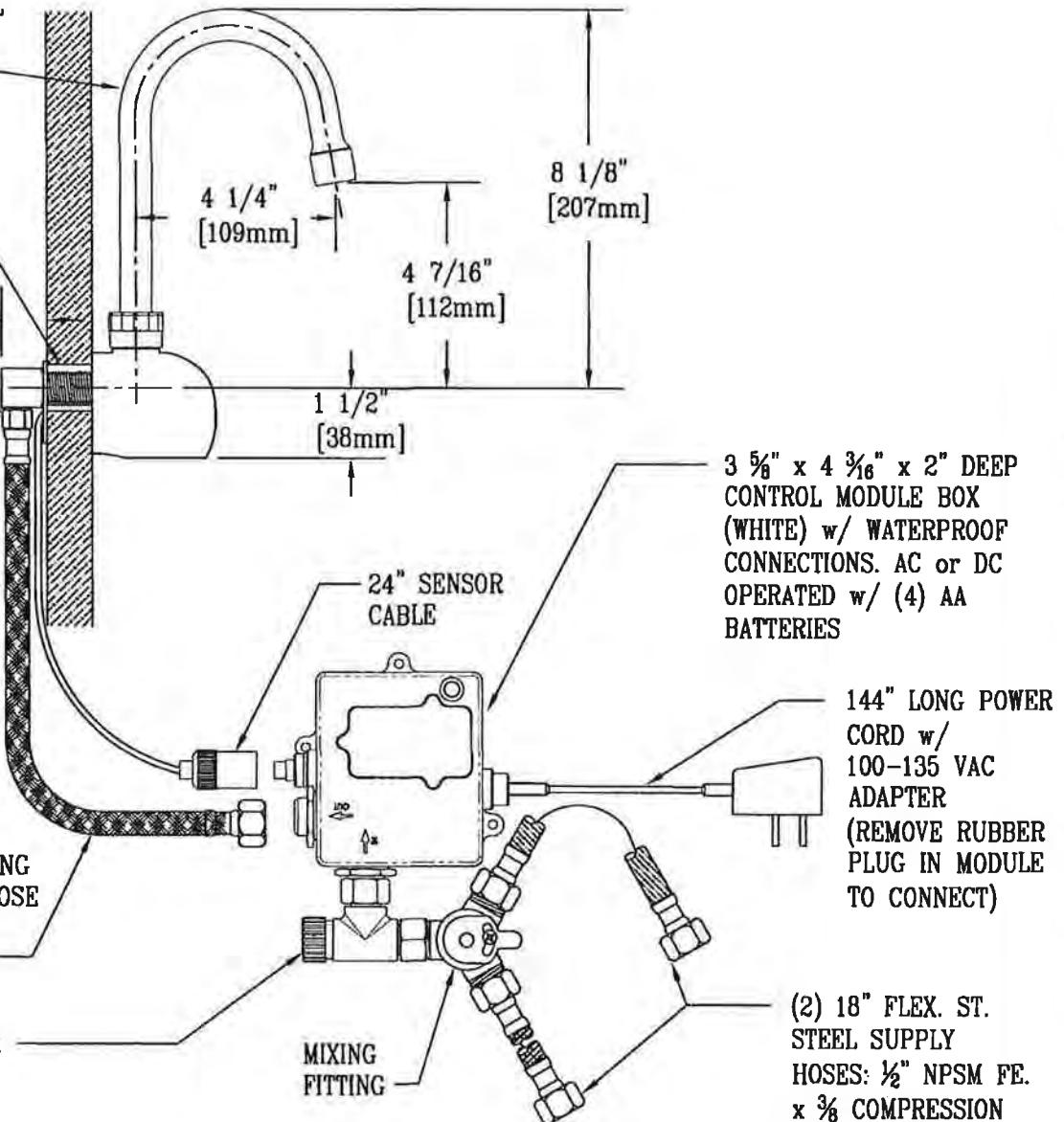
FURNISHED
 w/ SHORT EL.
 FOR
 RESTRICTED
 SPACE
 INSTALLATIONS

FURNISHED w/ 30" LONG
 FLEXIBLE ST. STEEL HOSE
 BETWEEN SHANK &
 CONTROL MODULE

REMOVEABLE STRAINER

NOTE:

SUPPLY STOPS BY OTHERS



MODEL NUMBER	DATE	SCALE	DRAWN	CHECKED	APPROVED
5EF-1D-WGAT	10/20/08	NTS	GEF	JRM	JHB



equip Foodservice Accessories
 P.O. BOX 1088, 2 SADDLEBACK COVE
 TRAVELERS REST, SOUTH CAROLINA 29690
 PHONE: 800.891.4808 FAX: 800.868.0084

DESCRIPTION

ELECTRONIC FAUCET: WALL MOUNT RIGID
 GOOSENECK w/ AERATOR, AC-DC CONTROL
 MODULE, TEMPERATURE CONTROL MIXING VALVE,
 AND 18" LONG HOT & COLD FLEX SUPPLY STOP HOSES

**FEATURES:**

Tile edge for ease of installation.

One piece **Deep Drawn** sink bowls with integral drainboards with splash.

Featuring the single bowl unit design.

All sink bowls have a large liberal 3" radius.

Placement of the welded leg assembly ensures stability and furnishes direct support of the column load requirement for the entire sink unit.

"940" series is supplied with adjustable front and rear cross brace featuring leg casting to secure left to right cross bracing.

CONSTRUCTION:

All TIG welded.

Welded areas blended to match adjacent surfaces and to a satin finish.

Gussets welded to a die-embossed reinforcing channel.

STAINLESS STEEL

REGALINE SINKS

Three Compartments - Two Drainboards

Item #: _____ Qty #: _____

Model #: _____

Project #: _____

MATERIALS:

Spec-Line (940 Series): 14 gauge type 304 stainless steel
11" High Splash.

Standard (930 Series): 16 gauge type 304 stainless steel
8" High Splash.

Super Saver (900 Series): 18 gauge type 304 stainless steel
8" High Splash.

- LEGS:**
- 1 5/8" diameter tubular stainless steel.
 - Stainless steel gussets & channels.
 - Stainless Steel 1" adjustable bullet feet.

YES! It's SeaMLess!

SPEC-LINE 940 Series14 Ga. 304 S/S
14" Water Level**STANDARD** 930 Series16 Ga. 304 S/S
12" Water Level**SUPER SAVER** 900 Series18 Ga. 304 S/S
12" Water Level

BOWL SIZE	O.A. LENGTH (inches) (mm)	DRBD. SIZE (inches) (mm)	MODEL #	Approx. Wt. (lbs.)	MODEL #	Approx. Wt. (lbs.)	MODEL #	Approx. Wt. (lbs.)	Cubic Feet
16 x 20 (406 x 508)	91" 2311	18" 457	94-3-54-18RL	230	93-3-54-18RL	189	9-3-54-18RL	182	49
	103" 2616	24" 610	94-3-54-24RL	248	93-3-54-24RL	197	9-3-54-24RL	190	55
	127" 3226	*36" 914	94-3-54-36RL	275	93-3-54-36RL	239	9-3-54-36RL	208	96
20 x 20 (508 x 508)	103" 2616	18" 457	94-23-60-18RL	248	93-23-60-18RL	203	9-23-60-18RL	198	59
	115" 2921	24" 610	94-23-60-24RL	276	93-23-60-24RL	220	9-23-60-24RL	195	65
	139" 3531	*36" 914	94-23-60-36RL	408	93-23-60-36RL	387	9-23-60-36RL	364	89
18 x 24 (457 x 610)	97" 2457	18" 457	94-63-54-18RL	323	93-63-54-18RL	289	9-63-54-18RL	226	62
	109" 2762	24" 610	94-63-54-24RL	334	93-63-54-24RL	304	9-63-54-24RL	233	85
	133" 3372	*36" 914	94-63-54-36RL	418	93-63-54-36RL	367	9-63-54-36RL	325	96
24 x 24 (610 x 610)	127" 3226	24" 610	94-43-72-24RL	390	93-43-72-24RL	331	9-43-72-24RL	318	98
	151" 3835	*36" 914	94-43-72-36RL	448	93-43-72-36RL	393	9-43-72-36RL	345	110
20 x 28 (508 x 711)	103" 2616	18" 457	94-83-60-18RL	358	93-83-60-18RL	315	9-83-60-18RL	277	83
	115" 2921	24" 610	94-83-60-24RL	394	93-83-60-24RL	346	9-83-60-24RL	305	95
	139" 3531	*36" 914	94-83-60-36RL	451	93-83-60-36RL	398	9-83-60-36RL	350	109

* Requires Two Faucets

* Regalines with 36" Drainboards are Supplied
with Two Sets of Legs for Support.

14" Water Level
17" Flood Level

12" Water Level
15" Flood Level

12" Water Level
15" Flood Level



Customer Service Available To Assist You **1-800-645-3166** 8:30 am - 8:00 pm E.S.T.

For Orders & Customer Service:

Email: customer@advancetabco.com or Fax: 631-242-6900

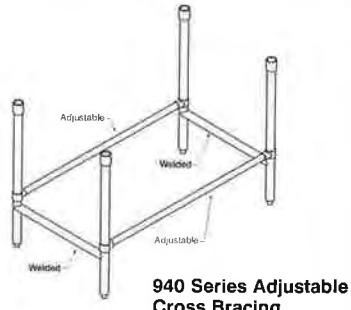
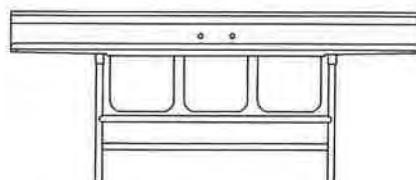
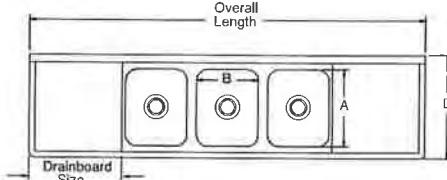
For Smart Fabrication™ Quotes:

Email: smartfab@advancetabco.com or Fax: 631-586-2933

DIMENSIONS and SPECIFICATIONS

TOL Overall: $\pm .500"$
Interior: $\pm .250"$

ALL DIMENSIONS ARE TYPICAL

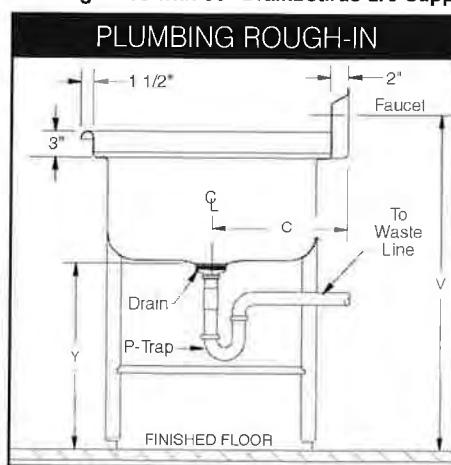


DESCRIPTION

BOWL (SIZE)	Overall Length	DRBD (SIZE)	Recommended Use	940 SERIES					900 & 930 SERIES								
				A	B	C	D	V	W	X	Y	Z	V	W	X	Y	Z
16x20	91" 103" 127"	18" 24" *36"	DISH SINKS	20"	16"	13 5/8"	27"	38"	11"	14"	20"	45"	38"	8"	12"	22"	42"
20x20	103" 115" 139"	18" 24" *36"	DISH & POT SINKS	20"	20"	13 5/8"	27"	38"	11"	14"	20"	45"	38"	8"	12"	22"	42"
18x24	97" 109" 133"	18" 24" *36"	POT & PAN SINKS	24"	18"	15 5/8"	31"	38"	11"	14"	20"	45"	38"	8"	12"	22"	42"
24x24	127" 151"	24" *36"	POT SINKS	24"	24"	15 5/8"	31"	38"	11"	14"	20"	45"	38"	8"	12"	22"	42"
20x28	103" 115" 139"	18" 24" *36"	PAN SINKS	28"	20"	17 5/8"	35"	38"	11"	14"	20"	45"	38"	8"	12"	22"	42"

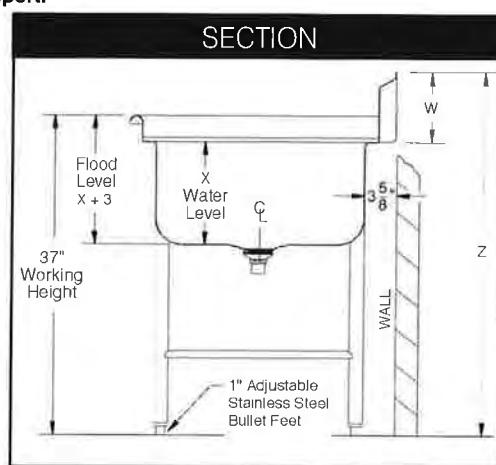
† Requires Two Faucets

* Regalines with 36" Drainboards are Supplied with Two Sets of Legs for Support.



MECHANICAL:

- Supply is 1/2" IPS hot & cold.
- Faucet holes on 8" centers.
- Faucets are not included ([see accessories](#)).
- Waste drains are 1 1/2" IPS S/S basket type, located in center of sink bowl, and are included.

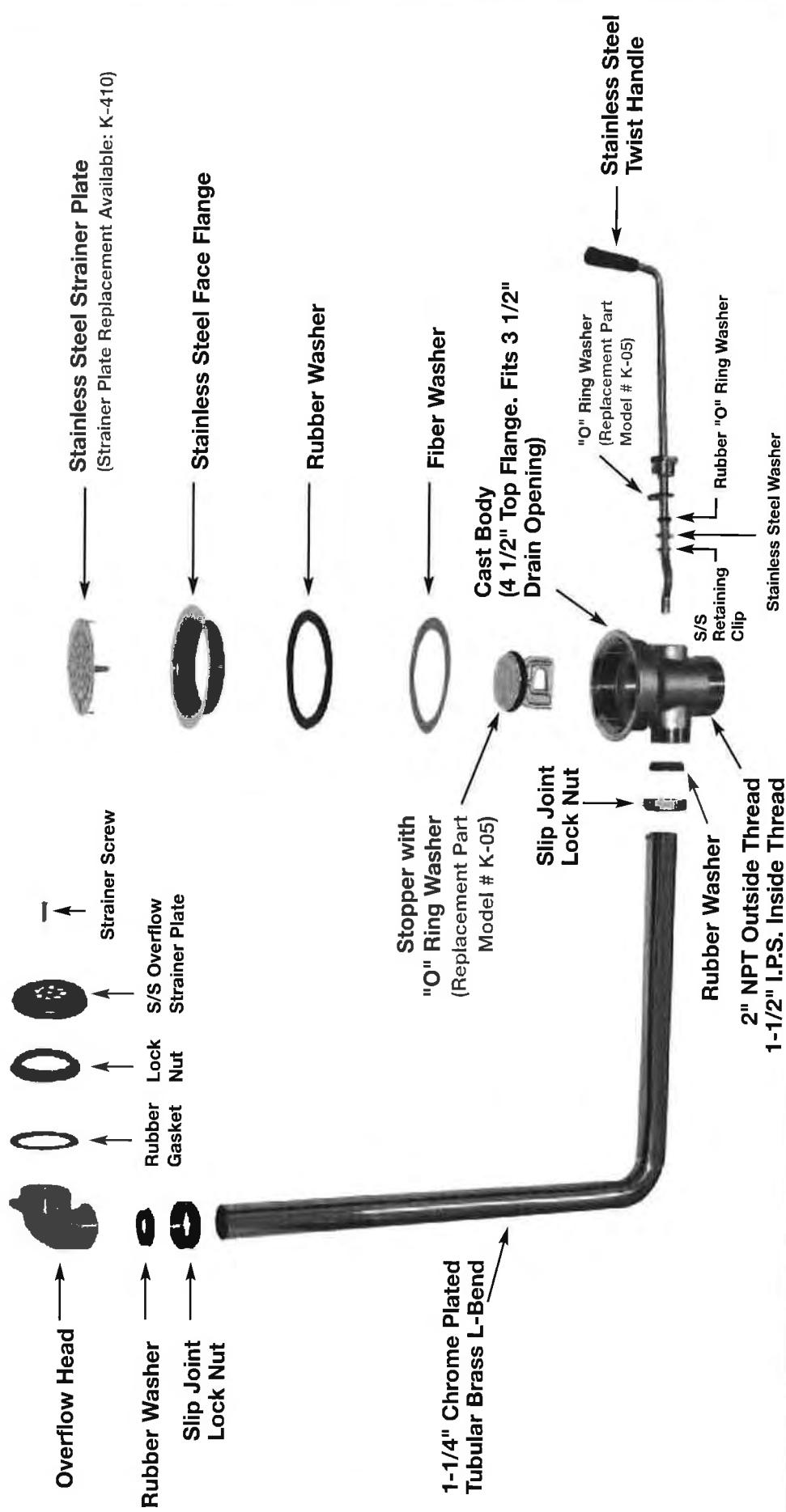


ADVANCE TABCO is constantly engaged in a program of improving our products. Therefore, we reserve the right to change specifications without prior notice.



TWIST HANDLE OPERATED DRAIN WITH OVERFLOW - EXPLoded VIEW

Model: K-15



Customer Service Available To Assist You 1-800-645-3166 8:30 am - 8:00 pm E.S.T.
 Email Orders To: customer@advancetabco.com. For Smart Fabrication™ Quotes, Email To: smartfab@advancetabco.com or Fax To: 631-586-2933

GEORGIA NEW YORK Fax: (631) 242-6900	TEXAS GEORGIA Fax: (770) 775-5625	NEVADA NEW YORK Fax: (972) 932-4795
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Fax: (775) 972-1578

FoodStrategy, Inc.

ADVANCE TABCO is constantly engaged in a program of improving our products. Therefore, we reserve the right to change specifications without prior notice. © ADVANCE TABCO, MAY 2011
 14048 AQUA WAIKI WAVE - KITCHEN



SINK DRAINS & ACCESSORIES

Lever Operated Drain



K-5

Lever Operated Drain With Overflow



K-15

Lever Operated Drain With Overflow



K-26

SPEC-LINE Lever Drain All Stainless Steel



K-40

3-1/2" Basket Drain



K-6

Replacement Drain Basket For K-6



K-310

Twist Drain Support Bracket



K-4

Replacement Strainer For K-5 and K-15



K-410



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smartfab@advancetabco.com



T&S BRASS AND BRONZE WORKS, INC.

2 Saddleback Cove / P.O. Box 1088
Travelers Rest, SC 29690



Model No.

B-0231-CR

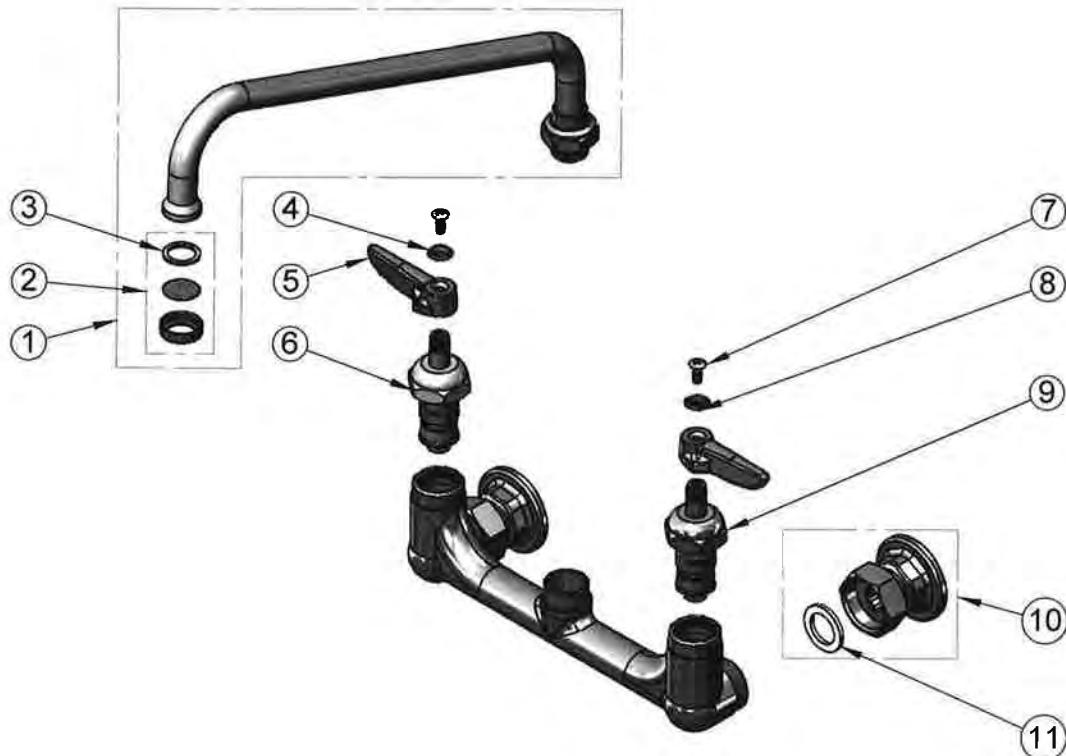
REG. #A2601

ISO #9001

Item No.

Travelers Rest, SC: 800-476-4103 • Simi Valley, CA: 800-423-0150 • Fax: 864-834-3518 • www.tsbrass.com

ITEM NO.	SALES NO.	DESCRIPTION
1	062X	12" Swing Nozzle Assembly
2	B-PT	Stream Regulator Assembly
3	001048-45	Nozzle Tip Washer
4	001661-45	Red Index-HW
5	001638-45	Lever Handle
6	011278-25	Cerama Cartridge RTC
7	000922-45	Lever Handle Screw
8	001660-45	Blue Index-CW
9	011279-25	Ceramic Cartridge LTC
10	00AA	Flange Assembly
11	001019-45	Coupling Nut Washer



Product Specifications:

8" Wall Mount Base Faucet, Cerama Cartridges, 062X Swing Nozzle,
Lever Handles & 00AA Wall Flanges

Drawn DHL	Checked KJG	Approved JHB
Scale: NTS		Date: 02/07/11

Sheet: 2 of 2



**STAINLESS STEEL & ALUMINUM
WALL SHELVES** 

KD Wall Shelf



Item #: _____ **Qty #:** _____

Model #: _____

Project #: _____

FEATURES:

Furnished with a 1 1/2" sanitary rolled rim with a 1-1/4" turn-up edge on sides and rear.

Unit is easily assembled employing the slip-fit TAB-LOK design.

CONSTRUCTION:

Shelf and brackets are die stamped and die formed.

MATERIAL:

WS-KD Series - 18 gauge stainless steel polished to a satin finish.

AWS-KD Series - Heavy gauge aluminum.

S/S	ALUMINUM	length
WS-KD-24	AWS-KD-24	24"
WS-KD-36	AWS-KD-36	36"
WS-KD-48	AWS-KD-48	48"
WS-KD-60	AWS-KD-60	60"

Standard Wall Shelf

FEATURES:

Brackets can be positioned to accommodate wall studs.

Furnished with a 1 1/2" sanitary rolled rim with a 1-1/2" turn-up edge at rear. Ends are turned down square.

CONSTRUCTION:

Secured to wall by means of bolts through support brackets.

Units 7 ft. and larger are furnished with 3 brackets.

MATERIAL:

16 Gauge Series - 304 stainless steel polished to a satin finish.

18 Gauge Series - 180 stainless steel polished to a satin finish.

Weld support brackets to
wall shelf



10" Wide		12" Wide		15" Wide		18" Wide		Approx. Wt.	Approx. Cubes
16 Ga.	18 Ga.								
WS-10-24-16	WS-10-24	WS-12-24-16	WS-12-24	WS-15-24-16	WS-15-24	WS-18-24-16	WS-18-24	10 lbs.	3
WS-10-36-16	WS-10-36	WS-12-36-16	WS-12-36	WS-15-36-16	WS-15-36	WS-18-36-16	WS-18-36	12 lbs.	4
WS-10-48-16	WS-10-48	WS-12-48-16	WS-12-48	WS-15-48-16	WS-15-48	WS-18-48-16	WS-18-48	14 lbs.	5
WS-10-60-16	WS-10-60	WS-12-60-16	WS-12-60	WS-15-60-16	WS-15-60	WS-18-60-16	WS-18-60	17 lbs.	6
WS-10-72-16	WS-10-72	WS-12-72-16	WS-12-72	WS-15-72-16	WS-15-72	WS-18-72-16	WS-18-72	19 lbs.	7
WS-10-84-16	WS-10-84	WS-12-84-16	WS-12-84	WS-15-84-16	WS-15-84	WS-18-84-16	WS-18-84	22 lbs.	8
WS-10-96-16	WS-10-96	WS-12-96-16	WS-12-96	WS-15-96-16	WS-15-96	WS-18-96-16	WS-18-96	26 lbs.	10
WS-10-108-16	WS-10-108	WS-12-108-16	WS-12-108	WS-15-108-16	WS-15-108	WS-18-108-16	WS-18-108	28 lbs.	11
WS-10-120-16	WS-10-120	WS-12-120-16	WS-12-120	WS-15-120-16	WS-15-120	WS-18-120-16	WS-18-120	31 lbs.	12
WS-10-132-16	WS-10-132	WS-12-132-16	WS-12-132	WS-15-132-16	WS-15-132	WS-18-132-16	WS-18-132	35 lbs.	13
WS-10-144-16	WS-10-144	WS-12-144-16	WS-12-144	WS-15-144-16	WS-15-144	WS-18-144-16	WS-18-144	38 lbs.	14

Length = 24" to 144" in 12" increments.



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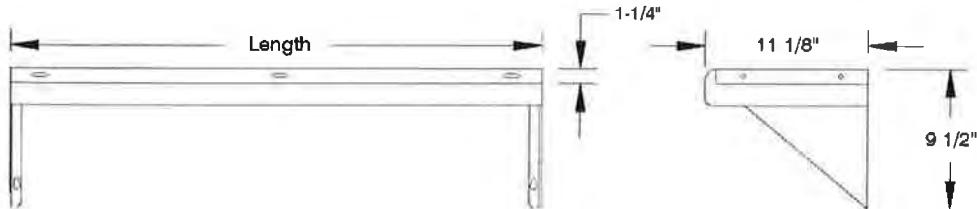
NEVADA
Fax: (775) 972-1578

DETAILS and SPECIFICATIONS

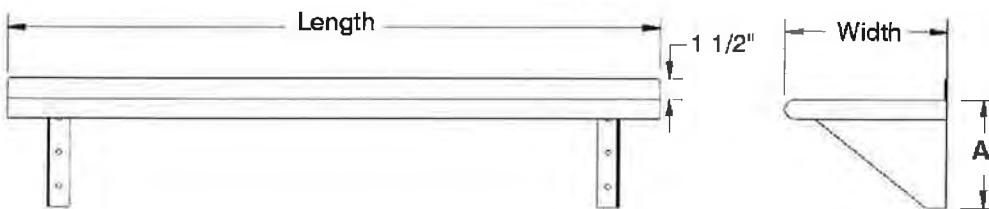
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ALL DIMENSIONS ARE TYPICAL

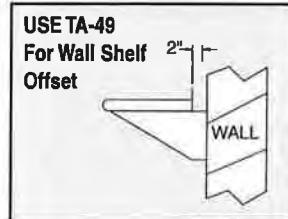
KD WALL SHELF



STANDARD WALL SHELF



Width	A
10"	8"
12"	10"
15"	10"
18"	10"

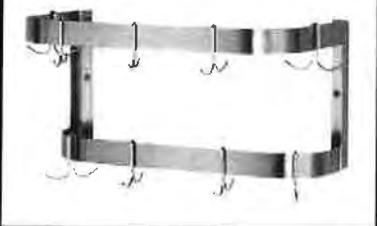


Requirements for NSF Installations

1. Install at least 60" above floor.
2. Limit to dry storage.
3. Avoid contact with liquids.
4. For "Ganging-Up" installation, allow at least 2" between units or mount units side by side and seal joints with an approved sealant.



ADVANCE TABCO is constantly engaged in a program of improving our products. Therefore, we reserve the right to change specifications without prior notice.

**CEILING MOUNTED****WALL MOUNTED****SHELF with POT RACK****FEATURES: (Ceiling Mounted)**

Ceiling suspension with chain hangers.
Optional stainless steel Flat Bar in lieu of
Chain available. Use **TA-98**.

MATERIAL:

Flat steel bar is 2" x 1/4", either stainless
steel or powder coated (as specified).

Pot hooks are plated.

24" long chain hangers are plated.

CONSTRUCTION:

All welded stainless steel units are
blended to a satin finish.

All powder coated units are coated with
FDA approved material.

Ceiling Mounted

L	S/S	POWDER COATED	# of Hooks	Wt
36"	SC-36	GC-36	12	23 lbs.
48"	SC-48	GC-48	12	26 lbs.
60"	SC-60	GC-60	18	29 lbs.
72"	SC-72	GC-72	18	32 lbs.
84"	SC-84	GC-84	18	36 lbs.
96"	SC-96	GC-96	18	44 lbs.
108"	SC-108	GC-108	18	48 lbs.
120"	SC-120	GC-120	18	51 lbs.
132"	SC-132	GC-132	18	55 lbs.
144"	SC-144	GC-144	18	58 lbs.

Wall Mounted

L	S/S	POWDER COATED	# of Hooks	Wt
24"	SW-24	GW-24	12	20 lbs.
36"	SW-36	GW-36	12	23 lbs.
48"	SW-48	GW-48	12	26 lbs.
60"	SW-60	GW-60	18	29 lbs.
72"	SW-72	GW-72	18	32 lbs.
84"	SW-84	GW-84	18	36 lbs.
96"	SW-96	GW-96	18	44 lbs.
108"	SW-108	GW-108	18	48 lbs.
120"	SW-120	GW-120	18	51 lbs.
132"	SW-132	GW-132	18	55 lbs.
144"	SW-144	GW-144	18	58 lbs.

Shelf with Pot Rack

L	12" Wide	Wt	15" Wide	Wt	18" Wide	Wt	# of Hooks
36"	PS-12-36	20 lbs.	PS-15-36	25 lbs.	PS-18-36	30 lbs.	6
48"	PS-12-48	30 lbs.	PS-15-48	35 lbs.	PS-18-48	40 lbs.	6
60"	PS-12-60	40 lbs.	PS-15-60	45 lbs.	PS-18-60	50 lbs.	9
72"	PS-12-72	50 lbs.	PS-15-72	55 lbs.	PS-18-72	60 lbs.	9
84"	PS-12-84	60 lbs.	PS-15-84	65 lbs.	PS-18-84	70 lbs.	9
96"	PS-12-96	70 lbs.	PS-15-96	75 lbs.	PS-18-96	80 lbs.	9
108"	PS-12-108	80 lbs.	PS-15-108	85 lbs.	PS-18-108	90 lbs.	9
120"	PS-12-120	90 lbs.	PS-15-120	95 lbs.	PS-18-120	100 lbs.	9
132"	PS-12-132	100 lbs.	PS-15-132	105 lbs.	PS-18-132	110 lbs.	9
144"	PS-12-144	110 lbs.	PS-15-144	115 lbs.	PS-18-144	120 lbs.	9

Units 8 ft. and larger are furnished with three (3) sets of supports brackets.

FEATURES: (Wall Mounted)

Secured to wall by means of bolts
through welded brackets.
(Hardware not provided)

MATERIAL:

Flat steel bar is 2" x 1/4", either stainless
steel or powder coated (as specified).

Pot hooks are plated.

CONSTRUCTION:

All welded stainless steel units are
blended to a satin finish.

All powder coated units are coated with
FDA approved material.

FEATURES: (Shelf/Pot Rack)

A dual purpose unit for shelf and utensil
storage.

Secured to wall by means of bolts
through welded brackets.
(Hardware not provided)

MATERIAL:

Flat stainless steel bar is 2" x 1/4".
Pot hooks are plated.
Type "430" stainless steel shelf.

CONSTRUCTION:

All welded stainless steel units are
blended to a satin finish.

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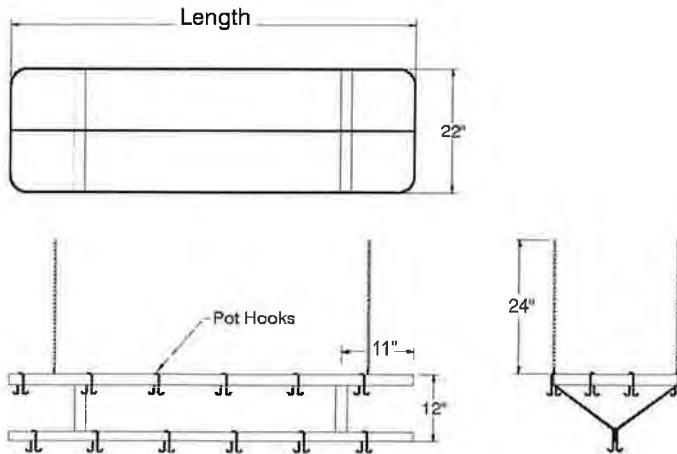
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Fax: (775) 972-1578

DETAILS and SPECIFICATIONS

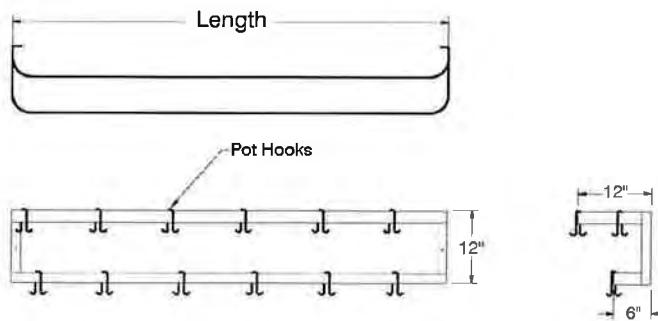
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ALL DIMENSIONS ARE TYPICAL

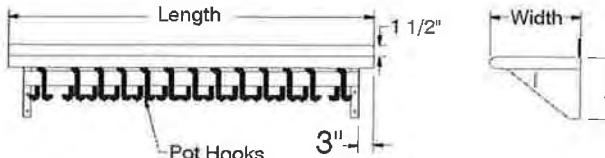
Ceiling Mounted



Wall Mounted

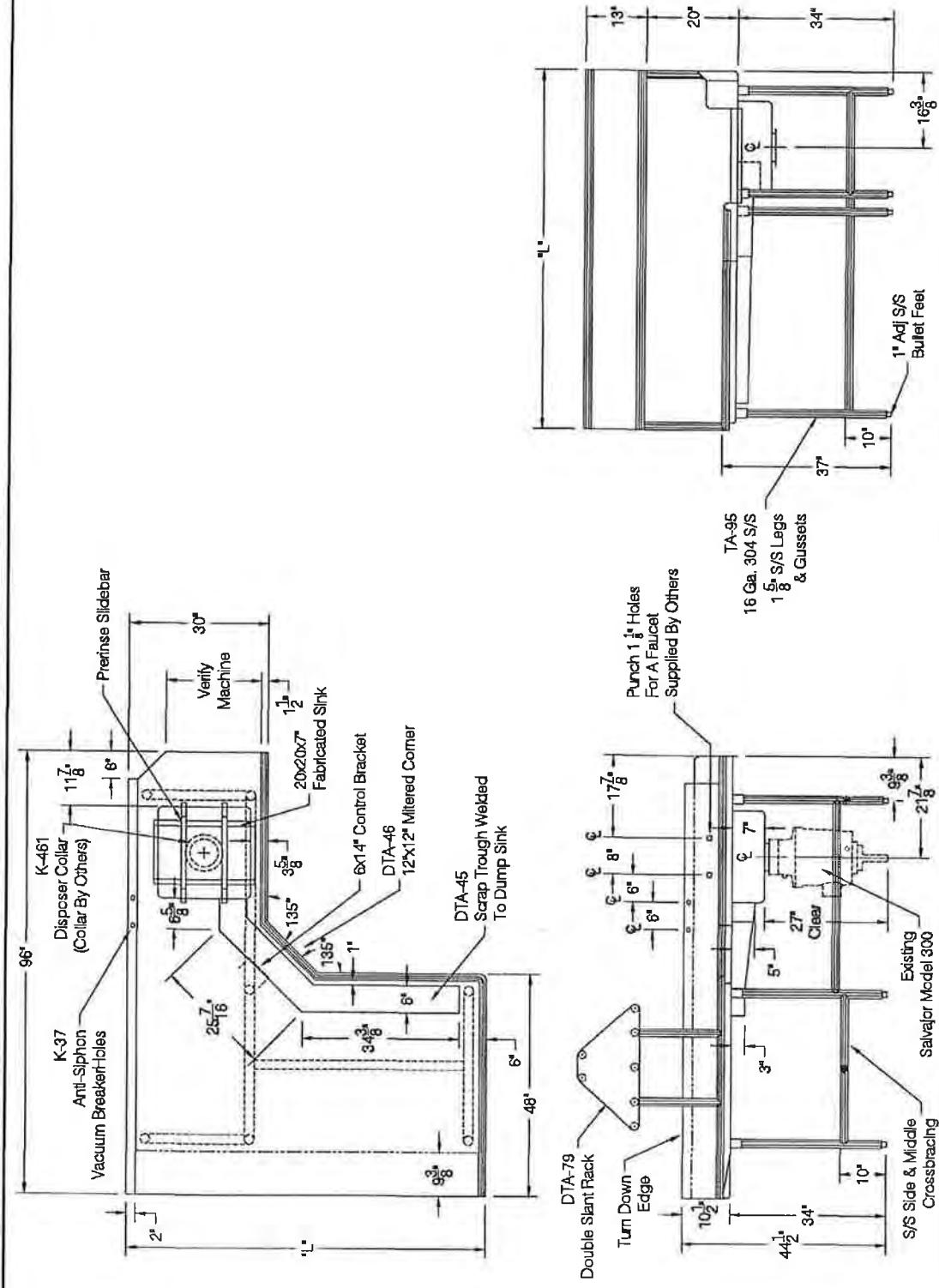


Shelf with Pot Rack



Width	A
12"	10"
15"	10"
18"	10"

Size and shape per plan



JOB NAME:		PO#	Order / Drawing#	DATE:	REVISIONS:	BY	Print Approval
MODEL #:	DTADV-X Option 2	NSF	Typical Dwg	07/07/08	1		
CUSTOMER:	FoodStrategy Inc		Top/Drainboard	Scale:	2		Accessory Locations MUST Be Verified Prior To Unit Being Fabricated
DRAWN BY:		T. Anderson	MATERIAL: 14 Ga. 304 S/S	3/8 = 12	3		Locations Verified By
ITEM #:		0	DRAWN BY:	4	6		Date
PRINT APPROVED BY:			PRINT APPROVED BY:	7	8		Date

ADVANCE TABCO
200 HEARTLAND BLVD
EDGWOOD, NY 11711-4380
TEL: 800-845-3166
FAX: 631-242-4689



T&S BRASS AND BRONZE WORKS, INC.

2 Saddleback Cove / P.O. Box 1088
Travelers Rest, SC 29690

Model No.

B-0133-CR-B-SWV

Item No.

Travelers Rest, SC: 800-476-4103 • Simi Valley, CA: 800-423-0150 • Fax: 864-834-3518 • www.tsbrass.com



This Space for Architect/Engineer Approval

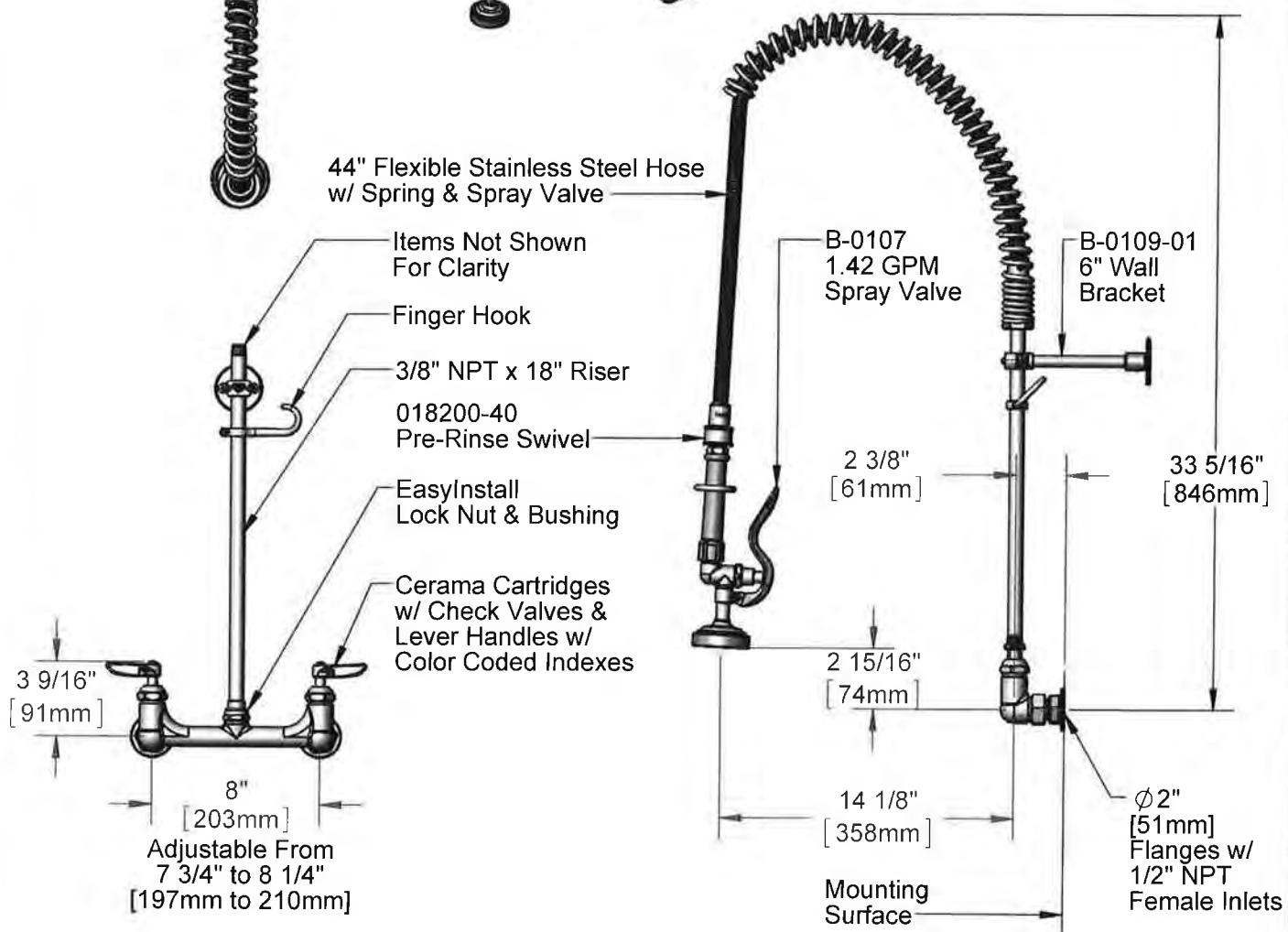
Job Name _____ Date _____

Model Specified _____ Quantity _____

Customer/Wholesaler _____

Contractor _____

Architect/Engineer _____



Product Specifications:

Pre-Rinse Unit: EasyInstall 8" Wall Mount Mixing Faucet, Cerama Cartridges w/ Check Valves, Lever Handles, 44" Flexible Stainless Steel Hose, 1.42 GPM Spray Valve w/ Swivel, 6" Wall Bracket & 1/2" NPT Female Inlets

Product Compliance:

ASME A112.18.1 / CSA B125.1
NSF 61 - Section 9
NSF 372 (Low Lead Content)
EPAct 2005 (PRSV)



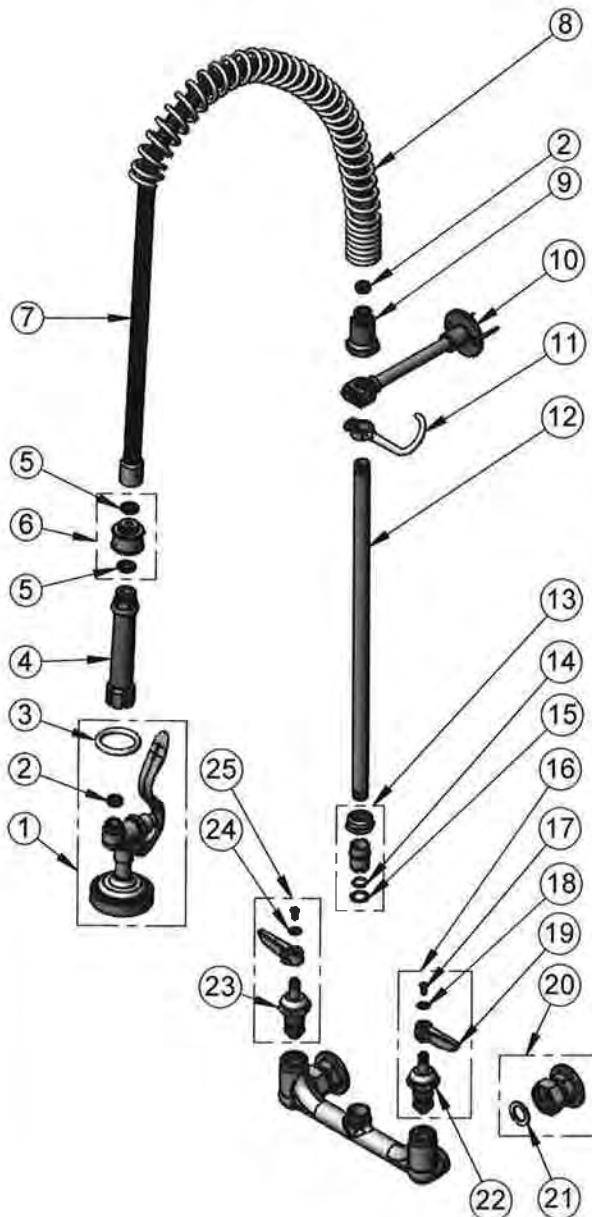
T&S BRASS AND BRONZE WORKS, INC.

2 Saddleback Cove / P.O. Box 1088
Travelers Rest, SC 29690

Model No.

B-0133-CR-B-SWV

Item No.

Travelers Rest, SC: 800-476-4103 • Simi Valley, CA: 800-423-0150 • Fax: 864-834-3518 • www.tsbrass.com

ITEM NO.	SALES NO.	DESCRIPTION
1	B-0107	1.42 GPM Spray Valve
2	010476-45	#27 Washer
3	000907-45	Spray Valve Hold Down Ring
4	002987-40	Grip Handle
5	001014-45	Washer, B-0100 Hose Barrel
6	018200-40	Pre-Rinse Swivel w/ (2) Washers
7	B-0044-H2A	44" Flexible Stainless Steel, Less Handle
8	000888-45	EasyInstall Overhead Spring
9	000821-40	Spring Body
10	B-0109-01	6" Wall Bracket
11	004R	Finger Hook
12	000369-40	3/8" NPT x 18" Riser
13	EZ-K	EasyInstall Kit: Nut, Bushing, O-ring & Lock Washer
14	001065-45	O-Ring
15	014200-45	Star Washer, Anti-Rotation
16	012447-25	Cerama Cartridge, LTC w/ Check Valve, Handle, Index & Screw
17	000922-45	Lever Handle Screw
18	001660-45	Blue Index-CW
19	001638-45	Lever Handle
20	00AA	1/2" NPT Female Eccentric Flange
21	001019-45	Coupling Nut Washer
22	012395-25	Cerama Cartridge, LTC w/ Check Valve
23	012394-25	Cerama Cartridge, RTC w/ Check Valve
24	001661-45	Red Index-HW
25	012446-25	Cerama Cartridge, RTC w/ Check Valve, Handle, Index & Screw

Product Specifications:

Pre-Rinse Unit: EasyInstall 8" Wall Mount Mixing Faucet, Cerama Cartridges w/ Check Valves, Lever Handles, 44" Flexible Stainless Steel Hose, 1.4 GPM Spray Valve w/ Swivel, 6" Wall Bracket & 1/2" NPT Female Inlets

Product Compliance:

ASME A112.18.1 / CSA B125.1
NSF 61 Section 9
NSF 372 (Low Lead Content)
EPAct 2005 (PRSV)

Drawn: DHL Checked: DMH Approved: JHB Date: 11/10/14 Scale: NTS Sheet: 2 of 2

3 H.P. Model 300

JOB:

Item No.:



NEMA 4 Watertight Controls



MSS

MRSS

ARSS-2

ARSS

Optional Line Disconnect (LD) available on MSS, MRSS, & ARSS

FOOD WASTE DISPOSER SPECIFICATIONS

CORROSION RESISTANT BODY

Permanent molded from heat treated aluminum alloy.

TEFLON LIP WATER SEAL

Protects the motor from damage by water.

TAPERED ROLLER BEARING

Provides longer motor life, quiet operation and shock absorbing.

WATER COOLED MOTOR

Provides maximum efficiency and longer life.

QUIET OPERATION

Extra thick rubber mounting adaptor and drain outlet isolates sound and eliminates vibration.

WASTE MIXING CHAMBER

Extra large to ensure proper mixture of water to waste.

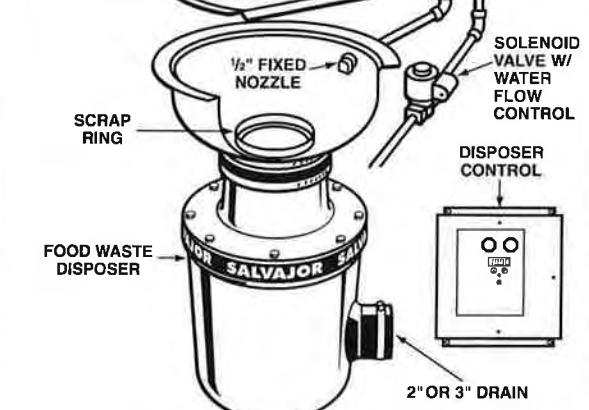
Cone Assembly

TABLE CUT-OUT:

12" CONE-12 7/8"

15" CONE-15 7/8"

18" CONE-18 7/8"



NOTE: INSTALL PER ALL APPLICABLE CODES

FULL LOAD AMPS

<input checked="" type="checkbox"/>	208 Volts	3 Phase	8.8 Amps
<input type="checkbox"/>	230 Volts	3 Phase	8.0 Amps
<input type="checkbox"/>	460 Volts	3 Phase	4.0 Amps

◆ SPECIFY EXACT OPERATING VOLTAGE ◆

Salvajor Model 300

Food Waste Disposer 3 HP – 3 Phase

DETAILS AND DIMENSIONS

SPECIFICATIONS:

MOUNTING – Rubber adaptor above grind chamber and rubber drain outlet isolates sound and eliminates vibration. No metal to metal contact.

EXTERIOR HOUSING – Permanent molded from heat treated, corrosion resistant aluminum alloy then computer machined to a smooth polished finish. Paint free.

SHREDDER – 9 inch diameter, machined high strength, wear resistant hardened carbide alloy.

ROTOR – 9 inch diameter with 4 cutter bars, machined high strength, wear resistant hardened carbide alloy.

MOTOR – 3 HP totally enclosed. Fan cooled and water cooled for efficiency and longer life. Built-in manual reset thermal overload protection. Available in 208-230/460 volts, 60 cycle, 3 phase.

BEARINGS – Tapered roller (top)
Sealed ball (bottom)

SEAL – Teflon Lip Water Seal.

WATER REQUIREMENT – 8 gallons of cold water per minute.

WASTE OUTLET – Rubber drain accepts 2" piping or 3" piping by removing drain insert.

DUAL DIRECTION GRINDING – Designed to operate in either direction. Direction of rotation can be controlled when installed with automatic reversing controls. *Reversing rotation can double cutting teeth life.*

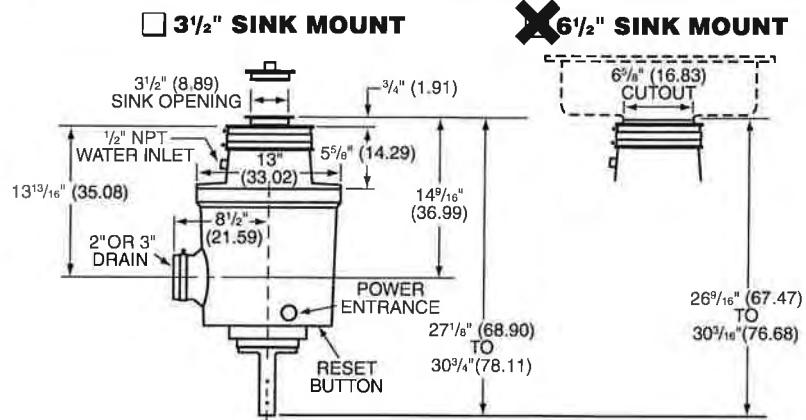
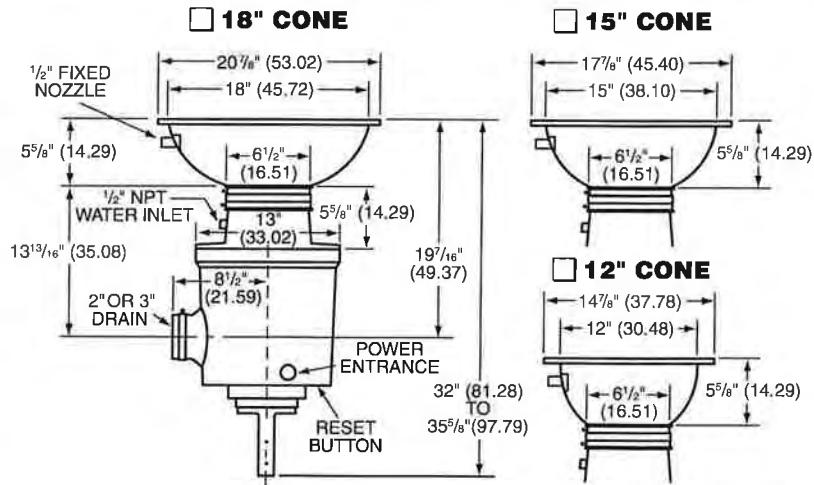
LEG SUPPORT – Single leg, adjustable.

ASSEMBLIES: (See Specification Sheet)

CA – Cone Assembly with 12", 15" or 18" Cone
SA – Sink Assembly with 3 1/2" or 6 1/2" Sink Collar

DISPOSER CONTROLS: (See Specification Sheet)

MSS: (Non Reversing)
MRSS: (Manual Reversing)
ARSS-2: (Automatic Reversing)
ARSS: (Automatic Reversing)



NOTE: Dimensions in parenthesis are in centimeters
(Specifications subject to change without notice)

Current specification details may be found online at www.salvajor.com

SAMPLE SPECIFICATION

300-CA-18	ARSS	(230/60/3)
Model	Cone Size	Disposer Control
Assembly		Electrical Specs.

◆ SPECIFY EXACT OPERATING VOLTAGE ◆



The Salvajor Company

4530 East 75th Terrace Kansas City, Missouri 64132-2081, USA

1-800-SALVAJOR

(816) 363-1030

FAX: 1-800-832-9373

www.salvajor.com

Email: sales@salvajor.com

service@salvajor.com

Manufacturers of Commercial Food Waste Disposing Systems since 1944

Pre-Wired Control Panels

FOR FOOD WASTE DISPOSER

Models: 75-100-150-200-300-500-750



MSS	NON-REVERSING 1-PHASE 115V, 208V, 230V 3-PHASE 208V, 230V, 460V <i>Best used with Models: 75 & 100</i> <i>For use in small to medium kitchens, vegetable prep areas, pot sink and soiled dish tables.</i>	SPECIFICATIONS: <ul style="list-style-type: none"> • NEMA 4 Stainless Steel Corrosion-Resistant Enclosure • Magnetic Contactor • START/STOP Push Buttons • Terminal Strip Connections 	ACCESSORIES: <ul style="list-style-type: none"> • Safety Line Disconnect (LD) • P - Mounted Solenoid Valve and Flow Control • PP - Mounted Solenoid Valve, Flow Control and Pressure Switch • #980104 - Mounting Bracket
MRSS	MANUAL REVERSING 1-PHASE 115V, 208V, 230V 3-PHASE 208V, 230V, 460V <i>Best used with Models: 100 & 150</i> <i>For use in small to medium kitchens, vegetable prep areas, pot sink and soiled dish tables.</i>	SPECIFICATIONS: <ul style="list-style-type: none"> • NEMA 4 Stainless Steel Corrosion-Resistant Enclosure • Manual Reversing Magnetic Contactors • START/STOP Push Buttons • Forward/Reverse Switch • Terminal Strip Connections 	ACCESSORIES: <ul style="list-style-type: none"> • Safety Line Disconnect (LD) • P - Mounted Solenoid Valve and Flow Control • PP - Mounted Solenoid Valve, Flow Control and Pressure Switch • #980104 Mounting Bracket for MRSS • #980105 Mounting Bracket for MRSS-LD
ARSS-2	AUTOMATIC REVERSING 1-PHASE 115V, 208V, 230V 3-PHASE 208V, 230V, 460V <i>Best used with all Models: 75, 100, 150, 200, 300, 500 & 750</i> <i>For use in medium to large kitchens, all prep areas and soiled dish tables.</i>	SPECIFICATIONS: <ul style="list-style-type: none"> • NEMA 4 Stainless Steel Watertight Enclosure • 24 Volt Safety Circuitry • Automatic Reversing Magnetic Contactors • Terminal Strip Connections • START/STOP Push Buttons 	ACCESSORIES: <ul style="list-style-type: none"> • P - Mounted Solenoid Valve and Flow Control • PP - Mounted Solenoid Valve, Flow Control and Pressure Switch • #980105 Mounting Bracket
ARSS	AUTOMATIC REVERSING 1-PHASE 115V, 208V, 230V 3-PHASE 208V, 230V, 460V <i>Best used with all Models: 75, 100, 150, 200, 300, 500 & 750</i> <i>For use in medium to large kitchens, all prep areas and soiled dish tables.</i>	SPECIFICATIONS: <ul style="list-style-type: none"> • NEMA 4 Stainless Steel Watertight Enclosure • Solid State Control Circuit • 24 Volt Safety Circuitry • 45 Second Drain Line Flush • Automatic Reversing Magnetic Contactors • Terminal Strip Connections • START/STOP Push Buttons • Energy/Water-Saving Mode • 3 Second Reversing Safety Delay • User Adjustable Run Time • LED Status Readout 	ACCESSORIES: <ul style="list-style-type: none"> • Safety Line Disconnect (LD) • P - Mounted Solenoid Valve and Flow Control • PP - Mounted Solenoid Valve, Flow Control and Pressure Switch • #980105 Mounting Bracket

SAFETY FEATURE:

All Salvajor Controls include an operator safety feature that prevents automatic starting of the disposer after a power interruption.

ALL SALVAJOR CONTROLS ARE:


HOBART701 S Ridge Avenue, Troy, OH 45374
1-888-4HOBART • www.hobartcorp.com**advansys VENTLESS
DOOR-TYPE DISHWASHER****STANDARD FEATURES**

- Internal condensing system minimizes water vapor
- Does not require a vent hood
- Energy recovery
- Sense-A-Temp™ 70°F rise electric booster heater
- .74 gallons per rack final rinse water
- 40 racks per hour – hot water sanitizing
- NSF pot and pan listed for 2-, 4- & 6- minute cycles plus condense time
- Timed wash cycles for 1, 2, 4 or 6 minutes plus condense time
- Solid state, integrated controls with digital status indicators
- Self-draining, high efficiency stainless steel pump and stainless steel impeller
- Stainless steel drawn tank, tank shelf, chamber, trim panels, frame and feet
- Spring counterbalanced chamber with UHMW polyethylene guides
- Revolving, interchangeable upper and lower anti-clogging wash arms
- Revolving, interchangeable upper and lower rinse arms
- Slanted, self-locating, one-piece scrap screen and basket system
- Pumped rinse for constant rinse pressure
- Cycle light
- End of cycle audible alarm (field activated)
- Automatic fill
- Door actuated start
- Automatic drain closure
- Delime cycle with notification (field activated)
- Service diagnostics
- NAFEM Data Protocol capable
- Straight-through or corner installation
- Hot water sanitation

VOLTAGE

- 208-240/60/1
 208-240/60/3
 480/60/3

MODEL

- AM15VL

OPTIONS AT EXTRA COST

- Single point electrical connection (3 phase only)

ACCESSORIES

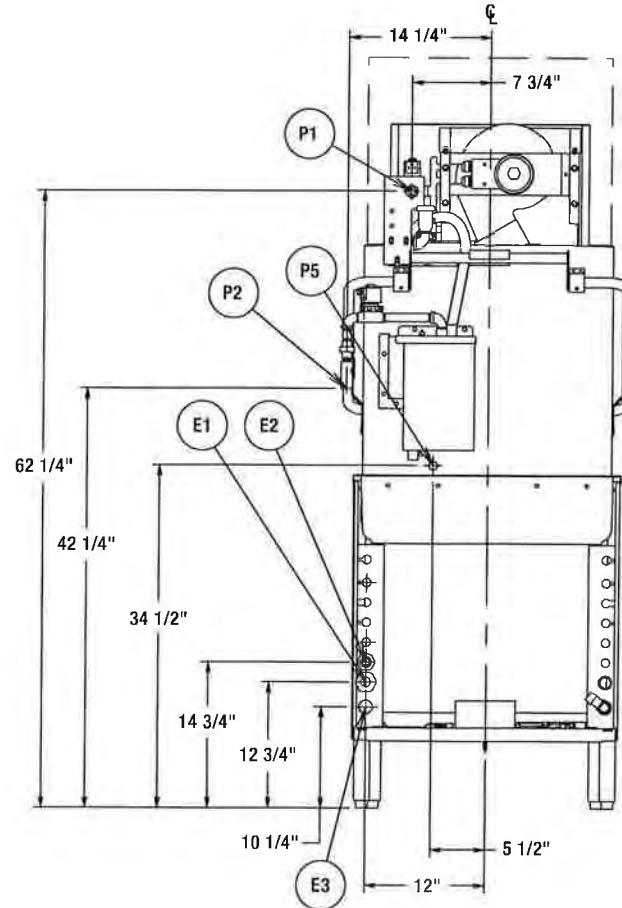
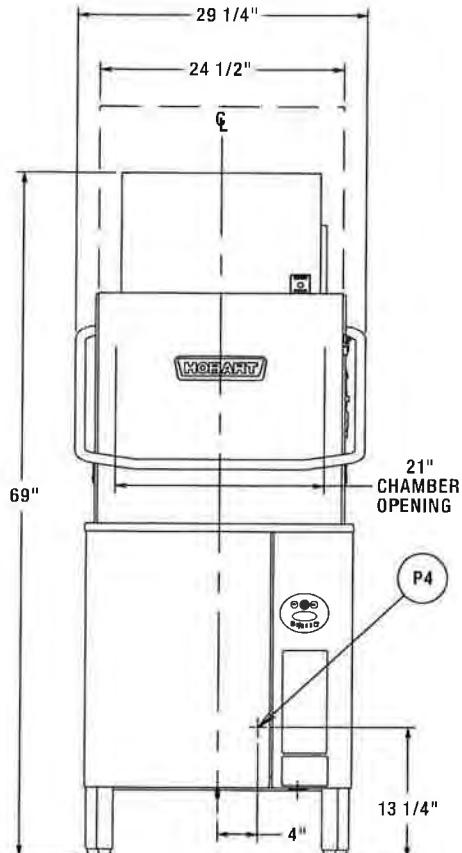
- Peg rack
 Combination rack
 Splash shield for corner installations
 Flanged and seismic feet
 Drain water tempering kit

Specifications, Details and Dimensions on Inside and Back.



advansys VENTLESS DOOR-TYPE DISHWASHER

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MACHINE
ELECTRICAL
SPECIFICATIONS
208-240/60/1
208-240/60/3
480/60/3

MODEL:
AM-15VL
E-941178
REV B

AM-15VL WITH ELECTRIC HEAT			
ELEC. SPECS	AMPS AMPS 3.4	WIRE SIZE IN CIRCUIT PROTECTOR CAPACITY	MAXIMUM OVERCURRENT PROTECTIVE DEVICE
208-240/60/1			50
208-240/60/3			30
480/60/3			15

WARNING

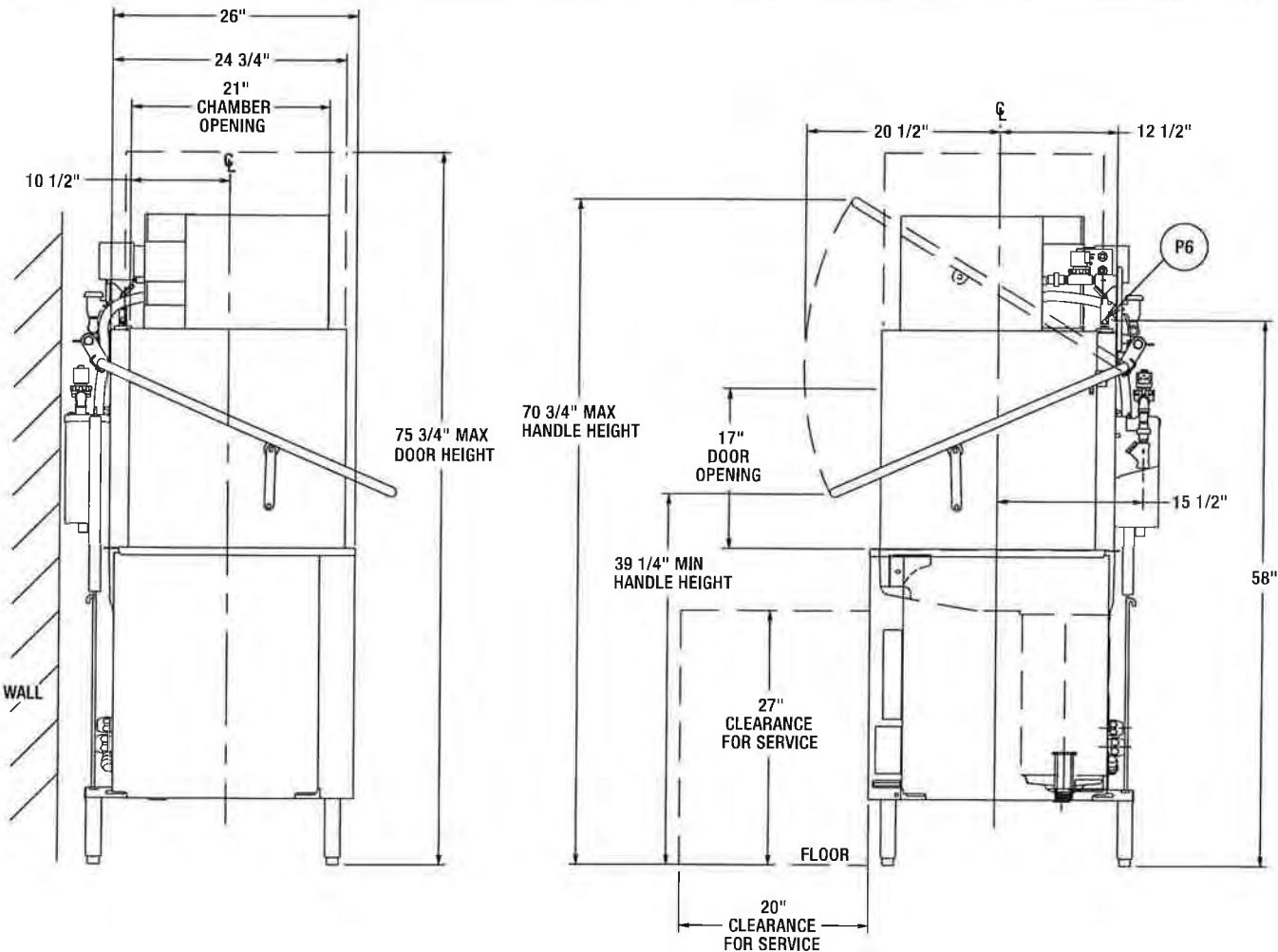
ELECTRICAL AND GROUNDING CONNECTIONS
MUST COMPLY WITH THE APPLICABLE
PORTIONS OF THE NATIONAL ELECTRICAL
CODE AND/OR OTHER LOCAL ELECTRICAL CODES.

PLUMBING CONNECTIONS MUST COMPLY
WITH APPLICABLE SANITARY, SAFETY,
AND PLUMBING CODES.

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advansys VENTLESS DOOR-TYPE DISHWASHER



**BOOSTER
ELECTRICAL
SPECIFICATIONS**
208-240/60/1
208-240/60/3
480/60/3

BOOSTER AMPACITY RATINGS 8.5KW

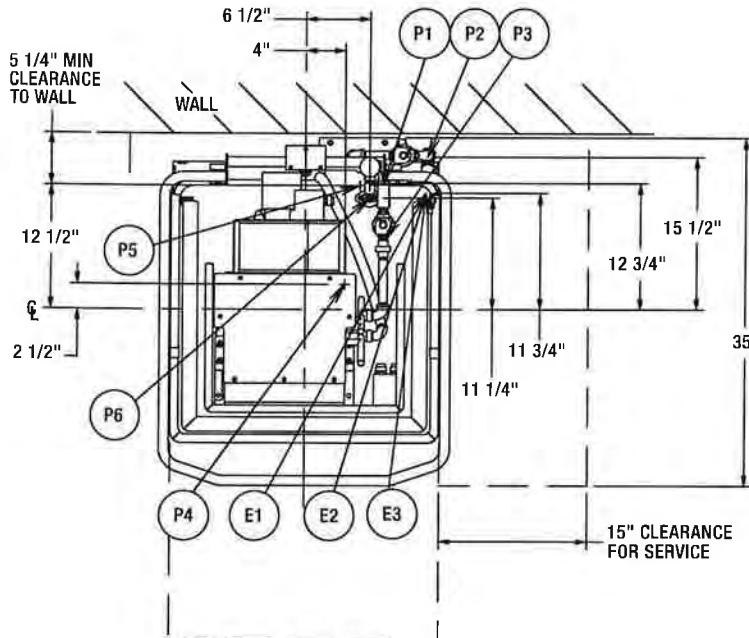
ELEC. SPECS	RATED AMPS	MIN. CIRCUIT BREAKER CAPACITY	MAXIMUM OVERCURRENT PROTECTIVE DEVICE
208-240/60/1			50
208-240/60/3	10.2	30	30
480/60/3	10.2	15	15

OPTIONAL AM15VL SINGLE POINT ELECTRICAL SERVICE CONNECTION AS SHOWN BELOW

ELEC. SPECS	RATED AMPS	MINIMUM SUPPLY CONDUCT OR AMPACITY	MAXIMUM PROTECTIVE DEVICE
208-240/60/3	45.4	60	60
480/60/3	23.7	60	30

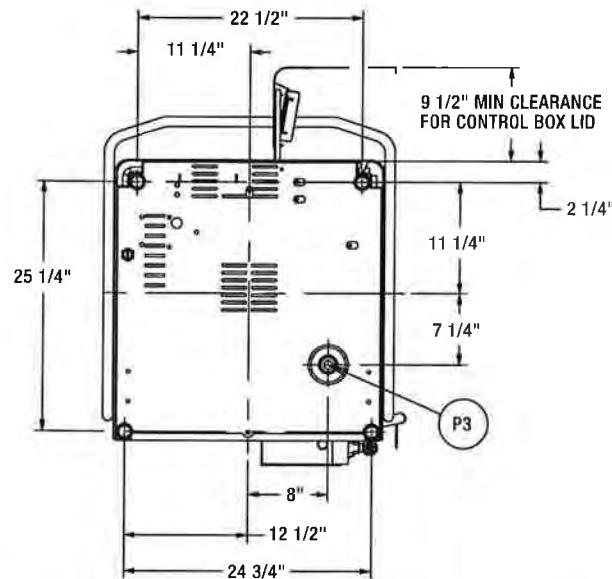
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CONNECTION INFORMATION
 (*AFF - ABOVE FINISHED FLOOR)

LEGEND

- E1 ELECTRICAL CONNECTION: MOTORS & CONTROLS (INCLUDING ELECTRIC HEAT). 1" OR 3/4" CONDUIT HOLE; 12-3/4" AFF.
- E2 ELECTRICAL CONNECTION: RINSE AGENT FEEDER, 1/2" CONDUIT HOLE, (DPS1 & DPS2) 1.5 AMPS @ NAMEPLATE SUPPLY VOLTAGE. (RPS1 & RPS2) 1.5 AMPS @ NAMEPLATE SUPPLY VOLTAGE; 14-3/4" AFF.
- E3 ELECTRICAL CONNECTION: ELECTRIC BOOSTER ONLY OR SINGLE POINT ELECTRICAL CONNECTION (3PH ONLY), 1" CONDUIT HOLE; 10-1/4" AFF.
- P1 COLD WATER CONNECTION: 90°F MAX. (65°F OPTIMAL); 1/2" FPT; 62-1/4" AFF.
- P2 HOT WATER CONNECTION: 110°F WATER MIN. (HOT WATER SANITIZING); 1/2" FPT; 42-1/4" AFF.
- P3 DRAIN: 1-1/2" MPT; 7-1/4" AFF.
- P4 DETERGENT PROBE SENSOR: REMOVE CAP AND STUD ASSEMBLY TO ACCESS 7/8" HOLE; 13-1/4" AFF.
- P5 DETERGENT FEEDER: REMOVE CAP PLUG TO ACCESS 7/8" HOLE; 34-1/2" AFF.
- P6 RINSE AGENT FEEDER: 1/8" NPT, REMOVE 1/8" NPT PIPE PLUG TO ACCESS TAPPED HOLE; 58" AFF.



RECOMMENDED CONDENSE TIMES (BASED ON INCOMING WATER TEMP.)			
INCOMING TEMP. (F°)	CONDENSE TIME (SEC.)	RINSE TIME (SEC.)	RACKS PER HOUR (1 MIN. CYCLE)
60	30	10	40
65	33	11	37
70	36	12	36
75	39	13	34
80	42	14	33
85-90	45	15	32

PLUMBING NOTES:

WATER HAMMER ARRESTOR (MEETING ASSE-1010 STANDARD OR EQUIVALENT) TO BE SUPPLIED (BY OTHERS) IN COMMON WATER SUPPLY LINE AT SERVICE CONNECTION.

RECOMMENDED WATER HARDNESS TO BE 3 GRAINS OR LESS FOR BEST RESULTS.

FOR CONVENIENCE WHEN CLEANING, WATER TAP SHOULD BE INSTALLED NEAR MACHINE WITH HEAVY DUTY HOSE AND SQUEEZE VALVE.

 THIS IS A PUMPED RINSE MACHINE.
 PRESSURE REGULATING VALVE IS NOT NECESSARY ON HOT OR COLD LINES.

MISCELLANEOUS NOTES:

ALL DIMENSIONS TAKEN FROM FLOOR LINE MAY INCREASE 3/4" OR DECREASE 1/2" DEPENDING ON LEG ADJUSTMENT.

NET WEIGHT OF MACHINE: 371 LBS.

DOMESTIC SHIPPING WEIGHT: 451 LBS.

SIZE OF RACKS - 19-3/4" X 19-3/4"

DRAIN LEVER LOCATED INSIDE TANK.

SINGLE POINT ELECTRICAL CONNECTION AVAILABLE ON 3 PH MACHINES ONLY.

APPROXIMATE HEAT GAIN TO SPACE WITHOUT VENT HOOD

TYPE	BTU/HR
LATENT	9,300
SENSIBLE	3,400

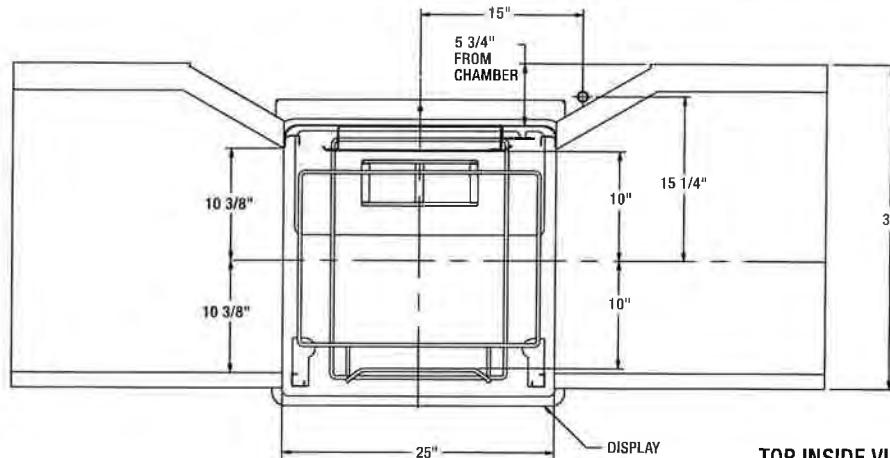
VENT HOOD IS NOT REQUIRED DUE TO INTERNAL CONDENSING SYSTEM.

CITY OF LA APPROVAL M-660004.

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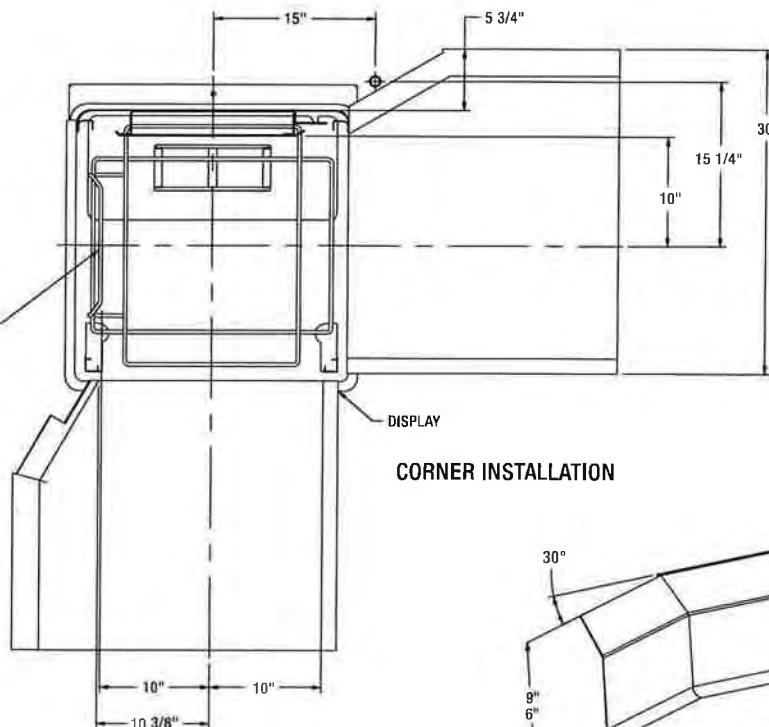
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advansys VENTLESS DOOR-TYPE DISHWASHER

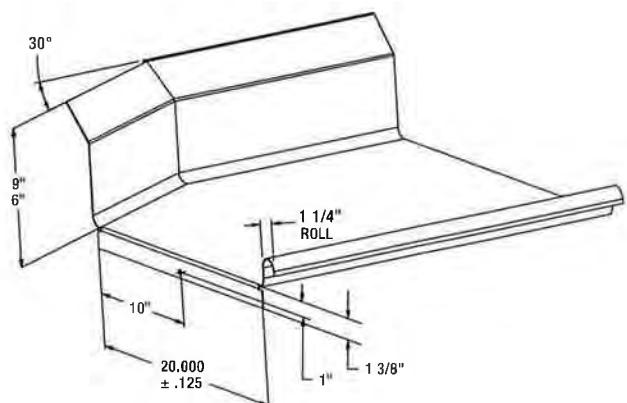


TOP INSIDE VIEW OF MACHINE

PASS THRU INSTALLATION



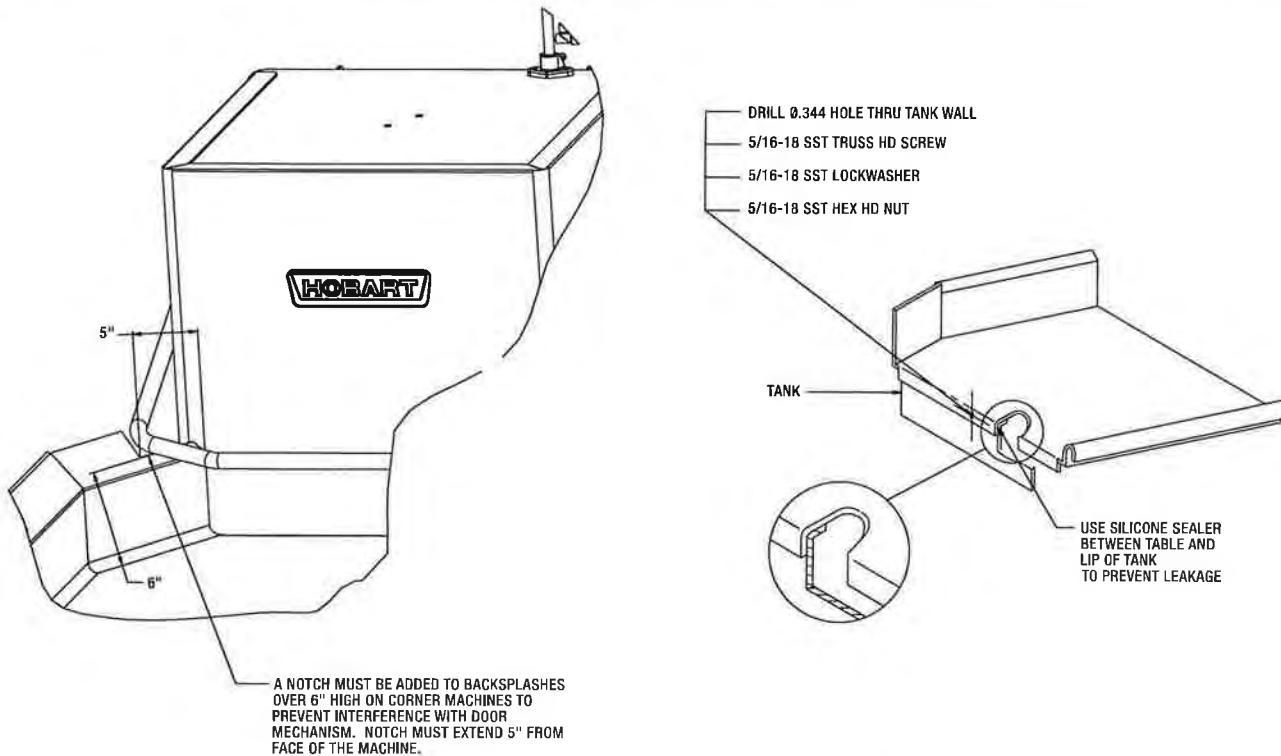
CORNER INSTALLATION



SUGGESTED TABLE DESIGN

advansys VENTLESS DOOR-TYPE DISHWASHER

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	advansys Ventless Door-Type Dishwasher
Machine Ratings (Mechanical)	
Racks per Hour (Max.)	40
Dishes per Hour (Average 25 per rack)	1,000
Glasses per Hour (Average 45 per rack)	1,800
Table to Table - Inside Tank at Table Connection (Inches)	25 ¹ / ₄ "
Overall Dimensions - (H x W x D) (Inches)	69" x 29 ¹ / ₄ " x 35"
Wash Motor H.P.	2
Wash Tank Capacity - Gallons	14
Wash Pump Capacity - Gallons per Minute - Weir Test	160
Electric Booster Heater (Kw)	8.5 Kw
Electric Heating Unit (Regulated)	5 Kw
Blower Motor H.P.	1 ¹ / ₂₀
Rinse Pump Motor H.P.	1 ¹ / ₁₅
Rinse - Minutes operated during hour of capacity operation	6.67
Seconds of rinse per rack	10
Rate of Rinse Flow - Gallons per Minute - at 20 lbs. Flow Pressure	4.4
Rinse Consumption - Gallons per Hour - Maximum - at 20 lbs. Flow Pressure	29.6
Rinse Cycle - Gallons per Rack - at 20 PSI Flow	.74 - 180°F Min.
Peak Rate of Drain Flow - Gallons per Minute (Initial rate with full tank)	14
Exhaust Requirements	0
Shipping Weight Crated - Approx. lbs. - Unit only	451

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advansys VENTLESS DOOR-TYPE DISHWASHER

The microcomputer-based control system is built into the **advansys** Ventless Door-Type Dishwasher. It is available in standard electrical specifications of 208-240/60/1, 208-240/60/3, 480/60/3 and is equipped with a reduced voltage pilot circuit transformer.

Water hardness must be controlled to 3 grains of hardness or less for best results.

CONSTRUCTION: Drawn tank, tank shelf and feet constructed of 16 gauge stainless steel. Wash chamber and front trim panel above motor compartment are polished, satin finish. Frame is 12 gauge stainless steel, chamber is 18 gauge, and removable trim panels are 20 gauge.

CHAMBER LIFT: Chamber coupled by stainless steel handle, spring counterbalanced. Chamber guided for ease of operation and long life.

WASH PUMP: With stainless steel pump and impeller, integral with motor assures alignment and quiet operation. Pump shaft seal with stainless steel parts and a carbon ceramic sealing interface. Easily removable impeller housing permits ease of inspection. Capacity 160 GPM. Pump is completely self-draining.

WASH PUMP MOTOR: Built for Hobart, 2 H.P., with inherent thermal protection, grease-packed ball bearings, splash-proof design, ventilated. Single-phase is capacitor-start, induction-run type. Three-phase is squirrel-cage, induction type.

RINSE PUMP: Powered by a $\frac{1}{15}$ H.P. single phase motor, the rinse pump is made of high strength engineered composite material.

BLOWER: The condenser blower is an all stainless steel forward curved centrifugal wheel powered by a $\frac{1}{20}$ H.P. TEFC single phase motor for nearly silent operation.

CONDENSER COIL: The condensing system using a tube and fin coil constructed of copper and corrosion resistant aluminum.

MICROCOMPUTER CONTROL SYSTEM: Hobart microcomputer controls, assembled within water-resistant enclosure, provide built-in performance and reliability.

The microcomputer control, relays and contactors are housed behind a stainless steel enclosure, hinged to provide easy access for servicing. The line voltage electrical components are completely wired with 105°C, 600V thermoplastic insulated wire with stranded conductors. Electrical components are

wired with type ST cord. Line disconnect switch NOT furnished.

CYCLE OPERATION: The microcomputer-timing program is started by closing the doors, which actuates the door cycle switch. The cycle light turns ON. The microcomputer energizes the wash pump motor contactor during the wash portion of the program. After the wash, a dwell permits the upper wash manifold to drain. At the end of the dwell, the final rinse pump is energized. After the final rinse pump turns off, Sani-Dwell permits sanitization to continue. The Rinse display remains on during this period. The Blower and Cold Water Valve turn on for 30 seconds to condense the vapor laden air inside of the chamber. The display shows a count down time (in seconds) during this operation. After the 30 seconds is complete the Cycle Light turns OFF, completing the program. If the microcomputer is interrupted during a cycle by the door-cycle switch, the microcomputer is reset to the beginning of the program. 40 racks per hour – 87 seconds: 38 Second Wash, 2 Second Dwell, 10 Second Rinse, 7 Second Sani-Dwell. 30 Second Condensing. Other programs can be pre-selected by your Hobart service technician.

Manual wash cycle selector also provides selection of 2-, 4- or 6-minute wash cycles plus condense time for heavier washing applications.

WASH: Hobart revolving stainless steel wash arms with unrestricted openings above and below provide thorough distribution of water jets to all dishware surfaces. Arms are easily removable for cleaning and are interchangeable. Stainless steel tubing manifold connects upper and lower spray system.

RINSE: Rotating rinse arms, both upper and lower, feature 14 rinse nozzles. The stainless steel upper and lower rinse arms are easily removable without tools for inspection and are interchangeable. The motor driven rinse pump gives constant rinse pressure regardless of water service supply pressure. Easy open brass line strainer furnished.

HOT FILL: Microcomputer controlled fill is supplied from the hot water service connection. It enters the machine through an air gap system which protects the potable water supply from contamination. Ratio fill method is used giving the correct fill at any flowing water pressure.

COLD WATER: Cold water supplied to condenser coil is heated during the condensing period at the end of each cycle. This pre-heated water is supplied to the booster for subsequent heating.

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DRAIN AND OVERFLOW: Large bell type automatic overflow and drain valve controlled from inside of machine. Drain automatically closed by lowering chamber. Drain seal is large diameter, high temperature "O" ring. Cover for overflow is integral part of the standpipe.

STRAINER SYSTEM: Equipped with large, exclusive self-flushing, easily removable perforated stainless steel, one-piece strainer and large capacity scrap basket. Submerged scrap basket minimizes frequent removal and cleaning.

HEATING EQUIPMENT: Standard tank heat is 5 KW electric immersion heating element. Water temperature regulation is controlled by thermistor sensor in combination with microcomputer controls. The tank heat and positive low water protection microcomputer circuits are automatically activated when the main power switch is turned "on". If tank is accidentally

drained, low water protection device automatically turns heat off. These features are standard with the Hobart Microcomputer Control System.

ENERGY RECOVERY: Heat energy is recovered from the condensation of vapors in the chamber at the end of each cycle. This pre-heats the water for the next rinse cycle from 55°F up to 140°F.

ELECTRIC BOOSTER HEATER: 8.5 KW electric booster with Sense-A-Temp™ technology adequately sized to raise 110°F inlet water to 180°F.

ACCESSORIES: 19 $\frac{3}{4}$ " x 19 $\frac{3}{4}$ " peg and combination dish racks. Splash shield for corner installations. End of cycle audible alarm (field activated). Delime notification (field activated). Desirable functional accessories can be furnished at added cost. See listed options and accessories on this specification sheet. Write to the factory for special requirements not listed above.

As continued product improvement is a policy of Hobart, specifications are subject to change without notice.



NEW Tile Edge Design

NSF



SPEC-LINE
DTC-K70-60L Shown

Optional Stainless Steel
UNDERSHELF
Die Cast LEG CLAMP
secured to shelf eliminates
unsightly nuts & bolts



10-1/2" EXTRA LARGE
Bold Looking Backsplash
with 2" return and tile edge



Nominal sizing on all
dishtables for ease of
installation.

STAINLESS STEEL DISHTABLES KORNER CLEAN

K-495 Turn down backsplash

K-397 Wall Bracket, for sink, price per sink

DTA-81 Leg Assembly, stainless steel with welded cross brace & stainless steel feet, for dishtables

Spec-Line: 14 ga. 304 Series Stainless Steel Top.
16 ga. 304 Stainless Steel Legs Stainless Steel Legs
with Welded Cross Bracing & Stainless Steel Bullet Feet.

UPGRADED! 16 ga. 304 Series Stainless Steel Top.
Standard: 16 ga. 304 Stainless Steel Legs Stainless Steel Legs
with Welded Cross Bracing & Stainless Steel Bullet Feet,

Super Saver: 16 ga. 304 Series Stainless Steel Top.
Galvanized Legs with Plastic Bullet Feet.

FEATURES:

Tile edge for ease of installation.
Dishtable system consists of SOIL and CLEAN sections.
Table is furnished with 10-1/2" splash with a 2" return.

CONSTRUCTION:

All TIG welded.
Welded areas blended to match adjacent surfaces and to a satin finish.
Stainless Steel Gussets welded to a stainless steel support channel.

ACCESSORIES	Model #	Qty
Wall Shelf		
Undershelf		

Nominal Size	"L"	SPEC-LINE	STANDARD	SUPER SAVER	Approx. Wt.
4 Ft.	47"	DTC-K30-48L or R	DTC-K70-48L or R	DTC-K60-48L or R	145 lbs.
5 Ft.	59"	DTC-K30-60L or R	DTC-K70-60L or R	DTC-K60-60L or R	165 lbs.
6 Ft.	71"	DTC-K30-72L or R	DTC-K70-72L or R	DTC-K60-72L or R	190 lbs.
7 Ft.	83"	DTC-K30-84L or R	DTC-K70-84L or R	DTC-K60-84L or R	205 lbs.
8 Ft.	95"	DTC-K30-96L or R	DTC-K70-96L or R	DTC-K60-96L or R	215 lbs.
9 Ft.	107"	DTC-K30-108L or R	DTC-K70-108L or R	DTC-K60-108L or R	330 lbs.
10 Ft.	119"	DTC-K30-120L or R	DTC-K70-120L or R	DTC-K60-120L or R	350 lbs.
12 Ft.	143"	DTC-K30-144L or R	DTC-K70-144L or R	DTC-K60-144L or R	370 lbs.



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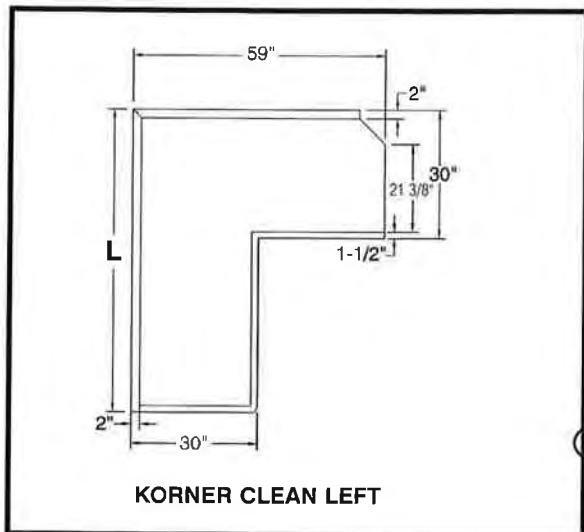
TEXAS
Fax: (972) 932-4795

NEVADA
Fax: (775) 972-1578

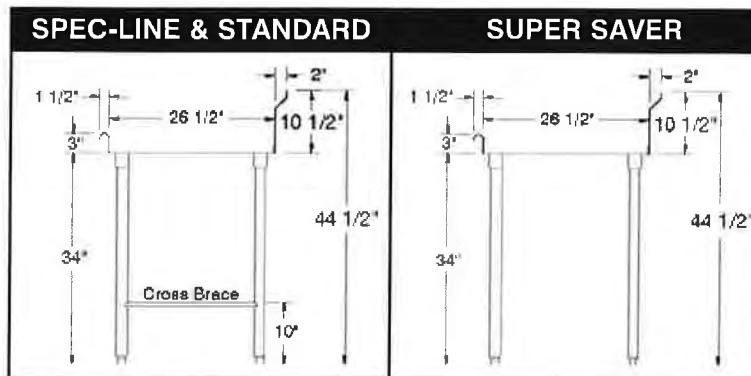
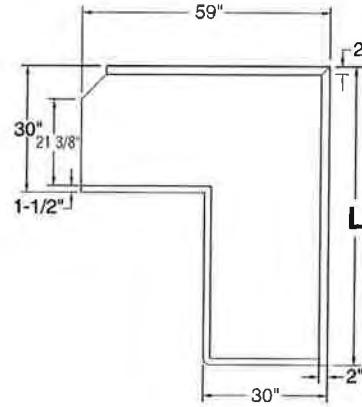
TOL ± .500"

DIMENSIONS and SPECIFICATIONS

ALL DIMENSIONS ARE TYPICAL

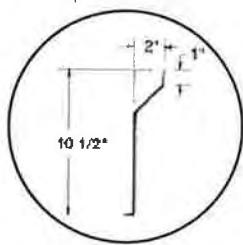
SEE DISH MACHINE COMPATIBILITY CHART TO ENSURE PROPER FITDish Machine Compatibility Chart can be found on our website at www.advancetabco.com under "Product Support"DISH
MACHINE

OPERATOR



*CUSTOMIZE YOUR OWN SYSTEM
by Ordering Optional Accessories from our
PRODUCT & PRICE GUIDE*

Splash Detail



Description	SPEC-LINE	STANDARD	SUPER SAVER
Material	14 Ga. 304 Series	16 Ga. 304 Series	16 Ga. 304 Series
1 5/8" Dia. Legs	Stainless Steel	Stainless Steel	Galvanized
Gussets	Stainless Steel	Stainless Steel	Stainless Steel
Bullet Feet (1" adj.)	Stainless Steel	Stainless Steel	Plastic
Cross Bracing	Welded	Welded	Optional



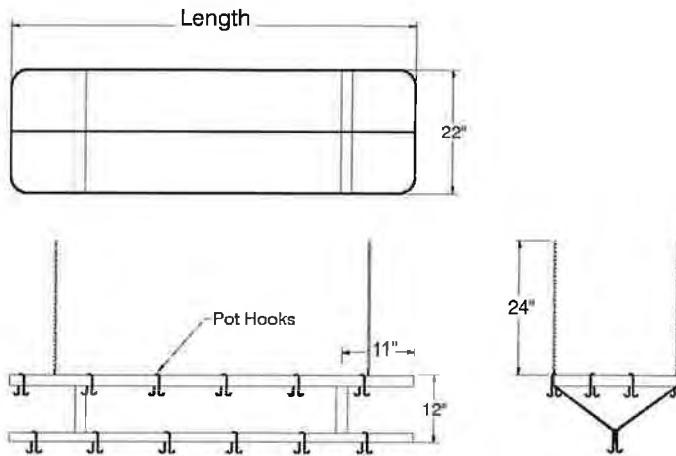
ADVANCE TABCO is constantly engaged in a program of improving our products. Therefore, we reserve the right to change specifications without prior notice.

DETAILS and SPECIFICATIONS

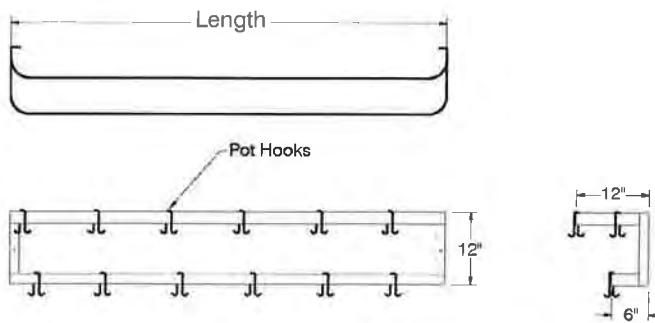
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ALL DIMENSIONS ARE TYPICAL

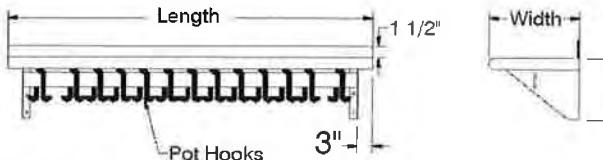
Ceiling Mounted



Wall Mounted



Shelf with Pot Rack



Width	A
12"	10"
15"	10"
18"	10"

Weld support brackets to
wall shelf





Item # _____

Job _____

ADJUSTABLE POLYMER “POKER CHIP” DISH DOLLY PCD SERIES

Adjustable:

- Metro's Adjustable Poker Chip Dish Dolly is perfect for holding multiple size dishes — anything from small 4 1/4-inch dishes to 11 3/4-inch dinner plates and platters.
- Easy one-handed adjustments on the underside of the dolly allows for flexibility and maximum loading density.

Maneuverable:

- Four recessed handles make it easy to maneuver in and out of tight areas and saves space. The compact design allows for maximum space utilization and convenient under counter storage.
- Four 5" (127mm) diameter swivel casters (two with brakes) with neoprene wheels provide for easy maneuverability and positioning.

Two-Handed Access:

- Unique design allows fast, safe and easy two-handed access to all dish columns. Minimize dish breakage and easily load and unload dishes.

Durable Construction:

- Sturdy polymer construction is extremely safe for dishes, easy to clean, and is resistant to cracking, peeling or chipping.

Sanitary:

- Dividers and tower are removable to facilitate cleaning.
- Smooth, rounded corners and seamless cart surfaces eliminate cracks and crevices and simplify cleaning.
- Built-in drain holes promote cleanability and eliminates the possibility of water build up.
- Dishes are stored 12" (305mm) above the floor surface, minimizing dust and water marks from floor dirt and splashing.
- Included translucent vinyl cover protects clean dishes from dust and water splashes while in storage and allows workers to view contents without removing the cover.
- NSF Listed.

Microban® Antimicrobial Product Protection:

- Cart body has built-in *Microban® Antimicrobial Product Protection which inhibits the growth of bacteria, mold, mildew, and fungi that cause odors, stains, and product degradation.



PCD11A

NSF



PCD11A

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InterMetro Industries Corporation
North Washington Street
Wilkes-Barre, PA 18705
www.metro.com



Adjustable Polymer “Poker Chip” Dish Dolly PCD Series

16.21

Job _____

16.21**Adjustable Polymer "Poker Chip" Dish Dolly PCD Series****ADJUSTABLE POLYMER "POKER CHIP" DISH DOLLY PCD SERIES****Specifications**

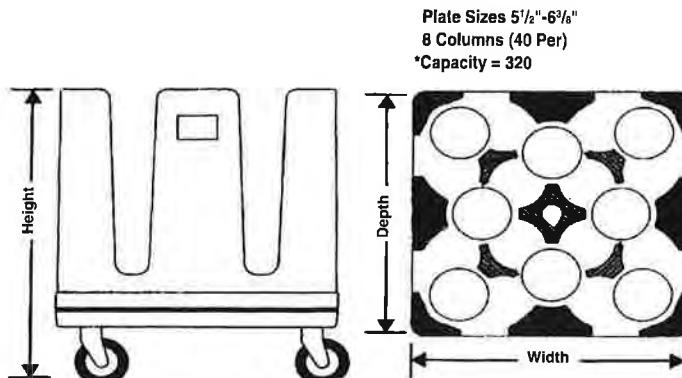
Material: High-density polymer containing Microban Antimicrobial product protection.

Construction: Seamless, molded polymer construction, equipped with handgrips on all four sides.

Casters: Four B5DN swivel casters (two with brakes). Ball bearing swivel; ball bearing axle. Nickel-plated, pre-lubricated casters with neoprene tires. Casters are bolted to an internal metal support plate.

Protective Cover: Standard heavy-duty 6-mil vinyl cover.

Standard Unit: Four dividers, center column and protective cover provided with each dolly.

**Dimensions**

Model No	Height (in.) (mm)	Width (in.) (mm)	Depth (in.) (mm)	Approx Pkd. Wt (lbs.) (kg)
PCD11A	31 $\frac{15}{16}$ 812	26 $\frac{5}{8}$ 677	26 $\frac{5}{8}$ 677	65 30

Accessories

Model No	Description
AD11A	4 Additional Dividers
PCDV11A	Additional Cover

*Loading capacity depends upon china shape and thickness. Usable column height is 20" (508mm).

SAMPLE CONFIGURATIONS (Standard Unit)

Plate Sizes 6 $\frac{1}{2}$ "-7 $\frac{3}{8}$ "
8 Columns
*Capacity = 320

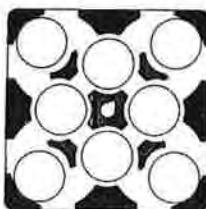


Plate Sizes 7 $\frac{1}{2}$ "-8 $\frac{1}{2}$ "
5 Columns (60 Per)
*Capacity = 300

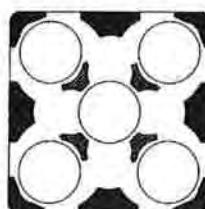


Plate Sizes 8 $\frac{1}{4}$ "-9 $\frac{1}{2}$ "
4 Columns (60 Per)
*Capacity = 240

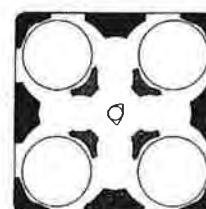


Plate Sizes 9 $\frac{1}{8}$ "-11 $\frac{1}{4}$ "
4 Columns (60 Per)
*Capacity = 240

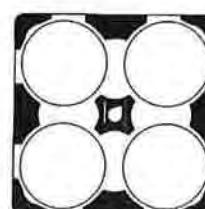
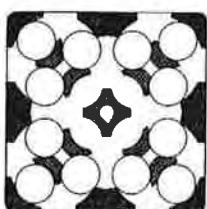
**SAMPLE CONFIGURATIONS (Accessory Dividers Required)**

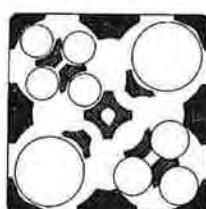
Plate Sizes 4 $\frac{1}{4}$ "-4 $\frac{5}{8}$ "
16 Columns (40 Per)
*Capacity = 640



Plate Sizes 4 $\frac{3}{4}$ "-5 $\frac{1}{8}$ "
12 Columns (40 Per)
*Capacity = 480



4 Columns (40 Per) 4 $\frac{1}{4}$ "-4 $\frac{5}{8}$ "
2 Columns (60 Per) 7 $\frac{1}{2}$ "-9 $\frac{1}{2}$ "
3 Columns (40 Per) 4 $\frac{1}{4}$ "-5 $\frac{1}{8}$ "



8 Columns (40 Per) 4 $\frac{1}{4}$ "-4 $\frac{5}{8}$ "
2 Columns (60 Per) 7 $\frac{1}{2}$ "-9 $\frac{1}{2}$ "

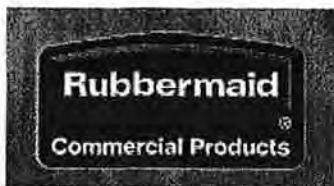


All Metro Catalog Sheets are available on our Web Site: www.metro.com



InterMetro Industries Corporation
North Washington Street, Wilkes-Barre, PA 18705
Phone: 570-825-2741 • Fax: 570-825-2852
For Product Information Call: 1-800-433-2232

L02-100A
Printed in U.S.A. Rev 4/08
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Waste > BRUTE® Utility

2632-56 BRUTE® Container without Lid with "Inedible" Black Imprint, English and Spanish



Durable, heavy-duty containers for a variety of uses.

- All-plastic, professional-grade construction will not rust, chip or peel; resists dents.
- Strong, snap-on lids are available for secure, stable stacking.
- Reinforced rims add strength and durability.
- Built-in handles allow easy, non-slip lifting and anti-jam nesting.
- Double-ribbed base increases stability and dragging capacity.
- Gray, White and Yellow are USDA Meat & Poultry Equipment Group Listed and assist in complying with HACCP guidelines.
- Certified to NSF Standards #2 and #21.
- 2637-88 is California State Fire Marshal (CSFM) approved for fire safety when used with 2632.



AVAILABLE COLORS

Order #	Color	Product UPC/ UCC Code
FG263256 GRAY	GRAY	086876130515 / 10086876130512



Gray
GRAY

SPECIFICATIONS

	U.S.	Metric
Diameter:	22 in	55.9 cm
Height:	27 1/4 in	69.2 cm
Volume Capacity [Nom]:	32 gal	121.1 L
Volume Capacity [Max]:		
Volume Capacity [Min]:		
Carton Height:		
Carton Length:		
Carton Width:		
Mass Capacity [Nom]:		
Mass Capacity [Max]:		
Carton Cube:	18.67 ft ³	0.53 m ³
Ship Weight/Carton:	49.45 lb	22.43 kg
Pack Quantity:	6	
Cartons Per Pallet:	4	

ADDITIONAL INFORMATION:

Chemical Resistance Guide: chem.pdf

Products in BRUTE® Round Containers

Item # Description

2620-46 BRUTE® Container without Lid with "USDA Condemned" Black Imprint, English and Spanish
2632-46 BRUTE® Container without Lid with "USDA Condemned" Black Imprint, English and Spanish

Diameter Height Volume Capacity

19 1/2 in 22 7/8 in 20 gal
22 in 27 1/4 in 32 gal



Waste > BRUTE® Utility

→ 2640 BRUTE® Dolly for 2620, 2632, 2643, 2655 Containers



Easy mobility and maneuverability of heavy loads.

- Up to 350 lb. continuous static load rating.
- All plastic construction resists rust, chipping and denting.
- Heavy-duty wheels with swivel capabilities provide for ease of mobility.
- User-friendly solution for moving heavy loads.

SUSTAINABLE PRODUCTS



This product has the following sustainable attributes:
LEED Credits
For Recycling

AVAILABLE COLORS

Order #	Color	Product UPC/ UCC Code
FG264000 BLA	BLA	086876015492 / 10086876015499



Black
BLA

SPECIFICATIONS

	U.S.	Metric
Length:		
Width:		
Height:	6 5/8 in	16.8 cm
Diameter:	18 1/4 in	46.4 cm
Square:		
Mass Capacity [Nom]:		
Mass Capacity [Max]:	250 lb	113.4 kg
Carton Height:		
Carton Length:		
Carton Width:		
Carton Cube:	1.88 ft ³	0.05 m ³
Ship Weight/Carton:	13.10 lb	5.94 kg
Pack Quantity:		2
Cartons Per Pallet:		24
Material: HDPE		
Process: Structural Foam Molding		

ADDITIONAL INFORMATION:

[Chemical Resistance Guide: chem.pdf](#)
[Frequently Asked Questions](#)

Products in BRUTE® Dollies

Item #	Description	Length	Width	Height	Diameter	Square	Mass Capacity
2640	BRUTE® Dolly for 2620, 2632, 2643, 2655 Containers	6 5/8 in	18 1/4 in				
2640-43	BRUTE® Quiet Dolly for 2620, 2632, 2643, 2655 Containers	6 5/8 in	18 1/4 in				

Slim Jim® Container

Combine efficiency and ease of handling with the 23 gallon Rubbermaid Slim Jim® Container, now available with optional handles. Positioned high on the container, the large handles are easy to grasp and help give improved leverage and control for lifting and emptying. For smaller volume requirements or where full container lifting weight is a concern, choose the 15.9 gallon Slim Jim® Container. Interchangeable, color-coded Recycling Tops fit both container sizes and help encourage effective waste separation. An innovative linking trolley system can be used to transport multiple Slim Jim® containers in one trip or individually as a dolly.

Make your operation productive and efficient with the Slim Jim® Containers, Tops and Trolley System—the strongest link in your waste separation program!



Containers come in two capacities for versatility to fit your needs.



Linking trolleys detach easily by pushing front toeplate.

Large handles positioned high on the Slim Jim® container give leverage and control.

Durable, lightweight plastic construction provides long life without the weight, sharp edges and rusting common with some metal containers.

Color-coded tops encourage effective separation of recyclable waste: blue top with slot for paper, green and brown tops with holes for bottles and cans, gray and yellow tops for general refuse.

2688-88

2692-88

2703-88



Slim Jim® Container

Item No.	Description	Dimensions	Capacity	Polyliner Bags	Color	Pack
3540	Slim Jim® Container	20" l x 11" w x 30" h (50.8 cm x 27.9 cm x 76.2 cm)	23 U.S. gal. (87.1 L)	5009-88, 5074, 5084	Light Gray, Dark Blue, Brown, Beige	4
3541	Slim Jim® Container with Handles	23 1/8" l x 11" w x 24 7/8" h (58.7 cm x 27.9 cm x 63.2 cm)	15 7/8 U.S. gal. (60 L)	5009-88, 5074, 5084	Light Gray, Dark Blue, Beige	4
3554	Slim Jim® Container with Handles	20" l x 11" w x 30" h (50.8 cm x 27.9 cm x 76.2 cm)	23 U.S. gal. (87.1 L)	5009-88, 5074, 5084	Light Gray, Dark Blue, Brown, Beige	4
2673	Slim Jim® Untouchable® Top fits 3540, 3541, 3554 Containers	20 3/8" l x 11 3/8" w x 4 3/4" h (51.8 cm x 28.9 cm x 12.1 cm)			Dark Blue, Brown, Light Gray	4
2688-88	Slim Jim® Handle Top fits 3540, 3541, 3554 Containers	20 3/8" l x 11 5/16" w x 2 3/4" h (51.8 cm x 28.7 cm x 7 cm)			Light Gray, Yellow	4
2692-88	Slim Jim® Bottle & Can Recycling Top fits 3540, 3541, 3554 Containers	20 3/8" l x 11 5/16" w x 2 3/4" h (51.8 cm x 28.7 cm x 7 cm)			Brown, Green	4
2703-88	Slim Jim® Paper Recycling Top fits 3540, 3541, 3554 Containers	20 3/8" l x 11 5/16" w x 2 3/4" h (51.8 cm x 28.7 cm x 7 cm)			Dark Blue	4
3551	Slim Jim® Trolley accommodates 3540, 3541, 3554 Containers	23 7/16" l x 15" w x 10 13/16" h (59.5 cm x 38.1 cm x 27.5 cm)			Gray	2

Products manufactured under a quality management system registered to ISO 9002.

www.rubbermaid.com/rpc
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Winchester, VA 22601
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Rubbermaid®
Commercial Products

DESCRIPTION: OPEN No.

OPEN NUMBER

CUSTOM FABRICATED BY KEC

- Stainless Steel**
- Millwork**

EXISTING EQUIPMENT

- Relocated by KEC**
- Remain In Place**

NOT IN KITCHEN EQUIPMENT CONTRACT (NIKEC)

- Equipment By Owner/Operator**
- Equipment By Vendor**
- Millwork By Architect/Interior Designer**
- Equipment by Others** _____.

REMARKS: _____

DESCRIPTION: OPEN NO.

OPEN NUMBER

CUSTOM FABRICATED BY KEC

- Stainless Steel**
- Millwork**

EXISTING EQUIPMENT

- Relocated by KEC**
- Remain In Place**

NOT IN KITCHEN EQUIPMENT CONTRACT (NIKEC)

- Equipment By Owner/Operator**
- Equipment By Vendor**
- Millwork By Architect/Interior Designer**
- Equipment by Others** _____

REMARKS: _____

DESCRIPTION: OPEN NO.

OPEN NUMBER

CUSTOM FABRICATED BY KEC

- Stainless Steel**
- Millwork**

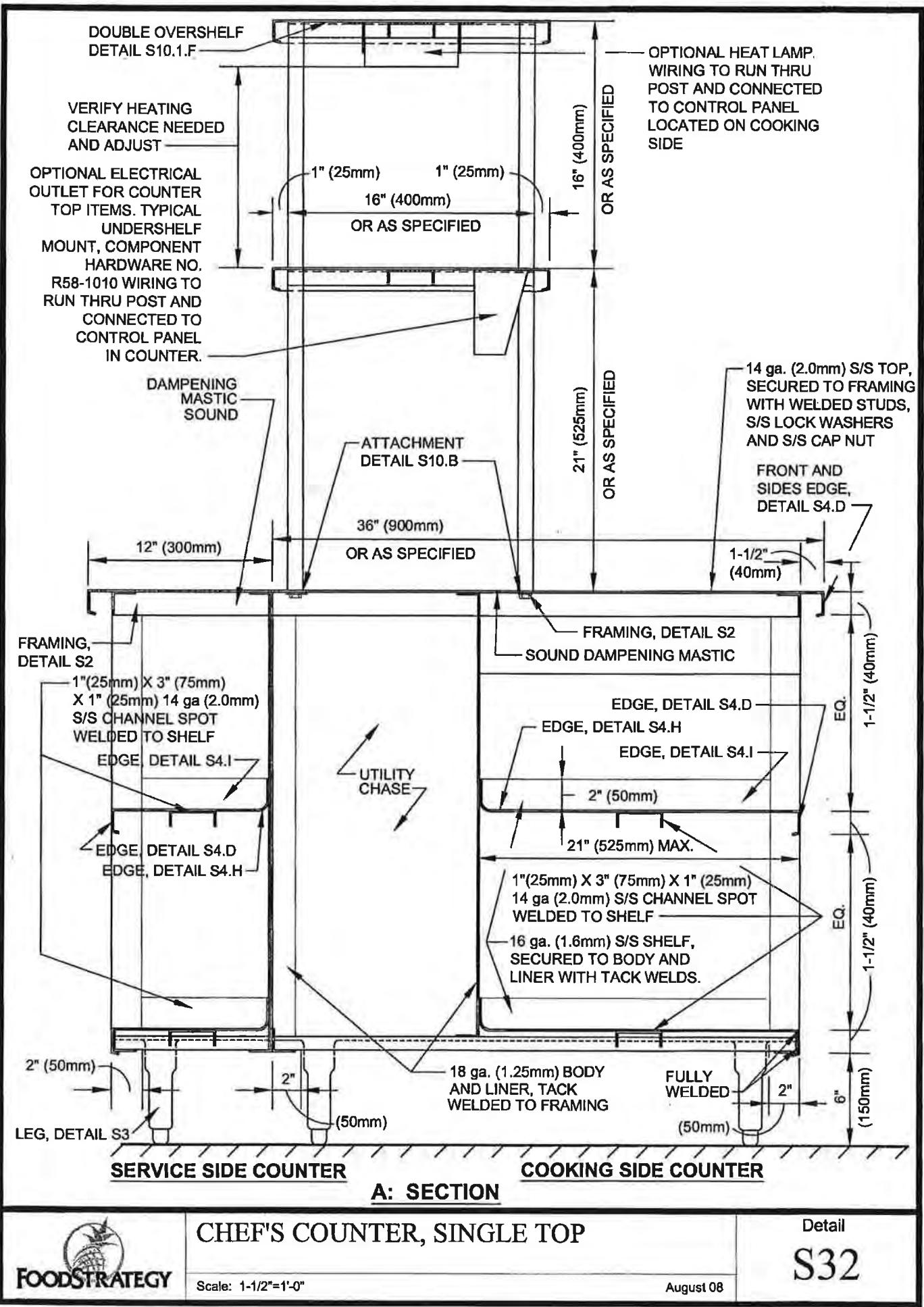
EXISTING EQUIPMENT

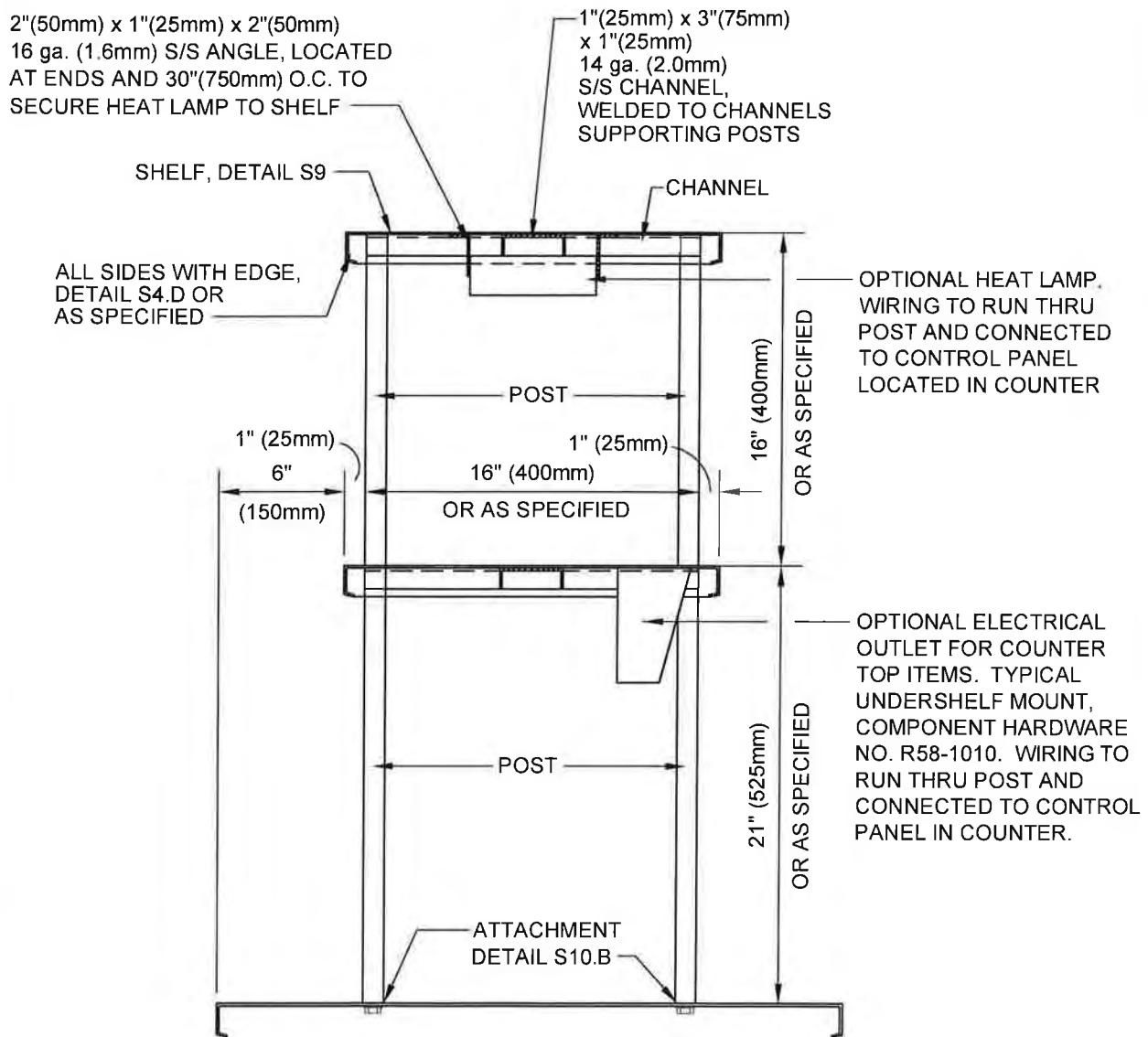
- Relocated by KEC**
- Remain In Place**

NOT IN KITCHEN EQUIPMENT CONTRACT (NIKEC)

- Equipment By Owner/Operator**
- Equipment By Vendor**
- Millwork By Architect/Interior Designer**
- Equipment by Others** _____

REMARKS: _____





F: DOUBLE OVERSHELF, TWO POSTS

NOTE:

EXPOSED ELECTRICAL CONDUIT/CABLE FROM HEAT LAMPS,
ELECTRICAL OUTLETS, ETC. IS NOT ACCEPTABLE. RUN CABLING
THRU POSTS.



DOUBLE OVERSHELF, COUNTER MOUNT

Scale: 1-1/2" = 1'-0"

Detail

S10.1

December 09



GLO-RAY® INFRARED FOODWARMERS

Models GRAH-18, -24, -30, -36, -42, -48, -54, -60, -66, -72, -84, -96, -108, -120, -132, -144
 GRAH-18, -24, -30, -36, -42, -48, -54, -60, -66, -72, -84, -96, -108, -120, -132, -144

GRH-18, -24, -36, -48, -60, -72, -96
 GR-18, -24, -36, -48, -60, -72, -96

Hatco Glo-Ray® Infrared Foodwarmers safely keep all hot foods at optimum serving temperatures longer. Foods do not dry out or become discolored; even the most delicate dishes hold that "just-prepared" look. The Glo-Ray pre-focused heat pattern directs heat from a tubular element to bathe the entire holding surface.

FLEXIBILITY

The continuous housings, up to 12' (3658 mm) in width (aluminum only), are very strong and eliminate the danger of sagging. Sturdy stainless steel housings are available up to 8' (2438 mm).

An on-off switch may be installed in front or back of the unit to suit the location. **Remote control installation is recommended on all installations to extend the life of the controls.** Many combinations of remote control enclosures are available in several sizes, built in accordance with UL Standards to accommodate power switches, infinite controls, indicator lights, and wiring.

Optional sneeze guards, made of shatterproof, easy-to-clean acrylic, are available, providing a safe environment for the food. Check NSF standards and local codes for requirements.

The color options help blend warmers into any décor.

All Glo-Ray models are shipped factory-assembled, with mounting tabs, ready-to-install quickly and easily.

QUALITY

The following features assure the finest performance for years to come:

- Available in widths from 18" to 144" (457-3658 mm).
- Sturdy continuous aluminum housings eliminate sagging.
- Pre-focused heat maintains serving temperatures longer without continuing to cook the food.
- Variety of models, configurations, colors, finishes and accessories provide unlimited design flexibility.

ITEM#



Model GRAH-36 with optional *Designer* color, infinite switch, cord and plug set, and accessory C-leg stand



Model GRAH-48 with optional sneeze guards and accessory t-legs



Remote Control Enclosures



Model RMB-3F with toggle switch and indicator light



Model RMB-7C with two infinite switches



HATCO CORPORATION P.O. Box 340500 Milwaukee, WI 53234-0500 U.S.A.
 (800) 558-0607 • (414) 671-6350 • Fax (800) 543-7521 • Int'l. Fax (414) 671-3976

www.hatcotech.com • E-mail: equipsales@hatcotech.com

Form No. GR Spec Sheet

Printed in USA
 April 2000

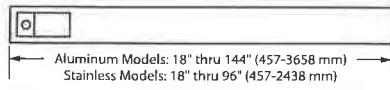
METAL SHEATHED ELEMENTS GUARANTEED AGAINST
 BURNOUT AND BREAKAGE FOR TWO YEARS.



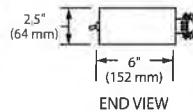
GLO-RAY® INFRARED FOODWARMERS

Models GRAH-18, -24, -30, -36, -42, -48, -54, -60, -66, -72, -84, -96, -108, -120, -132, -144
 GRAH-18, -24, -30, -36, -42, -48, -54, -60, -66, -72, -84, -96, -108, -120, -132, -144

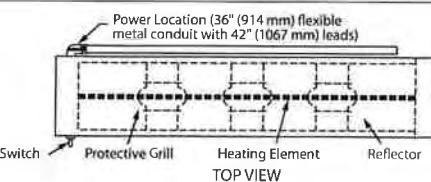
GRH-18, -24, -36, -48, -60, -72, -96
 GR-18, -24, -36, -48, -60, -72, -96



FRONT VIEW



END VIEW



TOP VIEW

SPECIFICATIONS

Aluminum High Watt		Aluminum Standard Watt			
Model	Watt	Model	Watt	Width	Shipping Weight*
GRAH-18	350	GRA-18	250	18" (457 mm)	6 lbs. (3 kg)
GRAH-24	500	GRA-24	350	24" (610 mm)	7 lbs. (3 kg)
GRAH-30	660	GRA-30	450	30" (762 mm)	8 lbs. (4 kg)
GRAH-36	800	GRA-36	575	36" (914 mm)	9 lbs. (4 kg)
GRAH-42	950	GRA-42	675	42" (1067 mm)	10 lbs. (5 kg)
GRAH-48	1100	GRA-48	800	48" (1219 mm)	11 lbs. (5 kg)
GRAH-54	1250	GRA-54	925	54" (1372 mm)	13 lbs. (6 kg)
GRAH-60	1400	GRA-60	1050	60" (1524 mm)	14 lbs. (6 kg)
GRAH-66*	1560	GRA-66	1160	66" (1676 mm)	16 lbs. (7 kg)
GRAH-72*	1725	GRA-72	1275	72" (1829 mm)	17 lbs. (8 kg)
GRAH-84**	2050	GRA-84*	1500	84" (2134 mm)	19 lbs. (9 kg)
GRAH-96**	2400	GRA-96*	1725	96" (2438 mm)	21 lbs. (10 kg)
GRAH-108	2500	GRA-108	1850	108" (2743 mm)	23 lbs. (10 kg)
GRAH-120	2800	GRA-120	2100	120" (3048 mm)	26 lbs. (12 kg)
GRAH-132	3120	GRA-132	2320	132" (3353 mm)	30 lbs. (14 kg)
GRAH-144	3450	GRA-144	2550	144" (3658 mm)	33 lbs. (15 kg)

Stainless High Watt		Stainless Standard Watt			
Model	Watt	Model	Watt	Width	Shipping Weight*
GRH-18	350	GR-18	250	18" (457 mm)	7 lbs. (3 kg)
GRH-24	500	GR-24	350	24" (610 mm)	7 lbs. (3 kg)
GRH-36	800	GR-36	575	36" (914 mm)	10 lbs. (5 kg)
GRH-48	1100	GR-48	800	48" (1219 mm)	12 lbs. (5 kg)
GRH-60	1400	GR-60	1050	60" (1524 mm)	15 lbs. (7 kg)
GRH-72	1725	GR-72	1275	72" (1829 mm)	19 lbs. (9 kg)
GRH-96	2400	GR-96	1725	96" (2438 mm)	24 lbs. (11 kg)

* Does not include RMB.

† When using an infinite control with 120 volt model, tandem elements are required, cord not available.

‡ 120 volt models require additional switches and tandem (end-to-end) elements.

OPTIONS (NOT FOR RETROFIT)

- ❑ Designer Colors, Aluminum Models 18" to 144" (457-3658 mm): Warm Red, Black, Gray Granite, White Granite, Navy Blue, Hunter Green, Antique Copper
- ❑ Gloss Finishes, Aluminum Models 18" to 144" (457-3658 mm): Smooth White, Gleaming Gold, Glossy Gray, Bold Black, Radiant Red, Brilliant Blue
- ❑ Indicator Light
- ❑ Tandem Charge (Max. two elements end-to-end)
- ❑ Extended Electrical Leads
- ❑ Sneeze Guard (Aluminum models only)
- ❑ Incandescent Lights available, see GR-I Spec Sheet
- ❑ Infinite Control* (Remote Recommended)
- ❑ Remote Control Enclosure
- ❑ Maximum of 122 amps Consult factory if rating of single element at 120 volts exceeds 1400 watts.

PRODUCT SPECS

Infrared Foodwarmer

The Infrared Foodwarmer shall be a Glo-Ray®, manufactured by the Hatco Corporation, Milwaukee, WI 53234 U.S.A.

With 24/7 parts and service assistance (U.S. and Canada only), the Foodwarmer shall be a Glo-Ray Model ..., rated at ... watts, ... volts, single phase and be ... inches (millimeters) in overall width.

The Glo-Ray shall consist of either a stainless steel or aluminum housing and include as standard equipment four stainless steel shelf mounting tabs and

- ❑ 6' (1829 mm) Cord and Plug Set (120V only)‡

‡ Available on models 6' (1829 mm) or less with C-leg or T-leg stand or Chain kit only.

ACCESSORIES

- ❑ Adjustable Tubular Stands 10"-14" (254-356 mm)
- ❑ Non-Adjustable Tubular Stands 10", 12", 14", or 16" (254, 305, 356, or 406 mm) – Available in Designer colors
- ❑ C-Leg Stands for Models up to 6' (1829 mm) (10" or 13.5" (254 or 343 mm) clearance)
- ❑ T-Leg Stands for Models up to 6' (1829 mm) (10", 13.5", 16", or 18" (254, 343, 406, or 457 mm) clearance)
- ❑ Adjustable Angle Brackets (Provides 1" – 2" (25-51 mm) clearance above unit)
- ❑ Chain Suspension

an on-off switch may be optionally installed to either the front or rear of the unit. The infrared heating element shall be tubular metal sheathed. The foodwarmer shall be factory assembled ready for electrical installation.

Options and accessories shall include adjustable or non-adjustable tubular stand, C-leg stand, T-leg stand, angle brackets, suspension chain and fittings, breath protector, cord and plug set, indicator light, and infinite control – remote or built-in.

HATCO CORPORATION P.O. Box 340500 Milwaukee, WI 53234-0500 U.S.A. • (800) 558-0607 • (414) 671-6350
Fax (800) 543-7521 • Int'l. Fax (414) 671-3976 • www.hatcocorp.com • E-mail: equipsales@hatcocorp.com

Form No. GR Spec Sheet

Printed in U.S.A.
 April 2009



**TRUE FOOD SERVICE
EQUIPMENT, INC.**

2001 East Terra Lane • O'Fallon, Missouri 63366-4434 • (636)240-2400
Fax (636)272-2408 • Toll Free (800)325-6152 • Intl Fax# (001)636-272-7546
Parts Dept. (800)424-TRUE • Parts Dept. Fax# (636)272-9471 • www.truemfg.com

Model:

TFP-48-18M

Food Prep Table:*Food Prep Unit*

Project Name: _____

AIA #

Location: _____

SIS #

Item #: _____ Qty: _____

Model #: _____

**TFP-48-18M**

- ▶ True's food prep units are designed with enduring quality that protects your long term investment.
- ▶ Energy saving, environmentally friendly (134A), exclusive forced-air refrigeration system holds 33°F to 41°F (.5°C to 5°C).
- ▶ All stainless steel front, top and ends. Matching aluminum finished back.
- ▶ Stainless steel, patented, foam insulated lid and hood keep pan temperatures colder, lock in freshness and minimize condensation. Removable for easy cleaning.
- ▶ 8" (204 mm) deep, $\frac{1}{2}$ " (13 mm) thick, full length removable cutting board included. Sanitary, high density, NSF approved white polyethylene provides tough preparation surface.
- ▶ Door fitted with 12" (305 mm) long recessed handle that is foamed-in-place with a sheet metal interlock to ensure permanent attachment.
- ▶ Foamed-in-place using Ecomate. A high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).

ROUGH-IN DATA

Specifications subject to change without notice.
Chart dimensions rounded up to the nearest $\frac{1}{8}$ " (millimeters rounded up to next whole number).

Model	Doors	Shelves	Pans (top)	Cabinet Dimensions (inches) (mm)				Voltage	Amps	NEMA Config.	Cord Length (total ft.) (total m)	Crated Weight (lbs.) (kg)
				L	Dt	H*	HP					
TFP-48-18M	2	4	18	48 $\frac{1}{8}$ 1223	31 $\frac{1}{2}$ 801	45 $\frac{3}{4}$ 1162	$\frac{1}{2}$ N/A	115/60/1	2.9 N/A	5-15P	7 2.13	480 218

† Depth does not include 2" (51 mm) for cutting board.

* Height does not include $\frac{3}{4}$ " (19 mm) for castors.

8/14

Printed in U.S.A.

APPROVALS:**AVAILABLE AT:**

Model:
TFP-48-18M

Food Prep Table: Food Prep Unit



STANDARD FEATURES

DESIGN

- True's commitment to using the highest quality materials and oversized refrigeration systems provides the user with colder product temperatures, lower utility costs, exceptional food safety and the best value in today's food service marketplace.

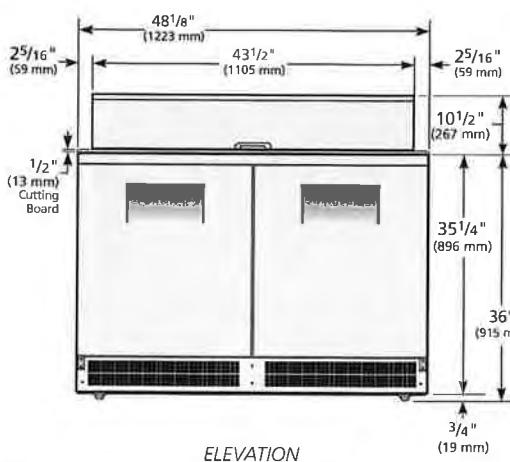
REFRIGERATION SYSTEM

- Factory engineered, self-contained, capillary tube system using environmentally friendly (CFC free) 134A refrigerant.
- Energy saving, factory balanced refrigeration system with guided airflow to provide uniform temperature in food pans and cabinet interior.
- Exclusive forced-air design holds 33°F to 41°F (.5°C to 5°C) product temperature in food pans and cabinet interior. Complies with and listed under ANSI/NSF-7-1997-6.3.
- High efficiency evaporator fan motor and larger fan blades give True Food Prep units a more efficient, low velocity, high volume airflow design.
- Easy access to all condensing unit components from back of cabinet.

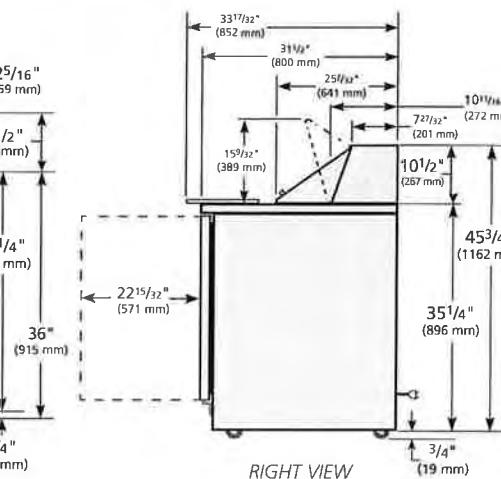
CABINET CONSTRUCTION

- Exterior - stainless steel front, top and ends. Matching aluminum finished back.
- Interior - attractive, NSF approved, white aluminum liner. Stainless steel floor with coved corners.

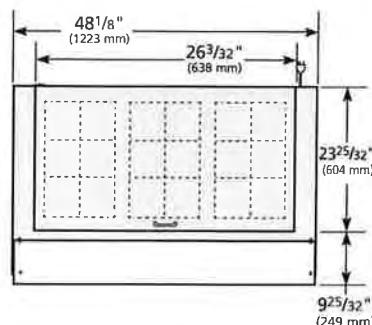
PLAN VIEW



ELEVATION



RIGHT VIEW

TOP VIEW
WITHOUT HOOD

WARRANTY*

Three year warranty on all parts and labor and an additional 2 year warranty on compressor.
(U.S.A. only)

*RESIDENTIAL APPLICATIONS: TRUE assumes no liability for parts or labor coverage for component failure or other damages resulting from installation in non-commercial or residential applications.

METRIC DIMENSIONS ROUNDED UP TO THE NEAREST WHOLE MILLIMETER

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE



Model	Elevation	Right	Plan	3D	Back
TFP-48-18M					

TRUE FOOD SERVICE EQUIPMENT

2001 East Terra Lane • O'Fallon, Missouri 63366-4434 • (636)240-2400 • Fax (636)272-2408 • Toll Free (800)325-6152 • Intl. Fax# (001)636-272-7546 • www.truemfg.com



Profit from the Eagle Advantage®

Specification Sheet

Short Form Specifications

Eagle Space-Saver Hand Wash Sink, model HWC-E. Constructed of type 304 stainless steel with 9 $\frac{1}{4}$ " x 11 $\frac{1}{2}$ " x 6" deep stainless steel sink, basket drain, hinged door with magnetic catch, built-in C-fold towel dispenser, deck mounted soap dispenser, and deck mounted gooseneck faucet. Note: For T&S faucet, use model HWC-T.

Eagle Drop-In Hand Wash Sink, model HWB-E. Constructed of type 304 stainless steel with 9 $\frac{1}{4}$ " x 11 $\frac{1}{2}$ " x 6" deep stainless steel sink, basket drain, hinged door with magnetic catch, built-in C-fold towel dispenser, deck mounted soap dispenser, and deck mounted gooseneck faucet. Note: For T&S faucet, use model HWB-T.



#HWC-E



#HWB-E

Hand Wash Sinks

MODELS:

- HWC-E**
- HWC-T**
- HWB-E**
- HWB-T**

Design and Construction Features

- All heavy gauge type 304 stainless steel all-welded construction.
- 1 $\frac{1}{2}$ " (38mm) bullnose front edge.
- Bowl is 9 $\frac{1}{4}$ " x 11 $\frac{1}{2}$ " x 6" (235 x 292 x 152mm).
- Hinged door with pull handle secured by magnetic catch.
- Pump action soap dispenser in rear deck.
- Built-in C-fold towel dispenser located in front of sink bowl.
- Deck mount faucet.
- 1 $\frac{1}{2}$ " (38mm) stainless steel basket drain and crumb cup.
- Wall-mountable "Space-Saver" models and drop-in models available.

EAGLE GROUP
100 Industrial Boulevard, Clayton, DE 19938-8903 USA
Phone: 302-653-3000 • Fax: 302-653-2065
www.eaglegrp.com

Foodservice Division: Phone 800-441-8440
MHC/Retail Display Divisions: Phone 800-637-5100

For custom configuration or fabrication needs, contact our **SpecFAB® Division**.
Phone: 302-653-3000 • Fax: 302-653-2065 • e-mail: quotes@eaglegrp.com

Certifications / Approvals



AUTOQUOTES



Spec sheets available for viewing, printing or downloading from our online literature library at www.eaglegrp.com

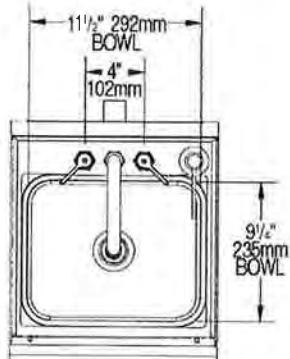
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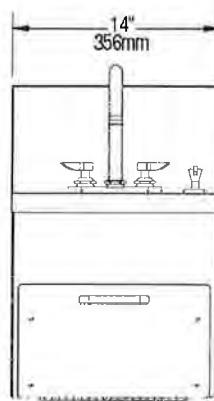
Profit from the Eagle Advantage®

Wall-Mountable "Space Saver" Hand Wash Sinks

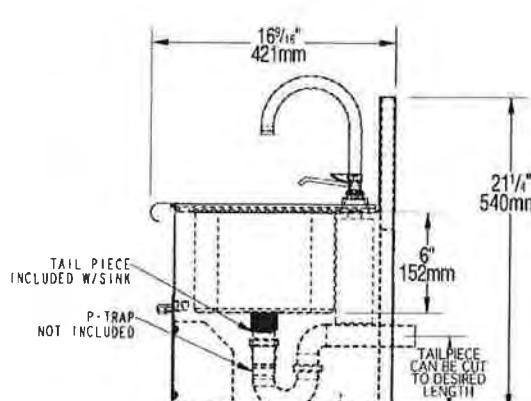
Furnished with Z-clips to secure to wall.



TOP VIEW



FRONT VIEW



SIDE VIEW

(model # HWB-T unit shown with T&S faucet)

inside bowl dimensionswidth x length x depth
in. mm

8 1/4" x 11 1/4" x 6" 235 x 292 x 152

overall sizewidth x length x height
in. mm

16 1/2" x 14" x 21 1/4" 421 x 356 x 540

WITH ENCORE FAUCETweight
lbs. kg

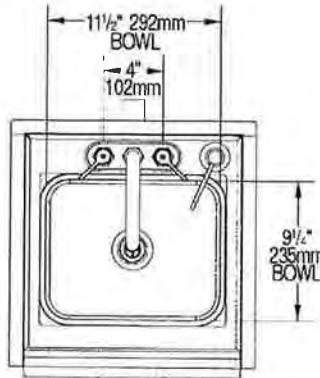
model #

36 16.3 HWB-E

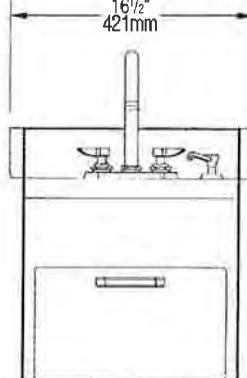
WITH T&S FAUCETweight
lbs. kg

model #

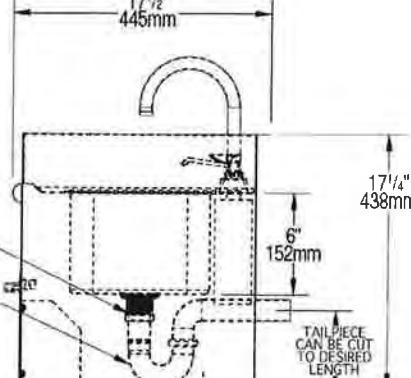
37 16.8 HWB-T

Drop-In Hand Wash Sinks

TOP VIEW



FRONT VIEW



SIDE VIEW

(model # HWB-T unit shown with T&S faucet)

inside bowl dimensionswidth x length x depth
in. mm

9 1/4" x 11 1/4" x 6" 235 x 292 x 152

overall sizewidth x length x height
in. mm

17 1/2" x 16 1/2" x 17 1/4" 445 x 419 x 438

cutout dimensionswidth x length
in. mm

16" x 14 1/2" 406 x 378

WITH ENCORE FAUCETweight
lbs. kg

model #

32 14.5 HWB-E

WITH T&S FAUCETweight
lbs. kg

model #

33 15.0 HWB-T

EAGLE GROUP

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Spec sheets available for viewing, printing or downloading from our online literature library at www.eaglegrp.com

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ph. 636.240.2400 • toll free 800.325.6152 • fax 636.222.2408 • parts fax 636.222.9471 • www.trueinfo.com

PROJECT NAME	LOCATION	AIA #
ITEM #	Qty	Model #

SPEC SERIES®

PASS-THRU GLASS FRONT/GLASS REAR SWING DOORS REFRIGERATOR

models

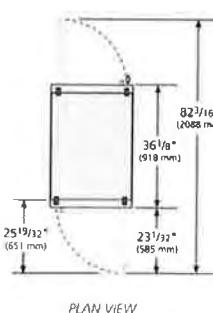
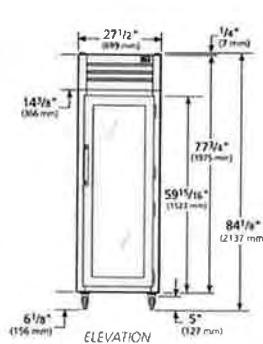
STR1RPT-1G-1G

STA1RPT-1G-1G

STG1RPT-1G-1G



plan view



Specifications subject to change without notice.
Chart dimensions are rounded up to the nearest 1/8" (millimeters rounded up to the next whole number).

STR1RPT-1G-1G

Exterior	Stainless steel door, front & sides.
Interior	Stainless steel side walls, back, floor, door liner, & ceiling.
Shelving	(1) Interior kit option included per full section, factory installed.

STA1RPT-1G-1G

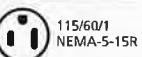
Exterior	Stainless steel door, front & sides.
Interior	Aluminum side walls & back. Stainless steel floor & ceiling.
Shelving	(3) Heavy duty, chrome plated, wire shelves per section.

STG1RPT-1G-1G

Exterior	Stainless steel door & front, with matching aluminum sides.
Interior	Aluminum side walls & back. Stainless steel floor & ceiling.
Shelving	(3) Heavy duty, PVC coated, wire shelves per section.

SPECIFICATIONS

Dimensions	In.	mm.
Length	27 1/2	699
Depth	36 1/8	918
Height	77 3/4	1975
Electrical	U.S. International	
Horsepower	1/3	N/A
Amps	4.8	N/A
Voltage	115/60/1	
NEMA	5-15P	
Cord Length	9 ft.	2.74 M.



* Height does not include 6 5/8" (156 mm) for castors or 6" (153 mm) for optional legs. Height does not include 1/4" (7mm) for system mechanical components.

† Depth does not include 1 1/2" for front & back door handles.



APPROVALS

AVAILABLE AT



PROJECT NAME	LOCATION	AIA #
ITEM #	QTY	MODEL #

SPEC SERIES®

PASS-THRU GLASS FRONT/GLASS REAR SWING DOORS REFRIGERATOR

models

STR1RPT-1G-1G

STA1RPT-1G-1G

STG1RPT-1G-1G



standard features

REFRIGERATION SYSTEM

- Factory engineered, self-contained, capillary tube system using environmentally friendly (CFC free) 134A refrigerant.
- High capacity, factory balanced refrigeration system that maintains cabinet temperatures of 33°F to 38°F (.5°C to 3.3°C) for the best in food preservation.
- State of the art, electronically commutated evaporator and condenser fan motors. ECM motors operate at higher peak efficiencies and move a more consistent volume of air which produces less heat, reduces energy consumption and provides greater motor reliability.
- Top mounted refrigeration system with evaporator positioned out of food zone to maximize capacity.
- Electronic control.

CABINET CONSTRUCTION

- Insulation - entire cabinet structure and solid door are foamed-in-place using Ecomate. A high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).
- 5" (127 mm) diameter plate castors - locks provided on front set.

DOORS

- "Low-E", double pane thermal insulated glass.
- Lifetime guaranteed bolt style door lock standard.

WARRANTY*

Three year warranty on all parts and labor and an additional 2 year warranty on compressor. (U.S.A. only)

*RESIDENTIAL APPLICATIONS: TRUE assumes no liability for parts or labor coverage for component failure or other damages resulting from installation in non-commercial or residential applications.

- Lifetime guaranteed heavy duty all metal working door handles.
- Positive seal self-closing doors with 120° stay open feature. Lifetime guaranteed external cam lift door hinges, four (4) per door section.
- Magnetic door gaskets of one piece construction, removable without tools for ease of cleaning.

LIGHTING

- LED interior lighting, safety shielded. (STR/STA models standard, STG optional)

MODEL FEATURES

- Exterior digital temperature display, available with either °F or °C.
- Evaporator epoxy coated to eliminate the potential of corrosion
- Curb mounting ready.
- NSF-7 compliant for open food product.

ELECTRICAL

- Unit completely pre-wired at factory and ready for final connection to a 115/60/1 phase, 15 amp dedicated outlet. Cord and plug set included.

OPTIONAL FEATURES/ ACCESSORIES

(upcharge & lead times may apply)

- 6" (153 mm) standard legs.
- 6" (153 mm) seismic/flanged legs.
- 6" (153 mm) stainless steel legs.
- Additional shelves.
- Security package.

SHELVING KIT OPTIONS

- STR series kits factory installed at no charge. STA & STG series kits field installed, upcharge applies, lead times may apply.
- Kit #1: Nine (9) sets of #1 type tray slides and pilasters (field installed), bottom support of one (1) 18"L x 26"D (458 mm x 661 mm) pan or two (2) 14)L x 18"D (356 mm x 458 mm) pans.
- Kit #2: One (1) set half-section #2 steel rod tray slides and pilasters (field installed), rim support of one (1) 18)L x 26"D (458 mm x 661 mm) pan.
- Kit #3: Six (6) sets of universal type tray slides and pilasters (field installed), bottom support of one (1) 18)L x 26"D (458 mm x 661 mm) pan, two (2) 14)L x 18"D (356 mm x 458 mm) pans or two (2) 12)L x 20"D (305 mm x 508 mm) pans.
- Kit #4: Three (3) chrome shelves 25)L x 27 3/4"D (635 mm x 705 mm). Optional wall mounted shelf support pilasters (field installed) with four (4) shelf clips per shelf available; adjustable on 1/2" (13 mm) increments (must order at time of cabinet order).
- Additional kit option components available individually.

METRIC DIMENSIONS ROUNDED UP TO THE NEAREST WHOLE MILLIMETER

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE



Model	Elevation	Right	Plan	3D	Back
ST()1RPT-1G-1G					



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PROJECT NAME

LOCATION

AIA #

ITEM #

QTY

MODEL #

SIS #

SPEC SERIES®

REACH-IN SOLID HALF SWING DOOR DUAL TEMPERATURE REFRIGERATOR/FREEZER

models

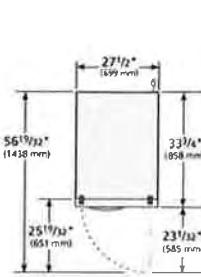
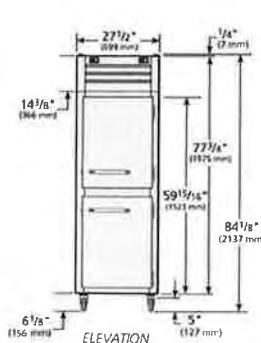
STR1DT-2HS

STA1DT-2HS

STG1DT-2HS



plan view



Specifications subject to change without notice.
Chart dimensions are rounded up to the nearest $\frac{1}{8}$ " (millimeters rounded up to the next whole number).

SPECIFICATIONS

Dimensions	In.	mm.
Length	27 1/2	699
Depth	33 3/4	858
Height	77 3/4	1975
Electrical	U.S.	International
HP Refrig.	1/5	
HP Freezer	1/3	
Amps	12.0	N/A
Voltage	115/60/1	
NEMA	5-15P	
Cord Length	9 ft.	2.74 M.
	115/60/1 NEMA-5-15R	

* Height does not include 6 1/8" (156 mm) for castors or 6" (153 mm) for optional legs. Height does not include 1/4" (7 mm) for system mechanical components.

† Depth does not include 1 1/2" for door handle.



APPROVALS

AVAILABLE AT



PROJECT NAME	LOCATION	AIA #
ITEM #	Qty	Model #

SPEC SERIES®

REACH-IN SOLID HALF SWING DOOR DUAL TEMPERATURE REFRIGERATOR/FREEZER

models

STR1DT-2HS

STA1DT-2HS

STG1DT-2HS



standard features

REFRIGERATION SYSTEM

- Two independent, self contained refrigeration systems; CFC free, environmentally friendly and factory balanced.
- R134A refrigerator refrigerant - R404A freezer refrigerant.
- High capacity, factory balanced system that maintains 33°F to 38°F (.5°C to 3.3°C) in the top refrigerator section and -10°F (-23.3°C) in the bottom freezer section.
- State of the art, electronically commutated evaporator and condenser fan motors. ECM motors operate at higher peak efficiencies and move a more consistent volume of air which produces less heat, reduces energy consumption and provides greater motor reliability.
- Top mounted refrigeration system with evaporator positioned out of food zone to maximize capacity.
- Freezer features automatic defrost system, time-initiated, time-terminated.
- Automatic evaporator fan motor delay during defrost cycle.

CABINET CONSTRUCTION

- Insulation - entire cabinet structure and solid door are foamed-in-place using Ecomate. A high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).
- 5" (127 mm) diameter plate castors - locks provided on front set.

DOORS

- Lifetime guaranteed bolt style door locks standard.
- Lifetime guaranteed heavy duty all metal working door handles.
- Positive seal self-closing doors with 120° stay open feature. Lifetime guaranteed external cam lift door hinges, four (4) per door section.
- Magnetic door gaskets of one piece construction, removable without tools for ease of cleaning.

LIGHTING

- LED interior lighting, safety shielded. (STR/STA models standard, STG optional)

MODEL FEATURES

- Two (2) exterior digital temperature displays, one for refrigerator section and one for freezer.
- Evaporator epoxy coated to eliminate the potential of corrosion
- Curb mounting ready.
- NSF-7 compliant for open food product.

ELECTRICAL

- Unit completely pre-wired at factory and ready for final connection to a 115/60/1 phase, 15 amp dedicated outlet. Cord and plug set included.

OPTIONAL FEATURES/

ACCESSORIES

(upcharge & lead times may apply)

- 6" (153 mm) standard legs.
- 6" (153 mm) seismic/flanged legs.
- 6" (153 mm) stainless steel legs. **6" (153 mm) stainless steel legs.**
- Field reversible hinge.
- Additional shelves.
- Stainless back. (STR, STA, STG)

SHELVING KIT OPTIONS

- STR series kits factory installed at no charge. STA & STG series kits field installed, upcharge applies, lead times may apply.
- Kit #1: Nine (9) sets of #1 type tray slides and pilasters (field installed), bottom support of one (1) 18"L x 26"D (458 mm x 661 mm) pan or two (2) 14)L x 18"D (356 mm x 458 mm) pans.
- Kit #2: One (1) set half-section #2 steel rod tray slides and pilasters (field installed), rim support of one (1) 18)L x 26"D (458 mm x 661 mm) pan.
- Kit #3: Six (6) sets of universal type tray slides and pilasters (field installed), bottom support of one (1) 18)L x 26"D (458 mm x 661 mm) pan, two (2) 14)L x 18"D (356 mm x 458 mm) pans or two (2) 12)L x 20"D (305 mm x 508 mm) pans.
- Kit #4: Three (3) chrome shelves 25)L x 27¾"D (635 mm x 705 mm). Optional wall mounted shelf support pilasters (field installed) with four (4) shelf clips per shelf available; adjustable on ½" (13 mm) increments (must order at time of cabinet order).
- Additional kit option components available individually.

WARRANTY*

Three year warranty on all parts and labor and an additional 2 year warranty on compressor. (U.S.A. only)

*RESIDENTIAL APPLICATIONS: TRUE assumes no liability for parts or labor coverage for component failure or other damages resulting from installation in non-commercial or residential applications.

METRIC DIMENSIONS ROUNDED UP TO THE NEAREST WHOLE MILLIMETER

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE



Model
STR1DT-2HS

Elevation

Right

Plan

3D
Back



A Tyco International Company

PIRANHA RESTAURANT FIRE SUPPRESSION SYSTEMS

Data/Specifications

FEATURES

- UL and ULC Listed – Meets requirements of UL 300
- Overlapping appliance protection
- Two nozzle styles cover all hazards
- Dual agents
- Rapid flame knockdown
- Proprietary agent with increased performance
- Fifteen times faster than single wet agent systems in reducing the temperature of the grease below the reflash point
- Reliable cartridge operation
- Aesthetically appealing
- CE Marked

APPLICATION

The PIRANHA Restaurant Fire Suppression System is an automatic, pre-engineered, fixed, fire suppression system designed to protect cooking equipment: ventilating equipment including hoods, ducts, plenums, and filters; fryers, griddles, and range tops; upright, natural charcoal, or chain-type broilers; electric, lava rock, mesquite or gas-radiant char-broilers; and woks.

The system is ideally suited for use in restaurants, hospitals, nursing homes, hotels, schools, airports, and other similar facilities.

Use of the PIRANHA Restaurant System is limited to interior applications only. The regulated release and tank assemblies must be mounted in an area where the air temperature will not fall below 32 °F (0 °C) or exceed 130 °F (54 °C). The system must be designed and installed within the guidelines of the UL Listed Design, Installation, Recharge, and Maintenance Manual.

SYSTEM DESCRIPTION

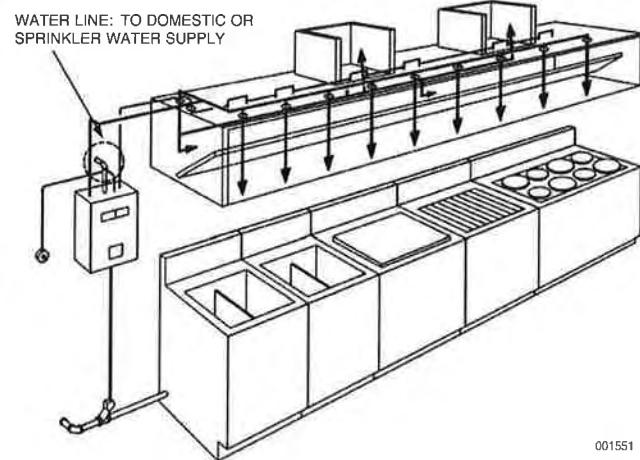
The PIRANHA Restaurant Wet Agent Fire Suppression System is a dual-agent, pre-engineered, fixed, automatic fire extinguishing system developed specifically for improved fire protection of commercial restaurant cooking appliances, exhaust hoods and ducts.

The PIRANHA system is available in three sizes:

- PIRANHA-SS-7 (1.5 gallon (5.7 L), 7 nozzle capacity)
- PIRANHA-SS-10 (2.25 gallon (8.5 L), 10 nozzle capacity)
- PIRANHA-SS-13 (3.0 gallon (11.4 L), 13 nozzle capacity)

When actuated, the system discharges a fixed amount of proprietary wet chemical agent followed by water through the same nozzles. Water is provided by a connection to the potable water supply. Advantages of the dual system over single wet agent systems include: (1) more robust suppression of hostile fires in protected restaurant hazards; (2) greater hazard area protection with less wet agent; (3) faster flame knockdown and securing of hot fuels such as cooking shortening; (4) overlapping protection of cooking appliances from fixed nozzle spacings, allowing appliances to be interchanged freely without changing nozzles; (5) more rapid cooling of hot fuels and appliances to prevent reignition; (6) simplicity of design and installation.

The addition of the water discharge significantly aids in increasing and prolonging the foam blanket generated by the wet chemical agent. The longer retention of the foam blanket allows the hot grease to cool well below the auto-ignition temperature.



001551

The system design for appliance protection under the hood allows the nozzles to be positioned uniformly from one end of the appliance line to the other. Most appliances under the hood can be protected in this overlapping manner; therefore, it is not necessary to protect each appliance individually. Appliances are free to be shifted around under the hood. The only exceptions to this overlapping type coverage are upright broilers, salamanders, and chain broilers. These types of appliances require dedicated nozzle protection.

The system is capable of automatic detection and actuation and/or remote manual actuation. Additional equipment is available for mechanical or electrical gas line shut-off applications.

The detection portion of the fire suppression system allows for automatic detection by means of specific alloy rated fusible link detectors which, when the temperature exceeds the rating of the link, separate, allowing the regulated release to actuate.

A system owner's guide is available containing basic information pertaining to system operation and maintenance. A detailed technical manual is also available including system description, design, installation, recharge, and maintenance procedures, plus additional equipment installation and resetting instructions.

The system is installed and serviced by authorized ANSUL distributors that are trained by the manufacturer.

The basic system consists of an AUTOMAN regulated release assembly which includes a regulated release mechanism and a wet chemical storage tank housed within a single enclosure. The tank valve is designed to allow the wet chemical agent to discharge onto the hazard area first.

Immediately following the agent discharge, the valve will automatically allow the water to flow through the piping and out the system nozzles. Nozzle blow-off caps, detectors, cartridges, agent, fusible links, and pulley elbows are supplied in separate packages in the quantities needed for the fire suppression system arrangement.

Additional equipment includes remote manual pull station, mechanical and electrical gas valves, pressure switches, and electrical switches for automatic equipment and gas line shut-off. Accessories can be added such as warning lights, etc., to install where required.

The water supply piping includes a lockable valve (for domestic and sprinkler water supply only).

Each tank is limited to a listed maximum number of nozzles.

COMPONENT DESCRIPTION**Wet Chemical Agent**

The PRX agent is a specially-formulated, aqueous solution of inorganic salts designed for rapid flame knockdown and foam securement of grease-related fires. It is available in 5.0 gallon (18.9 L) plastic containers with instructions for wet chemical handling and usage.

Agent Tank

The agent tank is constructed of stainless steel and is installed in a stainless steel enclosure.

Tanks are available in three sizes:

PIRANHA-SS-7: 1.5 gallon (5.7 L) capacity

PIRANHA-SS-10: 2.25 gallon (8.5 L) capacity

PIRANHA-SS-13: 3.0 gallon (11.4 L) capacity

Each tank has a working pressure of 150 psi (10.3 bar), a test pressure of 450 psi (31.0 bar), and a minimum burst pressure of 900 psi (62.1 bar).

The tank includes an adaptor/tube assembly. The adaptor is chrome-plated steel with 1/4 in. NPT female low pressure gas inlet port and a 3/8 in. NPT female agent outlet port. The adaptor also contains a bursting disc seal which prevents the siphoning of agent up the pipe during extreme temperature variations.

Connected to the adaptor/tube assembly is the water flow valve. This valve is designed to allow the wet chemical agent to flow first, and then the valve will automatically switch internally to allow the water to start flowing, thus increasing the foam blanket and providing additional cooling.

AUTOMAN Regulated Release Mechanism

The regulated release mechanism is a spring-loaded, mechanical/pneumatic type capable of providing the expellant gas supply to the agent tank. It contains a factory installed regulator deadset at 150 psi (10.3 bar) with an internal relief of approximately 190 psi (13.1 bar). It has automatic actuation capabilities by a fusible link detection system and remote manual actuation by a mechanical pull station.

The regulated release mechanism contains a release assembly, regulator, and expellant gas hose in a stainless steel enclosure with cover. The enclosure contains knock-outs for 1/2 in. conduit. The cover contains an opening for a visual status indicator.

The regulated release assembly also contains an anti-siphon valve which is designed to prevent back-siphonage of possible contaminated water into a potable water supply.

The regulated release mechanism is compatible with mechanical gas shut-off devices or, when equipped with a field or factory installed switch, compatible with electric gas line or appliance shut-off devices.

Discharge Nozzles

Two types of discharge nozzles are tested and listed with the PIRANHA system for all applications. The "AP" type is used for all high proximity appliance and plenum protection, and the "DL" type is used for all duct protection and low proximity appliance protection. Each nozzle must have a metal or rubber blow-off cap to keep the nozzle tip orifice free of cooking grease build-up.

Water Shutdown Device (Domestic and Sprinkler Water Supply Option Only)

The water shutdown device is an optional component which can be field installed in the AUTOMAN release. With the device installed, the water flow to the discharge nozzles will automatically shut down approximately 10 minutes after system actuation.

Agent Distribution Hose

Kitchen appliances manufactured with or resting on casters (wheels/rollers) may include an agent distribution hose as a component of the suppression system. This allows the appliance to be moved for cleaning purposes without disconnecting the appliance fire suppression protection. The hose assembly includes a restraining cable kit to limit the appliance movement within the range (length) of the flexible hose.

Flexible Conduit

Flexible conduit allows for quicker pull station and/or mechanical gas valve installations and the convenience of being able to route the cable over, under, and around obstacles. Flexible conduit can be used as a substitute for standard EMT conduit or can be used with EMT conduit.

Flexible conduit can be used only with the Molded Remote Manual Pull Station (Part No. 434618).

Pull Station Assembly

The remote manual pull station is made of a molded red composite material. The red color makes the pull station more readily identifiable as the manual means for fire suppression system operation. The pull station is designed with a pull handle to allow for three-finger operation, and includes a built-in guard to protect the pull handle.

The pull station is compatible with the ANSUL Flexible Conduit (Part No. 434525).

CODES AND STANDARDS

The PIRANHA hybrid wet agent system and its components meet the following codes, standards and recommended practices:

1. Underwriters Laboratories, Inc. (UL): Standard 300 – Fire Testing of Fire Extinguishing Systems for Protection of Restaurant Cooking Areas.
2. Underwriters Laboratories of Canada (ULC): Standard ORD-C1254.6 – Pre-Engineered Wet Chemical Extinguishing System Units.
3. National Fire Protection Association (NFPA): Standard 17A – Wet Chemical Extinguishing Systems.
4. National Fire Protection Association (NFPA): Standard 96 – Ventilation Control and Fire Protection of Commercial Cooking Operations.
5. American Society of Sanitary Engineers (ASSE): Standard 1001 – Cross Connection Protection Devices: Guidelines for Selection of the Proper Type of Backflow Preventor – Piped Applied Atmospheric Vacuum Breakers.
6. International Association of Plumbing and Mechanical Officials (IAPMO): Installation, Material and Property Standard PS 108-98 – Grease Fire Suppression Systems.
7. CE Marked.
8. Loss Prevention Certification Board (LPCB): LPS 1223 – Requirements and Testing Procedures for Approval of Fixed Extinguishing Systems for Catering Equipment.

ORDERING INFORMATION

Order all system components through your local authorized ANSUL Distributor.

SPECIFICATIONS

An ANSUL PIRANHA Fire Suppression System shall be furnished. The system shall be capable of protecting hazard areas associated with cooking equipment.

1.0 GENERAL**1.1 References**

- 1.1.1 Underwriters Laboratories, Inc. (UL)
 - 1.1.1.1 UL Standard 300
- 1.1.2 Underwriters Laboratories of Canada (ULC)
- 1.1.3 National Fire Protection Association (NFPA)
 - 1.1.3.1 NFPA 96
 - 1.1.3.2 NFPA 17A
- 1.1.4 International Association of Plumbing and Mechanical Officials (IAPMO)
 - 1.1.4.1 PS 108-98

1.2 Submittals

- 1.2.1 Submit two sets of manufacturer's data sheets
- 1.2.2 Submit two sets of piping design drawings

1.3 System Description

- 1.3.1 The system shall be an automatic fire suppression system using a dual agent concept; wet chemical agent and water for grease-related fires.
- 1.3.2 The system shall be approved for uniform, overlapping appliance protection.
- 1.3.3 The system shall be capable of suppressing fires in the following areas associated with cooking equipment: ventilating equipment including hoods, ducts, plenums, and filters; fryers, griddles and range tops; upright, natural charcoal, or chain-type broilers; electric, lava rock, mesquite or gas-radiant char-broilers; woks.
- 1.3.4 The system shall be the pre-engineered type having minimum and maximum guidelines established by the manufacturer and listed by Underwriters Laboratories, Inc. (UL) and Underwriters Laboratories of Canada (ULC).
- 1.3.5 The system shall be installed and serviced by personnel trained by the manufacturer.

1.4 Quality Control

- 1.4.1 Manufacturer: The Restaurant Fire Suppression System shall be manufactured by a company with at least forty years experience in the design and manufacture of pre-engineered fire suppression systems. The manufacturer shall be ISO 9001 registered.
- 1.4.2 Certificates: The wet agent shall be a specially formulated, aqueous solution of inorganic salts with a pH range between 9.5 – 10.5, designed for rapid flame knockdown and securement of grease-related fires, and specifically constituted to provide continuous evolution of foam when sprayed with water.

1.5 Warranty, Disclaimer, and Limitations

- 1.5.1 The pre-engineered restaurant fire suppression system components shall be warranted for five years from date of delivery against defects in workmanship and materials. Any purchased components, such as electric gas valves, reset relays, solenoids, pressure relief valves, regulators, electric switches, etc. shall be warranted for one year from date of purchase.

1.6 Delivery

- 1.6.1 Packaging: All system components shall be securely packaged to provide protection during shipment.

1.7 Environmental Conditions

- 1.7.1 The system shall be capable of operating in a temperature range of 32 °F to 130 °F (0 °C to 54 °C).

2.0 PRODUCT**2.1 Manufacturer**

- 2.1.1 Tyco Fire Protection Products,
One Stanton Street, Marinette, Wisconsin 54143-2542,
Telephone (715) 735-7411

2.2 Components

- 2.2.1 The basic system shall consist of a regulated release assembly which includes a regulated release mechanism, stainless steel enclosure, anti-siphonage valve (domestic and sprinkler water supply option only), and water flow valve (domestic and sprinkler water supply option only). The agent storage tank is purchased separately and shall be mounted within the enclosure.
Nozzles, blow-off caps, detectors, cartridges, agent, fusible links, and pulley elbows shall be supplied in separate packages in quantities needed for fire suppression system arrangements. Additional equipment shall include remote manual pull station, mechanical and electrical gas valves, pressure switches, and electrical switches for automatic equipment and gas line shut-off.
- 2.2.2 Wet Chemical Agent: The fire suppressant shall be a specially formulated, aqueous solution of inorganic salts with a pH range between 9.5 – 10.5, designed for rapid flame knockdown and securement of grease-related fires.
- 2.2.3 Agent Tank: The agent tank shall be installed in a stainless steel enclosure. The tank shall be constructed of stainless steel. Tanks shall be available in three sizes; 1.5 gallon (5.7 L), 2.25 gallon (8.5 L), and 3.0 gallon (11.4 L). The tanks shall have a working pressure of 150 psi (10.3 bar), a test pressure of 450 psi (31.0 bar), and a minimum burst pressure of 900 psi (62.1 bar). The tank shall include an adaptor/tube assembly containing a burst disc union.
- 2.2.4 Tank Valve: The tank valve shall be designed to discharge dual agent onto the hazards being protected. The valve shall automatically shuttle to switch from wet chemical agent discharge to water discharge.
- 2.2.5 Regulated Release Mechanism: The regulated release mechanism shall be a spring-loaded, mechanical/pneumatic type capable of providing the expellant gas supply via a pressurized cartridge to a single agent tank. It shall contain a factory installed regulator deadset at 150 psi (10.3 bar) with an internal relief of approximately 190 psi (13.1 bar).
It shall have automatic actuation by a fusible link detection system and remote manual actuation by a mechanical pull station.
The regulated release mechanism shall contain a release assembly, regulator, expellant gas hose, anti-siphonage valve, and agent storage tank housed in a stainless steel enclosure with cover. The enclosure shall contain knock-outs for 1/2 in. conduit. The cover shall contain an opening for a visual status indicator.
It shall be compatible with mechanical gas shut-off devices or, when equipped with a field or factory-installed switch, compatible with electric gas line or appliance shut-off devices.
- 2.2.6 Discharge Nozzles: Two types of discharge nozzles shall be tested and listed with the system for all applications. The "AP" type shall be used for all high proximity appliance and plenum protection, and the "DL" type shall be used for all duct and low proximity appliance protection. Each nozzle shall have a metal or rubber blow-off cap to keep the nozzle tip orifice free of cooking grease build-up.
- 2.2.7 Distribution Piping: Distribution piping shall be Schedule 40 black iron, chrome-plated, or stainless steel pipe conforming to ASTM A120, A53, or A106.
- 2.2.8 Detectors: The detectors shall be the fusible link type designed to separate at a specific temperature.
- 2.2.9 Cartridges: The cartridge shall be a sealed steel pressure vessel containing nitrogen gas. The cartridge seal shall be designed to be punctured by the releasing device supplying the required pressure to expel the wet chemical agent from the storage tank.

SPECIFICATIONS**2.0 PRODUCT (Continued)****2.2 Components (Continued)**

- 2.2.10 Water supply piping: The water supply piping portion of the dual agent system shall contain a lockable ball valve. The lockable ball valve shall be installed in the water supply piping to allow authorized personnel to close the valve after a system actuation and stop the flow of water into the hazard area.
- 2.2.11 Water shutdown device: With the approval of the AHJ, a water shutdown device shall be installed in the water supply piping. This device shall automatically shutdown the flow of water to the discharge nozzles approximately 10 minutes after system actuation.
- 2.2.12 Agent Distribution Hose: Kitchen appliances manufactured with or resting on casters (wheels/rollers) which have the fire suppression system hard piped, shall include a UL Listed agent distribution hose as a component of the suppression system. This option shall allow the appliance to be moved for cleaning purposes without disconnecting the appliance fire suppression protection. Hose assembly shall include a restraining cable kit to limit the appliance movement within the range (length) of the flexible hose.
- 2.2.13 Flexible Conduit: The manufacturer supplying the restaurant fire suppression system shall offer flexible conduit as an option to rigid EMT conduit for the installation of pull stations and/or mechanical gas valves. The flexible conduit shall be UL Listed and include all approved components for proper installation.
- 2.2.14 Pull Station Assembly: The fire suppression system shall include a remote pull station for manual system actuation. The pull station shall include a built-in guard to protect the pull handle. The pull station shall also be designed with a pull handle to allow for three finger operation and shall be red in color for quick visibility.

**Standard PIRANHA AUTOMAN Release****Size:** 20 1/2 in. x 23 1/2 in. x 7 1/2 in. (521 mm x 597 mm x 191 mm)**Weight:** Approx. 70 lb (32 kg) including charged tank**3.0 IMPLEMENTATION****3.1 Installation**

- 3.1.1 The fire suppression system shall be designed, installed, inspected, maintained, and recharged in accordance with the manufacturer's listed instruction manual.

3.2 Training

- 3.2.1 Employees shall be instructed in personal safety and the operation of the system by authorized distributors who are trained by the manufacturer.

F R Y E R S

VULCAN



Model 1TR45A

**SPECIFICATIONS**

45 - 50 lbs. capacity free standing gas fryer, Vulcan-Hart Model No. (1TR45A) (1TR45D) (1TR45C). 70,000 BTU/hr. input. Stainless steel cabinet. Set of four 6" adjustable casters (2 locking). Stainless steel fry tank with ThreePass™ heat transfer system. Energy Star® qualified. SoftStart™ ignition system using 35,000 BTU/hr. to extend oil life during start up. Idle rate of 4,251 BTU/hr. to maintain cooking temperature. 1¼" port ball type drain valve. Twin fry baskets with plastic coated handles. Solid state analog knob control, digital, or programmable computer control systems all standard with electronic matchless ignition. Tank brush and clean-out rod included.

Overall dimensions:

15½" w x 34¾" d x 47⅔" h. Working height 36⅔".

CSA design certified. NSF listed.

SPECIFY TYPE OF GAS WHEN ORDERING

- Natural Gas.
- Propane Gas.

SPECIFY ALTITUDE

The 1TR45 Series fryer does not require any special adjustments for varying altitudes ranging from 0 - 10,000 feet for either Natural or Propane gas.

1TR45 SERIES FREE STANDING GAS FRYER

2 TR45A: Solid state analog knob control behind the door. Accurate temperature control 200° to 390°F. User selectable fat melt modes. Electronic ignition.

1TR45D: Accurate temperature control 200-390°F with digital display. Fast recovery. Cook with compensating time or actual time. Electronic ignition. Digital temperatures: Fahrenheit or Celsius. Three melt modes. Two countdown timers. Auto boil-out mode.

1TR45C: Programmable computer controls with digital character display. 10 menu timers display product name and cook times. Offline programming of menu items uploaded through USB interface, software included. Accurate temperature control 200-390°F with digital display. Fast recovery. Cook with compensating time or actual time. Electronic ignition. Digital temperatures: Fahrenheit or Celsius. Three melt modes.

STANDARD FEATURES

- 70,000 BTU/hr. input.
- Maintains idle temperature setting with only 4,318 BTU/hr. to save energy.
- Energy saving SoftStart™ ignition system extends oil life while requiring lower BTU's.
- Energy Efficient ThreePass™ heat transfer system yielding 60.9% cooking efficiency and 72% Thermal Efficiency. ENERGY STAR® qualified.
- Stainless steel fry tank, 45 - 50 lb. capacity. Includes 10 year limited tank warranty.
- 1¼" port ball type drain valve.
- Stainless steel cabinet.
- Set of four 6" adjustable (2 locking) casters.
- Twin fry baskets with plastic coated handles.
- Hi-limit shut-off.
- Electronic matchless ignition.
- Tank brush and clean-out rod.
- One year limited parts and labor warranty.

ACCESSORIES

- FRYMATE-VX15 add-on frymate.
- Stainless steel tank cover – doubles as a work surface top.
- Connecting Kit(s) – Connects two fryers together (brackets, grease strip and hardware included).
- Single large basket – 13" w x 13¼" d x 5½" h.
- Set of twin baskets – 6½" w x 13¼" d x 6" h.
- ¾" Flexible gas hose with quick disconnect.
- 10" high stainless steel removable splash guard.

OPTIONS

- Second year extended limited parts and labor warranty

VULCAN

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F R Y E R S

VULCAN**TR KLEENSCREEN PLUS® FILTRATION SYSTEM
BUILT-IN FILTER SYSTEM FOR 2TRF, 3TRF & 4TRF FRYERS**

Model 2TR45CF

**SPECIFICATIONS**

Built-in filter system, Vulcan-Hart Model No. (# of fryers 2, 3, 4) TR(45, 65, 85) (control type A, D, or C) F (add suffix-F to fryer battery model No., i.e. 2TR45DF). Filter system accommodates maximum of four cabinets. Filter vessel constructed of drawn (seamless) 18 gauge series stainless steel. The 2TR45F filter pan weighs only 12.2 lbs. and the filter pan for the 2TR65 & TR85F weighs only 20.5 lbs. 1/3 H.P. motor/pump circulates hot frying compound at the rate of 8 gallons per minute, activated by a one touch push button switch. System provided standard with paperless stainless steel mesh filter screen. Optional KleenScreen PLUS® envelopes filter out particulate down to .5 microns (trial package included). Standard equipment comes on casters, has a tank brush, and clean-out rod. Hands free oil return line connection. Drain valve interlock switch turns fryer's burners off when drain valve is opened. Requires 120 volt, 60 Hz, 1 phase power supply.

CSA design certified. NSF listed.

SPECIFY TYPE OF GAS WHEN ORDERING

- Natural Gas
- Propane Gas

SPECIFY ALTITUDE

The TR Series fryer does not require any special adjustments for varying altitudes ranging from 0 - 10,000 feet for either Natural or Propane gas.

STANDARD FEATURES

- Filter system accommodates maximum of four fryer cabinets.
- Boil Out ByPass™ easily removes boil out solution from fry tank without contact of drain manifold, filter pan or motor/pump.
- Drain valve interlock switch – turns off gas burners automatically when draining oil.
- 6" Casters adjustable – 2 locking, 2 non-locking.
- Drawn (seamless) 18 gauge stainless steel filter pan. 70 lbs. frying compound capacity on TR45F, 110 lbs. capacity on TR65 & TR85F.
- Paperless stainless steel filter screen filters from 2 sides filter area = 270 square inches. Micro Filtration Fabric Envelope filters out particulate down to .5 microns.
- 1/3 H.P. motor and pump circulates frying compound at a rate of 8.0 gallons per minute.
- One touch push button switch to engage pump and motor.
- Tank brush and clean-out rod.
- 120 volt, 60 Hz, 1 phase (NEMA 5-15P).
- One year limited parts and labor warranty.
- 10 year fry tank limited warranty.
- 6' High Temperature Discard Hose.

ACCESSORIES (Packaged & Sold Separately)

- Stainless steel tank cover – doubles as a work surface top.
- Micro-Filtration Fabric Envelopes – 6 filters/per package.
- "Add-On" Frymate™ – VX15 or VX21S.
- Rear oil reclamation discard connection (Factory Installed).
- TR45F – Twin Basket Lifts (Factory Installed).
- TR65F & TR85F – Single and Twin Basket Lifts (Factory Installed).
- Prison Security Package (Factory Installed).
- Flexible gas hose with quick disconnect.

OPTIONS

- Second year extended limited parts and labor warranty.

REFERENCE MATERIALS

- See 1TR45 Spec Sheet F45378.
- See 1TR65 Spec Sheet F45381.
- See 1TR85 Spec Sheet F45383.

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F R Y E R S


**TR KLEENSCREEN PLUS® FILTRATION SYSTEM
BUILT-IN FILTER SYSTEM FOR 2TRF, 3TRF & 4TRF FRYERS**
INSTALLATION INSTRUCTIONS

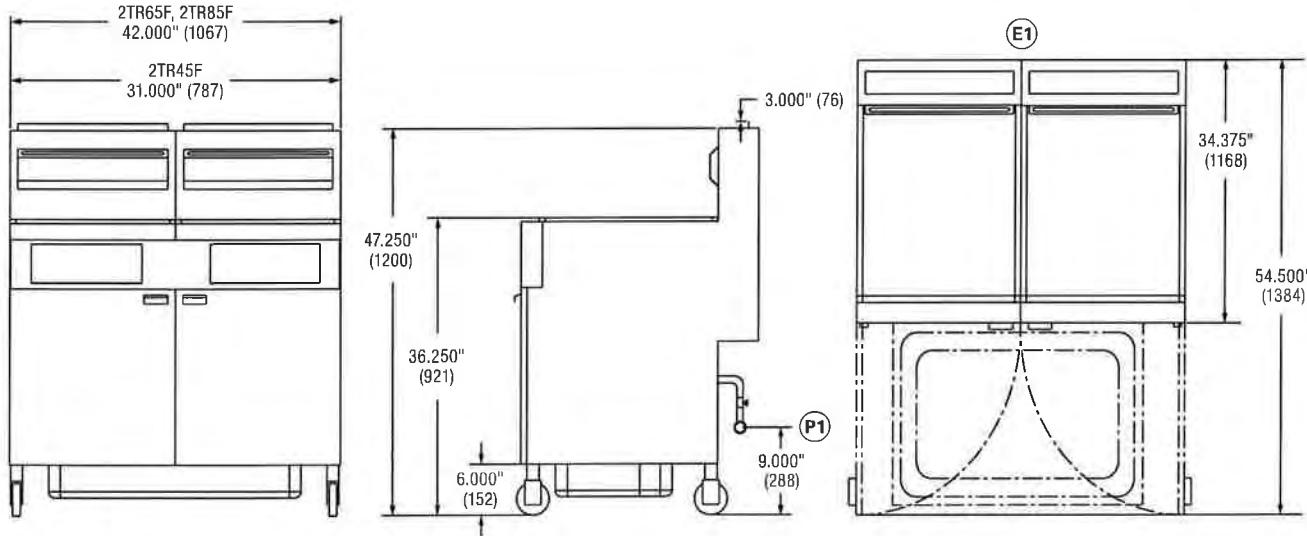
- An exterior gas regulator has been installed on the incoming gas manifold of the fryer and has been preset at the factory for the specific gas type – Natural or Propane Gas.
 - Natural Gas 8.0" (203 mm) W.C.
 - Propane Gas 11.0" (279 mm) W.C.
- An adequate ventilation system is required for Commercial Cooking Equipment. Information may be obtained by writing to the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269. When writing refer to NFPA No. 96.
- All models require a 6" (152 mm) clearance at both sides and rear adjacent to combustible construction.
- All models require a 16" (407 mm) minimum clearance to adjacent

- open top burner units.
- This appliance is manufactured for commercial installation only and is not intended for home use.

Service Connections:

- (P) 1 1/4" (32 mm) NPT common rear gas connection.
(E) 120 volt, 60 Hz, 1 phase electrical connection (NEMA 5-15P).

NOTE: In line with its policy to continually improve its product, Vulcan reserves the right to change materials and specifications without notice.



Views
Front, Side and Top
2TR45F, 2TR65F, 2TR85F,

Model	Filter Pan Capacity	Filter Area / Fabric Envelope	Motor	Pump	Electric Amps	Electric Power	Battery Dimensions (Widths)		
							2 Fryers	3 Fryers	4 Fryers
TR45F	70 lbs.	270 sq. in 350 sq. in	1/3 HP 1750 RPM	8 Gal/Min	115V 6.0A	115V 60Hz 1Ph	31"	46 1/2"	62"
TR65F	110 lbs.	270 sq. in 350 sq. in	1/3 HP 1750 RPM	8 Gal/Min	115V 6.0A	115V 60Hz 1Ph	42"	63"	84"
TR85F									

This appliance is manufactured for commercial use only and is not intended for home use.



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GRIDDLES & BROILERS

VACB SERIES
HEAVY DUTY COUNTER MODEL GAS CHARBROILER

Model VACB36



SPECIFICATIONS

Low profile, high volume gas charbroiler, Vulcan-Hart Model No. _____. All welded chassis with stainless steel front, sides, top trim and grease trough. Heavy cast iron char-radiants. 5 $\frac{1}{4}$ " wide cast iron diamond grates. Supercharger burner dividers. One 17,000 BTU/hr. burner for each broiling grate. Underburner deflector system reflects heat upwards. Standing pilot ignition system. One high range infinite heat control valve for each burner. 4" adjustable legs. $\frac{3}{4}$ " rear gas connection and gas pressure regulator.

Exterior dimensions:

____" wide x 31" deep x 12" working height

CSA design certified. NSF Certified.

SPECIFY TYPE OF GAS WHEN ORDERING.

SPECIFY ALTITUDE WHEN ABOVE 3,999 FT.

 VACB25 25 $\frac{1}{8}$ " wide

VACB36 36" wide

VACB47 46 $\frac{7}{8}$ " wide

VACB60 62 $\frac{1}{8}$ " wide

VACB72 72 $\frac{1}{2}$ " wide

STANDARD FEATURES

- All welded chassis with stainless steel sides, control panel, top trim, backsplash and grease trough
- Heavy duty cast iron char-radiants
- 5 $\frac{1}{4}$ " wide cast iron diamond grates
- One 17,000 BTU/hr burner for each broiler grate
- Easy lighting standing pilot ignition system
- One high range infinite heat control valve for each burner. Valve adjustment marks engraved into front panel for easy set-up.
- Heat deflector tray system reflects heat upwards creating a "Cool Zone" in the grease drawer and facilitates easier cleaning.
- 4" adjustable legs
- $\frac{3}{4}$ " rear gas connection and gas pressure regulator
- Supercharger burner dividers minimize heat transfer to enhance multi-zone cooking capability
- One year limited parts and labor warranty

ACCESSORIES

- 6" legs
- Cutting board
- Deep plate rail
- Condiment rail
- Back and side splash kit
- Griddle plate
- Welded steel diamond and round rod grates.
- 10 $\frac{1}{2}$ " wide griddle plate inserts
- Stainless steel stand with undershelf and casters
- Fajita pan rack
- Upper warming shelf



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GRIDDLES & BROILERS

VULCAN**VACB SERIES**
HEAVY DUTY COUNTER MODEL GAS CHARBROILER**INSTALLATION REQUIREMENTS:**

1. A gas pressure regulator supplied with the unit must be installed:
Natural Gas 5.0" (127 mm) W.C.
Propane Gas 10.0" (254 mm) W.C.
2. An adequate ventilation system is required for commercial cooking equipment. Information may be obtained by writing to the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269. When writing refer to NFPA No. 96.
3. These units are manufactured for installation in accordance with National Fuel Gas Code, ANSI-Z223.1/NFPA #54 (latest edition). Copies may be obtained from The American Gas Association, Accredited Standards Committee Z223 at 400 N. Capital St. NW, Washington, DC 20001, or the Secretary Standards Council, NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471.

NOTE: In The Commonwealth of Massachusetts

All gas appliances vented through a ventilation hood or exhaust system equipped with a damper or with a power means of exhaust shall comply with 248 CMR.

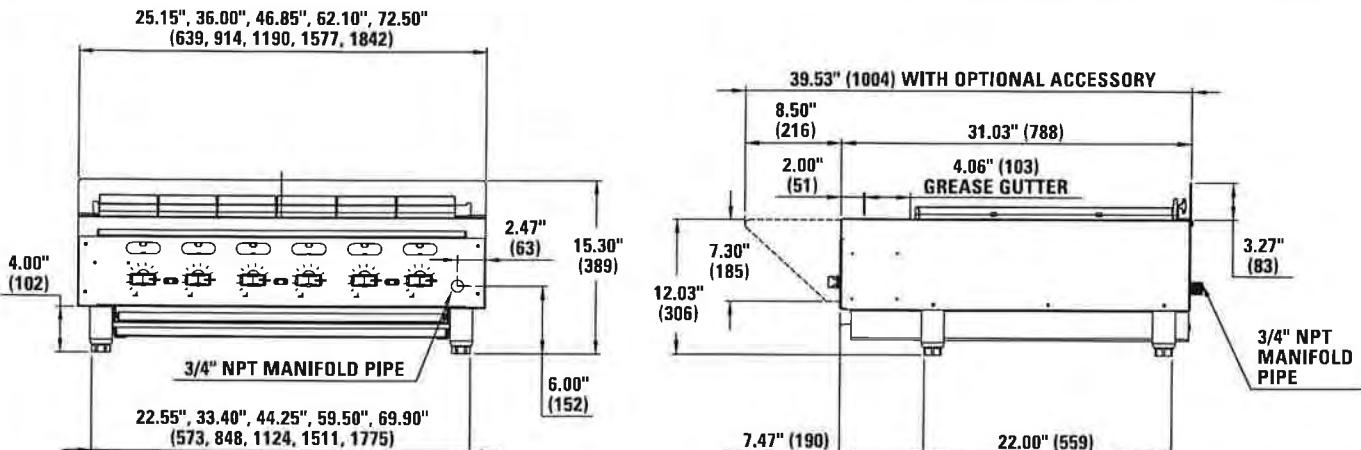
4. CLEARANCES

Non-Combustible

Rear	3"
Sides	0"

All models require a 4" bottom clearance from a non-combustible counter and must be installed with minimum 4" legs.

5. This appliance is manufactured for commercial installation only and is not intended for home use.



MODEL	WIDTH	DEPTH	OVERALL HEIGHT	WORKING HEIGHT*	BROILING AREA
VACB25	25.15" (639)				21.50" (546) x 22.31" (567)
VACB36	36.00" (914)				32.25" (819) x 22.31" (567)
VACB47	46.85" (1190)				43.00" (1092) x 22.31" (567)
VACB60	62.10" (1577)				57.00" (1448) x 22.31" (567)
VACB72	72.50" (1842)				68.75" (1746) x 22.31" (567)

*These are nominal dimensions and can vary by +1.75" with adjustable legs. Dimensions in "()" are in millimeters.

MODEL	# BURNERS	# DRIP TRAYS	TOTAL BTU/HR NATURAL GAS	TOTAL BTU/HR LP GAS	APPROX SHIP WT (LB/KG)
VACB25	4	1	68,000	64,000	290/131
VACB36	6	1	102,000	96,000	370/167
VACB47	8	2	136,000	128,000	450/203
VACB60	11	2	187,000	176,000	500/225
VACB72	13	2	221,000	208,000	580/263

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NOTE: In line with its policy to continually improve its products, Vulcan reserves the right to change materials and specifications without notice.



ACCESSORIES

VACB COUNTER MODEL GAS CHARBROILER



Model VACB47 With Backsplash, Plate Rail And Grate Options
Grates - Left To Right: Steel Round Rod(2), Cast Diamond(2), Griddle Plate(1) and
 Cast Straight(2)



GRIDDLE
CUTTING BOARD

CHARBROILER
CONDIMENT RAIL

HOTPLATE
PLATE RAIL

- CUTTING BOARD
- CONDIMENT RAIL
- PLATE RAIL
- BACKSPLASH
- GRATE OPTIONS
- GRIDDLE PLATE

STANDARD FEATURES

- Stainless steel construction.
- Welded and smooth blended edges.
- Line matched to MSA,900RX griddles and VHP hotplate accessories.
- Cutting board accessory features stainless steel frame with removable board inserts. Inserts are 1" thick X 7" wide, Sani-TUFF® rubber NSF listed boards.
- Condiment rails will accommodate up to the following amounts of 1/6 size containers:
 - 25" model – 3
 - 36" model – 4
 - 47" model – 6
 - 60" model – 8
 - 72" model – 10
- Plate rails feature a full 12 $\frac{1}{4}$ " deep stainless steel shelf.
- Back splash kit has 6" back and tapered sides.
- Variety of grate options available to fit your broiling needs. Grates are cast iron or welded standard steel construction.
- Griddle plate accessory is constructed of 1/4" welded standard steel plate.
- One year limited parts and labor warranty.

OPTIONS

- Product variations available. See your sales representative for product variance requests.

SPECIFY CHARBROILER SIZE WHEN ORDERING.

VULCAN-HART COMPANY, P.O. BOX 696, LOUISVILLE, KY 40201, TEL. 1-800-814-2028

502-778-2791 QUOTE & ORDER FAX: 1-800-444-0602

F-36993 (04-09)
 14048 AQUA WAIKIKI WAVE - KITCHEN

FoodStrategy, Inc.

VULCAN

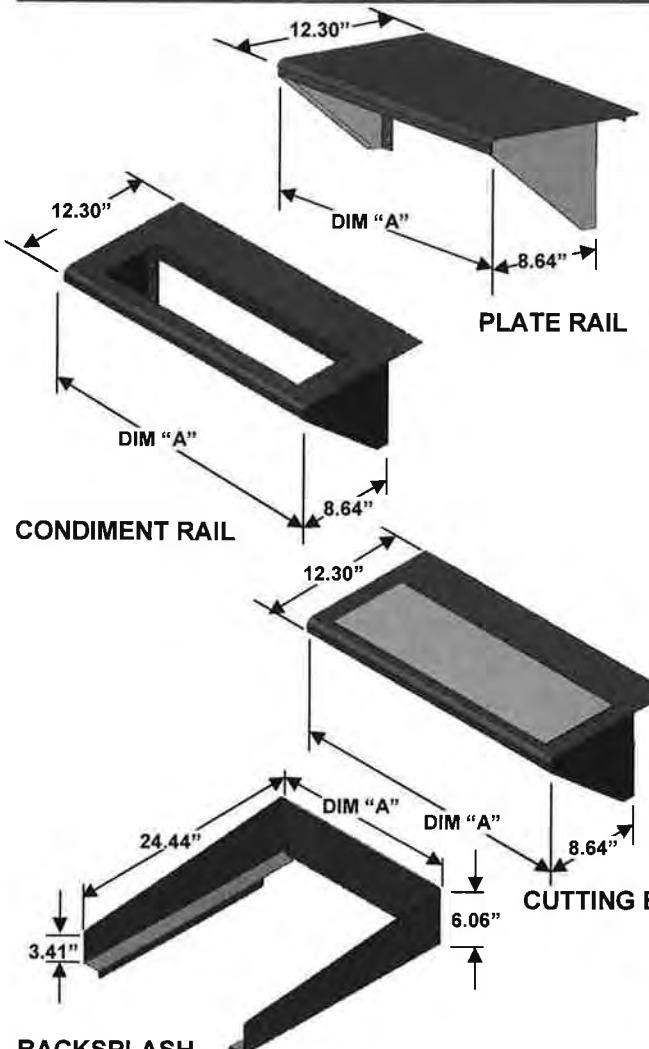
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Vulcan-Hart Co.

ACCESSORIES: VACB Counter Model Gas Charbroiler



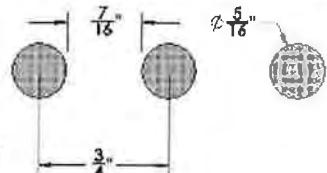
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ACCESSORIES VACB COUNTER MODEL GAS CHARBROILER

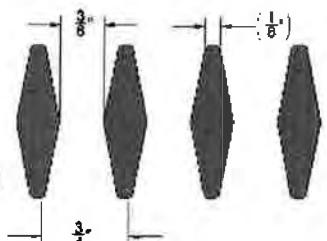


Dim "A" = 25.38", 36.13", 46.81", 60.63", 72.63"

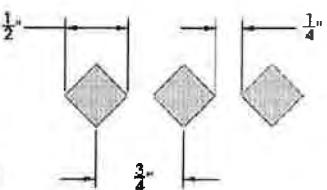
GRATES	
DESCRIPTION	ACCESSORY CODE
Round rod(1/2" welded steel rods)	GRATE-RR724
Cast diamond(standard cast iron)	GRATE-CDIA24
Diamond fabricated(welded steel)	GRATE-DIA24
Cast straight(cast iron)	GRATE-CSTR24
Griddle Plate(welded 1/4" steel)	GRATE-GRID24



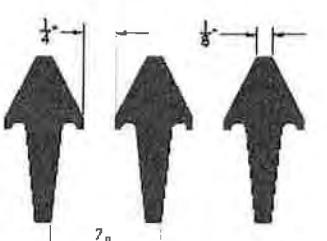
GRATE-RR724



GRATE-CDIA24



GRATE-DIA24



GRATE-CSTR24

All above grates are 5.25" wide X 24"



GRATE-GRID24

*Two piece board

NOTE: In line with its policy to continually improve its products, Vulcan-Hart Company reserves the right to change materials and specifications without notice.

VULCAN-HART COMPANY, P.O. BOX 696, LOUISVILLE, KY 40201, TEL. 1-800-814-2028

502-778-2791 QUOTE & ORDER FAX: 1-800-444-0602



DONE TO PERFECTION.

**WOLF**

No worries.

VCCB & SCB CHARBROILER ACCESSORIES

DESCRIPTION	GRATE PICTURE	PROFILE
SERVICE PART: 710424 CAST IRON SLANTED GRATE STANDARD ON ALL UNITS		
ACCESSORY CODE: GRATE-CDIA7 CAST IRON DIAMOND GRATE		
ACCESSORY CODE: GRATE-SSDIA7 CARBON STEEL DIAMOND FABRICATED GRATE		
ACCESSORY CODE: GRATE-RROD7 CARBON STEEL 1/2" ROUND ROD GRATE		
ACCESSORY CODE: GRATE-WAFFLE CAST IRON WAFFLE GRATE		

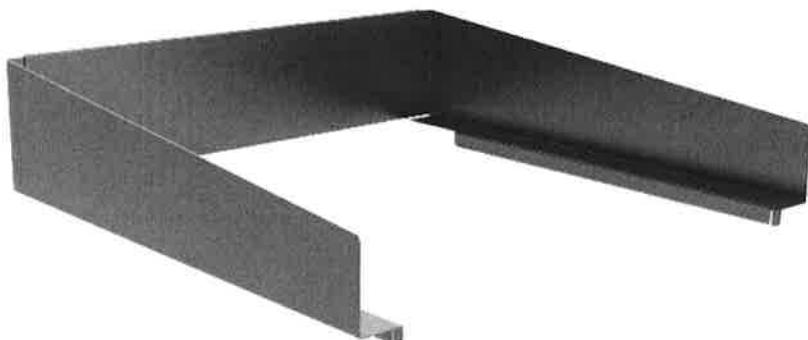


DONE TO PERFECTION.



No worries.

VCCB & SCB CHARBROILER ACCESSORIES



ACCESSORY CODE:
SPLASH6-CBxx

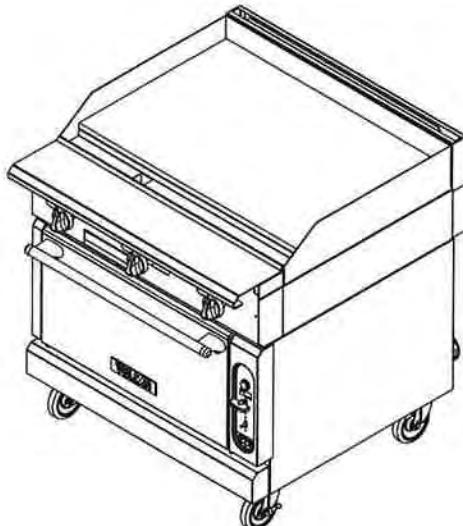
STAINLESS STEEL SPLASH KIT.
"xx" REPRESENTS UNIT SIZE



ACCESSORY CODE:
PLTRAIL-VCCBxx

STAINLESS STEEL PLATE RAIL
"xx" REPRESENTS UNIT SIZE

F-38323 (10-11)

HEAVY DUTY COOKING**VULCAN**

Model VGM36C
(shown on convection oven base)

**SPECIFICATIONS**

36" wide heavy duty gas range, Vulcan Model No. VGM36 (modular), VGM36B (cabinet base), VGM36S (standard oven base) or VGM36C (convection oven base). Modular construction for ease of installation. Stainless steel front, front top ledge, plate ledge, sides, base, burner box, stub back, and 6" adjustable legs on all "B", "S", & "C" models. Stainless steel extra deep crumb tray. Three 30,000 BTU/hr burners. Individual pilots and controls for each burner. $\frac{3}{4}$ " polished steel griddle plate with 4" side splash. Standard Oven: 50,000 BTU/hr. with porcelain oven bottom, sides, and interior door panel. Convection Oven: 32,000 BTU/hr. with porcelain oven bottom, sides, and interior door panel (115v-1 phase blower motor, 4 amps, 9' cord & plug). Ovens measure 27"w x 27"d x 13'h. Standard oven thermostats adjust from 150° – 550°F. Convection oven adjusts from 175° – 550°F and the optional finishing oven for standard ovens adjusts from 300° – 650°F. Standard oven supplied with one rack, convection oven with two. Both ovens allow for three rack positions. Oven door is heavy-duty with counter weight door hinges. 1 $\frac{1}{4}$ " front manifold connection and 1 $\frac{1}{4}$ " rear gas, capped.

Exterior Dimensions:

36 $\frac{3}{4}$ "d x 36"w x 40 $\frac{1}{2}$ "h on 4" adjustable legs

HEAVY DUTY GAS RANGE
36" WIDE MANUAL GRIDDLE GAS RANGE

- VGM36** 36" Wide Manual Griddle / Modular
- VGM36B** 36" Wide Manual Griddle / Cabinet Base
- VGM36S** 36" Wide Manual Griddle / Standard Oven
- VGM36C** 36" Wide Manual Griddle / Convection Oven

STANDARD FEATURES

- Stainless steel front, front top ledge, burner box, sides, base, and stub back
- 1 $\frac{1}{4}$ " diameter front gas manifold with 1 $\frac{1}{4}$ " rear gas connection (capped)
- 30,000 BTU/hr. burners (3 each)
- 50,000 BTU/hr. standard oven burner
- 32,000 BTU/hr. convection oven burner
- Individual pilots and controls for each burner
- $\frac{3}{4}$ " polished steel griddle plate
- 4" high side splash
- 4" stainless steel stub riser
- 6" adjustable stainless steel legs for "B" models (no legs for modular model)
- Stainless steel cabinet base doors
- Universal rack guides, with one removable shelf (cabinet base)
- One year limited parts and labor warranty

OPTIONAL FEATURES (Factory Installed)

- Cap and cover front manifold
- 650° oven thermostat and steel hearth ("S" models)
- 4" adjustable flanged feet for modular models
- Less legs for dolly mounting of cabinet base models
- 3" high toe base for curb mounting of cabinet base models
- Universal rack guides, with one shelf (shelf is removable)

ACCESSORIES (Packaged & Sold Separately)

- $\frac{3}{4}$ ", 1", or 1 $\frac{1}{4}$ " gas pressure regulator (specify gas type – pack loose)
- Set of 4 casters, 6" high (two locking)
- 6" adjustable flanged feet for "S", "C", and "B" models
- Extra removable shelves for use with Universal rack guides (cabinet base)
- Banking strip
- Common condiment type, telescoping plate rails (starting at 24" length)
 - 10", 22", or 34" high back risers (no shelf)
 - 22" single deck solid or flo-thru high shelf risers
 - 34" double deck solid or flo-thru high shelf risers
 - Dolly frames
 - Flexible gas hose with quick disconnect and restraining device

VULCAN

a division of ITW Food Equipment Group LLC

P.O. Box 696 ■ Louisville, KY 40201 ■ Toll-free: 1-800-814-2028 ■ Local: 502-778-2791 ■ Quote & Order Fax: 1-800-444-0602

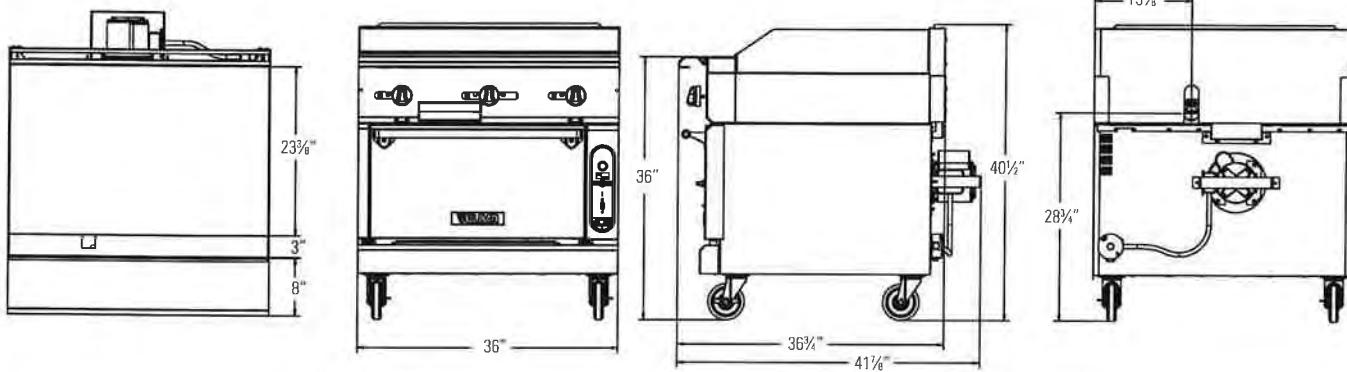
HEAVY DUTY COOKING
HEAVY DUTY GAS RANGE
36" WIDE MANUAL GRIDDLE GAS RANGE
INSTALLATION INSTRUCTIONS

1. A properly sized gas pressure regulator suitable for battery or single unit application must be furnished and installed. Natural gas 6.0" W.C., propane gas 10.0" W.C.
2. An adequate ventilation system is required for commercial cooking equipment. Information may be obtained by writing to the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269, www.NFPA.org. When writing, refer to NFPA No. 96.
3. These units are manufactured for installation in accordance with ANS Z223.1A (latest edition), National Fuel Gas Code. Copies may be obtained from The American Gas Association, 400 N Capitol St. NW, Washington, DC 20001, www.AGA.org.
4. **Clearances**

Combustible	Rear	Sides
Non-combustible	10"	10"
	0"	0"
5. For proper combustion, install equipment on adjustable legs or casters. On curb or platform, allow 3½" front overhang. Toe base with leveling bolts are required for curb installation. Specify when ordering.
6. Cannot be battered with GH series equipment.
7. This appliance is manufactured for commercial installation only and is not intended for home use.

NOTE: In line with its policy to continually improve its product, Vulcan reserves the right to change materials and specifications without notice.

**Specify type of gas when ordering.
Specify altitude when above 2,000 feet.**



TOP CONFIGURATION	MODEL NUMBER	DESCRIPTION	TOTAL INPUT BTU / HR	SHIPPING WEIGHT LBS / KG
	VGM36	36" Wide Manual Griddle / Modular	90,000	404 / 183
	VGM36B	36" Wide Manual Griddle / Cabinet Base	90,000	304 / 229
	VGM36S	36" Wide Manual Griddle / Standard Oven	140,000	685 / 311
	VGM36C	36" Wide Manual Griddle / Convection Oven	122,000	763 / 346

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14048 AQUA WAIKIKI WAVE - KITCHEN

FoodStrategy, Inc.

HEAVY DUTY COOKING

VULCAN

Model V6B36C
shown on a convection oven base

**SPECIFICATIONS**

36" wide heavy duty gas range, Vulcan Model No. V6B36 (modular) and V6B36B (cabinet base) or V6B36S (standard oven base) and V6B36C (convection oven base). Modular construction for ease of installation. Stainless steel front, plate ledge, front top ledge with pull-out condiment rails, sides, base, stub back, and 6" adjustable legs on all "B", "S", & "C" models. Stainless steel extra deep crumb tray. Six 33,000 BTU/hr. cast burners with lift-off burner heads. Individual pilots and controls for each burner. Heavy duty cast burner grates, easy lift-off 11" x 12" in front, 14" x 12" in rear. Grates are separate from aeration bowl for ease of cleaning. **Standard Oven:** 50,000 BTU/hr. with porcelain oven bottom, sides and indoor panel. **Convection Oven:** 32,000 BTU/hr. with porcelain oven bottom, sides and interior door panel (115v-1 phase blower motor, 4 amps, 6' cord and plug). Oven measures 27" w x 27" d x 13" h. Standard oven thermostat adjusts from 150° - 550°F. Convection oven adjusts from 175° - 550°F and the optional finishing oven for standard ovens adjusts from 300° - 650°F. Standard oven supplied with one rack, convection oven with two racks. Both ovens allow for three rack positions. Oven door is heavy duty with counter weight door hinges. 1 1/4" diameter front gas manifold and 1 1/4" rear gas connection, capped. Total input 198,000 BTU/hr.

Exterior Dimensions:

36 3/4" d x 36" w x 36" h on 6" adjustable legs

HEAVY DUTY GAS RANGE
6-BURNER / 36" WIDE GAS RANGE

- V6B36** 6-Burners / Modular
- V6B36B** 6-Burners / Cabinet Base
- V6B36S** 6-Burners / Standard Oven
- V6B36C** 6-Burners / Convection Oven

STANDARD FEATURES

- Stainless steel front, front top ledge, burner box, sides, base, and stub back
- 1 1/4" diameter front gas manifold with 1 1/4" rear gas connection (capped)
- 33,000 BTU/hr. open top burners with lift off heads
- 50,000 BTU/hr. standard oven burner
- 32,000 BTU/hr. convection oven burner
- Porcelain oven cavity
- Individual pilots and controls for each burner
- Heavy-duty cast grates
- 4" stainless steel stub riser
- 6" adjustable stainless steel legs for "S", "C", and "B" models (no legs for modular model)
- Stainless steel cabinet base door
- Universal rack guides, one removable shelf (cabinet base)
- One year limited parts and labor warranty

OPTIONAL FEATURES (Factory Installed)

- Cap and cover front manifold
- Stainless steel oven cavity
- 650°F oven thermostat and steel hearth ("S" models)
- Fan cooling package ("C" models)
- 4" adjustable flanged feet for modular models
- Less legs for dolly mounting for "S", "C", and "B" models
- 3" high toe base for curb mounting
- Common condiment type, telescoping plate rails

ACCESSORIES (Packaged & Sold Separately)

- 1", or 1 1/4" gas pressure regulator (specify gas type - pack loose)
- Set of 4 casters, 6" high (locking)
- 6" adjustable flanged feet for "S", "C", and "B" models
- Extra removable shelves for use with Universal rack guides (for cabinet base)
- "S" Grates
- Banking strip
- Common condiment type, telescoping plate rails (starting at 24" length)
- 10", 22", or 34" high back risers (no shelf)
- 22" single deck solid or flo-thru high shelf risers
- 34" double deck solid or flo-thru high shelf risers
- Dolly frames
- Flexible gas hose - quick disconnect & restraining device

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H E A V Y D U T Y C O O K I N G**VULCAN****HEAVY DUTY GAS RANGE**
6-BURNER / 36" WIDE GAS RANGE**INSTALLATION INSTRUCTIONS**

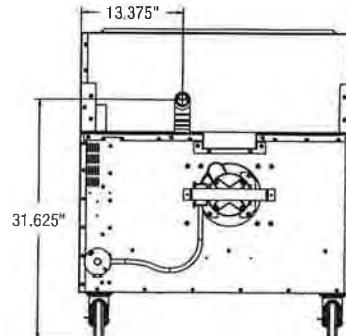
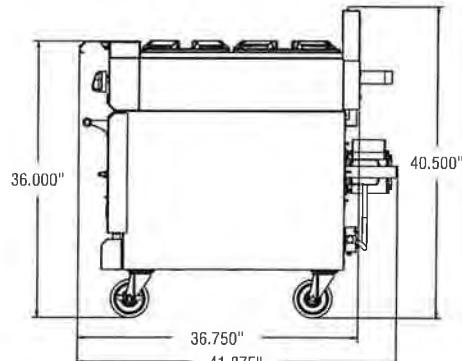
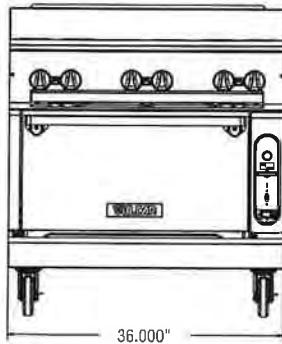
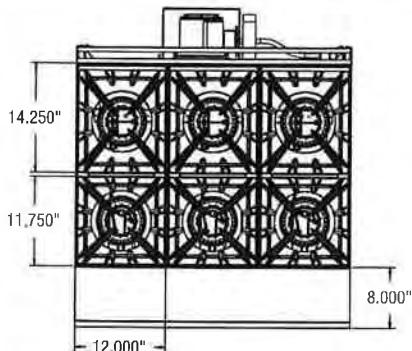
1. A properly sized gas pressure regulator suitable for battery or single unit application must be furnished and installed. Natural gas 6.0" W.C., propane gas 10.0" W.C.
2. An adequate ventilation system is required for commercial cooking equipment. Information may be obtained by writing to the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269, www.NFPA.org. When writing, refer to NFPA No. 96.
3. These units are manufactured for installation in accordance with ANSI Z223.1A (latest edition), National Fuel Gas Code. Copies may be obtained from The American Gas Association, 400 N Capitol St. NW, Washington, DC 20001, www.AGA.org.
4. **Clearances**

	Rear	Sides
Combustible	10"	10"
Non-combustible	0"	0"

5. For proper combustion, install equipment on adjustable legs or casters. On curb or platform, allow 3½" front overhang. Toe base with leveling bolts are required for curb installation. Specify when ordering.
6. Cannot be battered with GH series equipment.
7. This appliance is manufactured for commercial installation only and is not intended for home use.

NOTE: In line with its policy to continually improve its product, Vulcan reserves the right to change materials and specifications without notice.

**Specify type of gas when ordering.
Specify altitude when above 2,000 feet.**



TOP CONFIGURATION	MODEL NUMBER	DESCRIPTION	TOTAL INPUT BTU / HR	SHIPPING WEIGHT LBS / KG
	V6B36	6-Burners / Modular	198,000	400 / 180
	V6B36B	6-Burners / Cabinet Base	198,000	435 / 196
	V6B36S	6-Burners / Standard Oven Base	248,000	690 / 311
	V6B36C	6-Burners / Convection Oven Base	230,000	730 / 329

This appliance is manufactured for commercial use only and is not intended for home use.

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HEAVY DUTY COOKING
**HEAVY DUTY GAS RANGE
REFRIGERATED EQUIPMENT STANDS**


Model VSC84

**SPECIFICATIONS**

Vulcan Hart VSC Series refrigerated equipment stands are designed for use along the cookline where cabinet strength and system performance really matter. Their rear mounted evaporators keep food cold in very warm kitchen environments despite frequent drawer openings. They also offer greater capacity, as each drawer accommodates 6" deep pans, and a variety of other features making them ideal for the equipment stand application. Drawers include a stay open and self-closing feature, as well as a guard to protect the gasket from damage. Grease accumulation on the condenser is prevented by an easy to remove and clean filter. Even installation is facilitated through use of factory installed casters mounted on an adjustable rail, making it easy to position these around such common floor obsructions as drains, junction boxes, and gas connections.

- | | |
|---|-----------------|
| <input type="checkbox"/> VSC36, VSC48, VSC60 | 2 Drawer Models |
| <input type="checkbox"/> VSC72, VSC84 | 4 Drawer Models |
| <input type="checkbox"/> VSC96 | 6 Drawer Model |

STANDARD FEATURES

- Stainless steel exterior and interior
- Custom stainless steel top for unitized assembly with V Series range components only
- Microprocessor control system
- Balanced, self-contained refrigeration system using R-404A
- Front-breathing design for "zero-clearance" installation
- Non-electric automatic condensate evaporator
- Condenser filter
- Off-cycle evaporator defrost
- Controllable anti-condensate drawer perimeter heaters
- Full length drawer handle with gasket guard
- Magnetic snap-in door gaskets
- Drawers accommodate 12" x 20" x 6" pans (pans by others)
- Self-closing drawers with stay open feature
- 14-gauge stainless steel drawer slide
- Side, front and rear access panel for ease of service and maintenance
- NEMA 5-15P plug with 9' cord and cord retainer
- 3" casters on adjustable channel moving system
- One year parts and labor warranty
- Two year control warranty (parts and labor)
- Five year compressor warranty
- Three year drawer parts warranty

OPTIONS

- Set of 6" high stainless steel legs in lieu of casters
- 6" cabinet length extension
- Stainless steel exterior finished back
- NAFEM Data Protocol Gateway package
- Export 220/50/1 voltage
- Remote applications
- Water cooled self-contained condenser suitable for connection to glycol
- System relocated to right



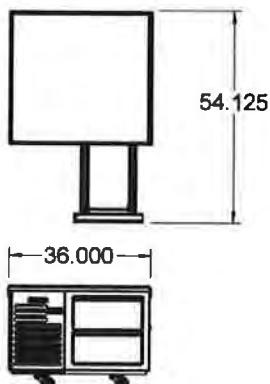
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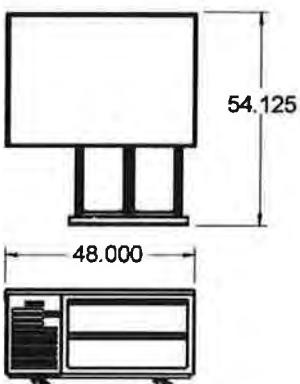
HEAVY DUTY COOKING

VULCAN**HEAVY DUTY GAS RANGE
REFRIGERATED EQUIPMENT STANDS**

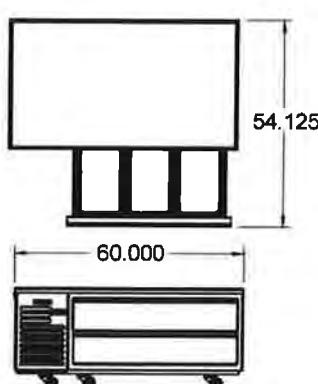
36" BASE



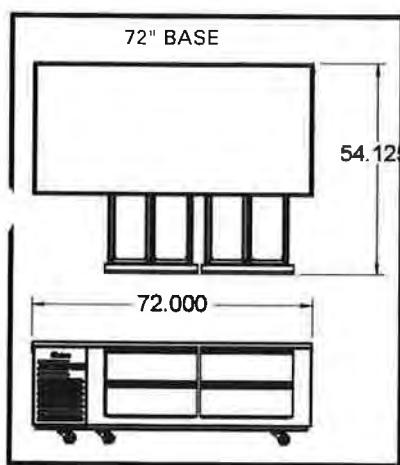
48" BASE



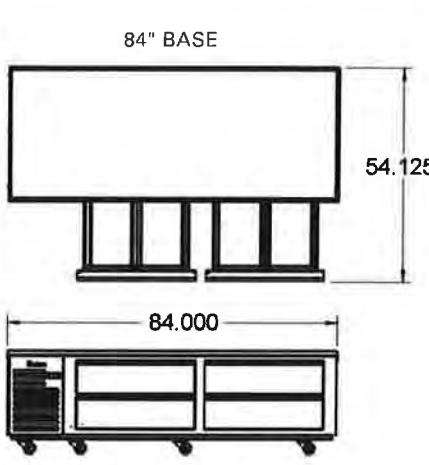
60" BASE



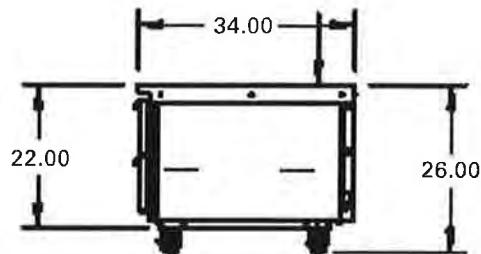
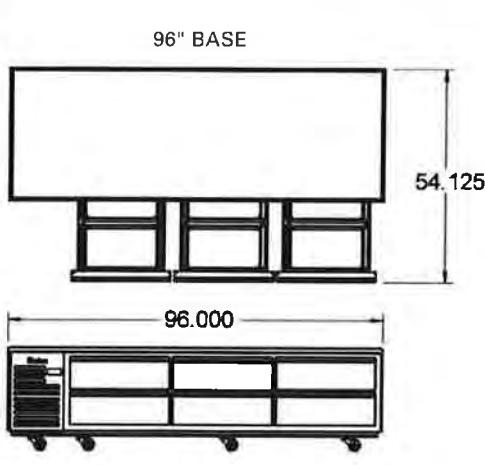
72" BASE



84" BASE



96" BASE



Section - All Models



All units equipped with one NEMA 5-15P plug.

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14048 AQUA WAIKIKI WAVE - KITCHEN

FoodStrategy, Inc.

H E A V Y D U T Y C O O K I N G**HEAVY DUTY GAS RANGE
REFRIGERATED EQUIPMENT STANDS****INSTALLATION INSTRUCTIONS****Construction, Hardware and Insulation**

Cabinet exterior front, sides, louver assembly and drawers are constructed of 20-gauge 430 stainless steel, exterior back and bottom are constructed of heavy gauge galvanized steel. Cabinet interior sides are constructed of 22-gauge 400 series stainless steel, top and bottom are constructed of 22-gauge 300 series stainless steel. A set of 3" high casters are included standard. Vinyl magnetic snap-in drawer gasket assures tight drawer seal. Both the cabinet and drawers are insulated with an average of 2" thick high density, non-CFC, foamed in place polyurethane.

Controller

The easy to use water resistant microprocessor control system is supplied standard. Unit is NAFEM Data Protocol communication (NDP) ready. Optional hardware required to be NDP compliant (3rd party software required for network connection). It includes a 3-Digit LED Display, °F or °C Temperature Scale Display Capability, and an RS485 data port. In addition it includes audio/visual alarms for: Hi/Lo Cabinet Temp, Clean Condenser, Evaporator Coil and Discharge Line Sensor Failures, and Power Supply Interruption.

Refrigeration System

The left side mounted, self-contained, balanced refrigeration system using R-404A refrigerant features an off-cycle defrost, capillary tube, air-cooled hermetic compressor, automatic condensate evaporator, and a dedicated rear-mounted evaporator design which distributes cold air through each drawer section. A 9' cord and retainer is provided. Standard operating temperature is 34 to 38°F.

Drawers

Each heavy-duty drawer is designed to accommodate 12" x 20" x 6" deep pans. They are constructed using 14-gauge stainless steel drawer slides and 2" diameter stainless steel rollers. Drawers include both a self-closing and stay-open feature.

Warranties

Both a one year parts and labor warranty and a five year compressor warranty (self-contained models only) are provided standard. An optional 2nd year extended parts and labor warranty is also available. In addition the control is warranted by a two year parts and labor warranty, and the drawers are covered by a three years parts only warranty (excluding gaskets).



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HEAVY DUTY COOKING
**HEAVY DUTY GAS RANGE
REFRIGERATED EQUIPMENT STANDS**
DIMENSIONAL DATA

MODEL	LENGTH OVERALL IN.	DEPTH CABINET ONLY IN.	DEPTH WITH DRAWER OPEN	DEPTH OVER HANDLE IN.	HEIGHT OVERALL ON 4" CASTERS IN.	MAX TOP LOAD CAPACITY LBS.	PAN CAPACITY 12" x 20" x 6"	PAN ORIENTATION	DRAWERS PER CABINET	GROSS WEIGHT CRATED LBS.
VSC36	36 (91.4 cm)	32 (81.3 cm)	54½ (137.5 cm)	34½ (86.7 cm)	26 (66.0 cm)	625	2	n/a	2	410 (186 kg)
VSC48	48 (121.9 cm)	32 (81.3 cm)	54½ (137.5 cm)	34½ (86.7 cm)	26 (66.0 cm)	625	4	Side by Side	2	430 (195 kg)
VSC60	60 (152.5 cm)	32 (81.3 cm)	54½ (137.5 cm)	34½ (86.7 cm)	26 (66.0 cm)	1200	6	Side by Side	2	475 (216 kg)
VSC72	72 (182.9 cm)	32 (81.3 cm)	54½ (137.5 cm)	34½ (86.7 cm)	26 (66.0 cm)	1200	8	Front to Back	4	555 (252 kg)
VSC84	84 (213.4 cm)	32 (81.3 cm)	54½ (137.5 cm)	34½ (86.7 cm)	26 (66.0 cm)	1500	8	Side by Side	4	655 (297 kg)
VSC96	96 (243.8 cm)	32 (81.3 cm)	54½ (137.5 cm)	34½ (86.7 cm)	26 (66.0 cm)	1500	12	Front to Back	6	760 (345 kg)

MODEL	ELECTRICAL DATA			REFRIGERATION DATA	
	VOLTAGE	FULL LOAD AMPERES	NEMA PLUG TYPE	REFRIGERANT	BTU/HR - HP
VSC36	115/60/1	6.7	5-15P	R-404A	2440 (½ HP)
VSC48	115/60/1	6.7	5-15P	R-404A	2440 (½ HP)
VSC60	115/60/1	6.7	5-15P	R-404A	2440 (½ HP)
VSC72	115/60/1	6.7	5-15P	R-404A	2440 (½ HP)
VSC84	115/60/1	6.7	5-15P	R-404A	2440 (½ HP)
VSC96	115/60/1	12.0	5-15P	R-404A	4090 (½ HP)

NOTE: When ordering please specify: Voltage, Options and any additional warranties.

NOTE: Figures in parentheses reflect metric equivalents.



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NOTE: In line with its policy to continually improve its products, Vulcan reserves the right to change materials and specifications without notice.

RANGES



Model 36RB

**SPECIFICATIONS**

Gas salamander broiler, Vulcan Model No. 36RB. Stainless steel front, top and sides. Six 8,300 BTU/hr. cast iron burners with stainless steel radiants; 50,000 BTU/hr. total input. Dual heat controls with improved temperature control (250°F-800°F at rack). Pilot ignition system. Cool-to-the-touch knob on lever provides positive positioning of the broiling carriage. Heavy-duty chrome plated broiling grid measures 27½" w x 13" d. Removable full width spillage pan. ¾" top gas connection and gas pressure regulator.

Exterior Dimensions:

36" w x 19" d x 17⅝" h.

CSA design certified. NSF listed.

SPECIFY TYPE OF GAS WHEN ORDERING.**SPECIFY ALTITUDE WHEN ABOVE 3,999 FT.**

36RB

36" HEAVY DUTY GAS SALAMANDER BROILER

- 36RB-N Natural Gas
- 36RB-P Propane Gas

NOTE: 36RB may be used in conjunction with appropriate reinforced range back riser, wall mounted with optional brackets or counter mounted with optional 4" legs.

STANDARD FEATURES

- Stainless steel front, top and sides.
- Dual heat controls for zone cooking.
- Six 8,300 BTU cast iron burners with stainless steel radiants. 50,000 BTU/hr. total input.
- Standing pilot ignition system.
- Cool-to-the-touch knob on lever provides positive positioning of the broiler carriage (6 positions).
- Heavy-duty chrome plated grid (27½" w x 13" d).
- Removable full width spillage pan.
- ¾" top gas connection and gas pressure regulator.
- One year parts and labor warranty.

OPTIONS

- Set of wall mount brackets.
- Set of 4" legs with adjustable feet.
- Stainless steel reinforced back riser for range mounting.
- Range inter-plumb kit.
- Stainless steel back panel.

R A N G E S

VULCAN

36RB**36" HEAVY DUTY GAS
SALAMANDER BROILER****INSTALLATION REQUIREMENTS:**

1. A gas pressure regulator sized for this unit is included. Natural gas 5" W.C., Propane gas 10" W.C.
2. An adequate ventilation system is required for commercial cooking equipment. Information may be obtained by writing to the National Fire Protection Association, Batterymarch Park, Quincy, MA 02169. When writing refer to NFPA No. 96.
3. These units are manufactured for installation in accordance with National Fuel Gas Code, ANSI-Z223.1/NFPA #54 (latest edition). Copies may be obtained from The American Gas Association, Accredited Standards Committee Z223 @ 400N. Capital St. NW,

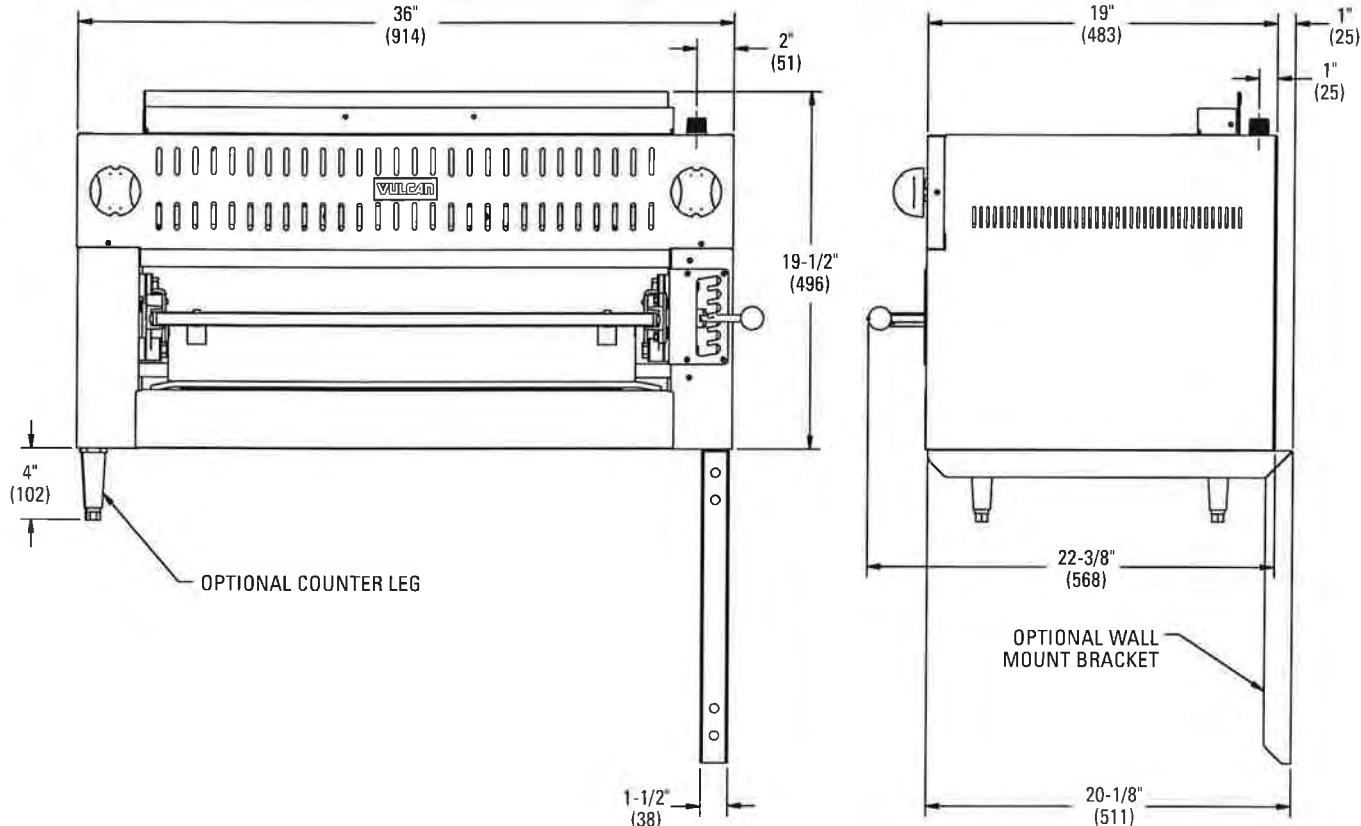
Washington, DC 20001, or the Secretary Standards Council, NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471.

NOTE: In the Commonwealth of Massachusetts

All gas appliances vented through a ventilation hood or exhaust system equipped with a damper or with a power means of exhaust shall comply with 248 CMR.

4. Clearances:	Combustible	Non-Combustible
Rear	0"	0"
Sides	6"	0"
Bottom	10"	4"

5. This appliance is manufactured for commercial installation only and is not intended for home use.

**GAS CONNECTION: 3/4" (19 mm)**

MODEL	INPUT BTU/hr.	WIDTH	DEPTH	HEIGHT	APPROX. SHIP. WT.
36RB	50,000	36" (914 mm)	19" (483 mm)	See Drawing	180 lbs./82 kg

Mounting of salamander requires purchase of correct reinforced riser or reinforced shelf

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NOTE: In line with its policy to continually improve its products, Vulcan reserves the right to change materials and specifications without notice.



STUBBY SERIES GAS DECK OVENS



SPECIFICATIONS

BAKERS PRIDE Stubby Series gas Deck Ovens are designed for high volume pizza and all-purpose operations and are only 33" deep (838mm) to fit in line with other kitchen equipment.

Ovens may be stacked three high. Oven exteriors are all heavy-gauge, type 403 stainless steel and are fully insulated for cooler outer temperatures and consistent interior temperatures.

Interior oven frame is constructed of 1/4" (6mm) heavy-duty angle iron frame, completely welded to form a single, unitized section. The oven body and lining are then welded to the framework.

Oven interiors are manufactured of high-heat resistant 16-gauge aluminized steel. Doors are fully insulated, spring balanced with tubular steel handles and will remain open or closed until moved.

All models feature independent, operator-controlled top & bottom heat control damper.

Stubby Series features a 300°-650° F (149°-343°C) throttling thermostat, 8" (203mm) interior deck height with 1 1/2" (38mm) thick hearth stone decks (steel decks optional) and are supported by a 1/4" (6mm) angle iron frame.

Combination gas control incorporates a manual gas valve, pilot safety and pressure regulator. Easily removable, slide-out, heavy-duty flame diverters distribute the burner flame uniformly in the burner chamber. A 3/4" (19mm) NPT gas connection is located on the left side and left rear of oven - operator/installer may choose.

Heavy-duty, 7-gauge hot rolled steel legs are standard and finished with durable Bakertone.

2 Year limited parts and labor warranty standard.

Job _____ Item # _____

GAS DECK OVENS



Single	Double	Triple
151	152	153
3151	3152	3153
4151	4152	4153

STANDARD FEATURES

- 48,000 to 70,000 BTUH per deck, natural or LP gas (LP not CE approved)
- 300°-650° F (149°-343°C) throttling thermostat
- Top & bottom heat control damper
- Combination gas controls with valve, regulator & pilot safety
- Heavy-duty, slide-out flame diverters
- 8" (203mm) interior deck heights with 1 1/2" (38mm) thick hearth stone decks
- All stainless steel exteriors
- Aluminized steel interiors
- Spring balanced, fully insulated doors
- Side or rear gas connections
- 7-Gauge legs
- Fully insulated throughout
- 2 Year limited part and labor warranty

OPTIONS & ACCESSORIES

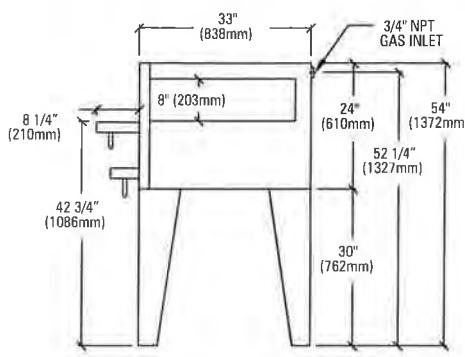
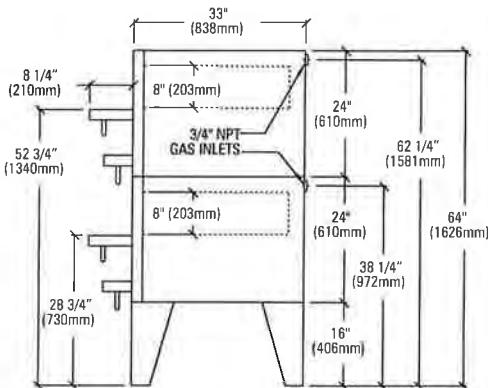
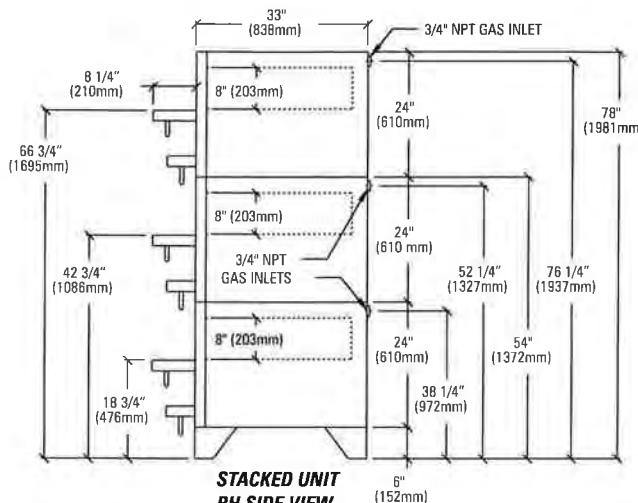
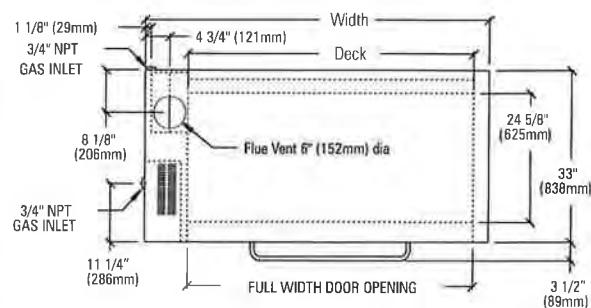
- Steel decks
- 150°-550° F (65°-288°C) thermostat
- Set of 4 casters - two with locks
- Stainless steel leg covers
- Special height legs
- Steam Injection
- Automatic oven starter
- Draft flue for direct vent (not available on CE units)

CERTIFICATIONS



BAKERS PRIDE OVEN COMPANY, INC.
30 Pine Street, New Rochelle, NY 10801
914/576-0200 • 1-800-431-2745 • fax 914/576-0605
www.bakerspride.com

Continuous product improvement is a policy of Bakers Pride Oven Company. Therefore, specifications and design are subject to change without notification.

SINGLE UNIT
RH SIDE VIEWSTACKED UNIT
RH SIDE VIEWSTACKED UNIT
RH SIDE VIEW

TOP VIEW

ALL DIMENSIONS NOMINAL

SHIPPING INFORMATION

Model	Shipping Weight		Carton Dimensions			Crate Size	
	Lbs.	Kilos	Width inches mm	Depth inches mm	Height inches mm	Cubic Feet	Cubic Meter
151	820	372	53 1346	40 1016	37 940	44.4	1.4
3151	958	434	52 1321	36 914	72 1829	76.2	2.7
4151	1093	496	52 1321	36 914	72 1829	76.2	2.7

Shipping Class # 70

Each oven ships separately

Hearth decks & legs ship in separate cartons

SPECIFICATIONS

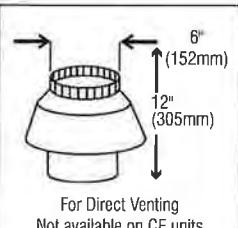
Model	Deck Size		# Decks	Overall Dimensions		
	Width inches mm	Height inches mm		Width inches mm	Depth inches mm	Height inches mm
151	36x24 1/2	914x622	8 203	48	1219	33 838 54 1372
152	36x24 1/2	914x622	8 203	48	1219	33 838 64 1626
153	36x24 1/2	914x622	6 203	48	1219	33 838 76 1301
3151	45x24 1/2	1143x622	8 203	57	1448	33 838 54 1372
3152	45x24 1/2	1143x622	8 203	57	1448	33 838 64 1626
3153	45x24 1/2	1143x622	8 203	57	1448	33 838 78 1981
4151	54x24 1/2	1372x622	8 203	66	1676	33 838 54 1372
4152	54x24 1/2	1372x622	8 203	66	1676	33 838 64 1626
4153	54x24 1/2	1372x622	8 203	66	1676	33 838 78 1981

* Height includes 30" (762mm) standard legs on models 151, 3151, 4151

* Height includes 6" (152mm) standard legs on models 153, 3153, 4153

* Height includes 6" (152mm) standard legs on models 153, 3152, 4152

CE approved units may only be stacked two high

For Direct Venting
Not available on CE unitsFor Installation Under
Ventilation Hood

MUST BE SPECIFIED AT TIME OF ORDER

STANDARD

GAS SUPPLY

Model	BTUH	kW	Connection
151	48,000	14	3/4"
3151	70,000	21	3/4"
4151	70,000	21	3/4"

Each oven requires separate gas connection
CE certification not available in LP gas

MINIMUM CLEARANCES

	Non Combustible Construction* Inches mm	Combustible Construction** Inches mm
Left Side	0 0	1 25
Right Side	0 0	3 76
Rear	2 51	3 76

* In European Community Countries and North America. In NON-COMBUSTIBLE locations only.

** In European Community Countries only in COMBUSTIBLE locations. NOT for North America.



BAKERS PRIDE OVEN COMPANY, INC.
30 Pine Street, New Rochelle, NY 10801
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www.bakerspride.com

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TSW: 11/07



TRUE FOOD SERVICE EQUIPMENT, INC. • 2001 East Terra Lane • O'Fallon, Missouri 63366-4434
ph. 636.240.2400 • toll free 800.325.6152 • fax 636.272.2408 • parts fax 636.272.2947 • www.truefmq.com

PROJECT NAME	LOCATION	AIA #
ITEM #	QTY	SIS #

SPEC SERIES®

REACH-IN SOLID HALF SWING DOOR REFRIGERATORS

models

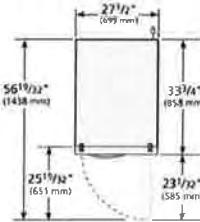
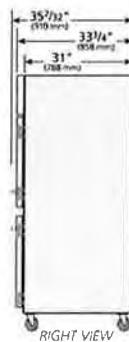
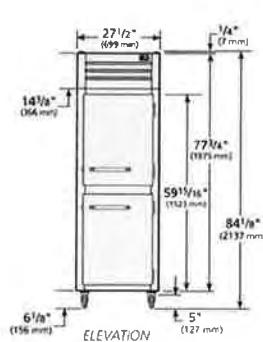
STR1R-2HS

STA1R-2HS

STG1R-2HS



plan view



PLAN VIEW

Specifications subject to change without notice.
Chart dimensions are rounded up to the nearest 1/16" (millimeters rounded up to the next whole number).

STR1R-2HS

Exterior	Stainless steel door, front & sides.
Interior	Stainless steel side walls, back, floor, door liner, & ceiling.
Shelving	(1) Interior kit option included per full section, factory installed.

STA1R-2HS

Exterior	Stainless steel door, front & sides.
Interior	Aluminum side walls & back. Stainless steel floor & ceiling.
Shelving	(3) Heavy duty, chrome plated, wire shelves per section.

STG1R-2HS

Exterior	Stainless steel door & front, with matching aluminum sides.
Interior	Aluminum side walls & back. Stainless steel floor & ceiling.
Shelving	(3) Heavy duty, PVC coated, wire shelves per section.

SPECIFICATIONS

Dimensions	in.	mm.
Length	27 1/2	699
Depth	33 3/4	858
Height	77 3/4	1975
Electrical	U.S.	International
Horsepower	1/3	N/A
Amps	4.8	N/A
Voltage	115/60/1	
NEMA	5-15P	
Cord Length	9 ft.	2.74 M.
	115/60/1 NEMA-5-15R	

* Height does not include 6 1/8" (156 mm) for castors or 6" (153 mm) for optional legs. Height does not include 1/4" (7mm) for system mechanical components.

† Depth does not include 1 1/2" for door handle.



8/14

Printed in U.S.A.

APPROVALS

AVAILABLE AT



PROJECT NAME	LOCATION	AIA #
ITEM #	QTY	MODEL #

SPEC SERIES®

REACH-IN SOLID HALF SWING DOOR REFRIGERATOR

models

STR1R-2HS

STA1R-2HS

STG1R-2HS



standard features

REFRIGERATION SYSTEM

- Factory engineered, self-contained, capillary tube system using environmentally friendly (CFC free) 134A refrigerant.
- High capacity, factory balanced refrigeration system that maintains cabinet temperatures of 33°F to 38°F (.5°C to 3.3°C) for the best in food preservation.
- State of the art, electronically commutated evaporator and condenser fan motors. ECM motors operate at higher peak efficiencies and move a more consistent volume of air which produces less heat, reduces energy consumption and provides greater motor reliability.
- Top mounted refrigeration system with evaporator positioned out of food zone to maximize capacity.
- Electronic control.

CABINET CONSTRUCTION

- Insulation - entire cabinet structure and solid door are foamed-in-place using Ecomate. A high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).
- 5" (127 mm) diameter plate castors - locks provided on front set.

DOORS

- Lifetime guaranteed bolt style door locks standard.
- Lifetime guaranteed heavy duty all metal working door handles.

- Positive seal self-closing door with 120° stay open feature. Lifetime guaranteed external cam lift door hinges, four (4) per door section.
- Magnetic door gaskets of one piece construction, removable without tools for ease of cleaning.

LIGHTING

- LED interior lighting, safety shielded. (STR/STA models standard, STG optional)

MODEL FEATURES

- Exterior digital temperature display, available with either °F or °C.
- Evaporator epoxy coated to eliminate the potential of corrosion
- Curb mounting ready.
- NSF-7 compliant for open food product.

ELECTRICAL

- Unit completely pre-wired at factory and ready for final connection to a 115/60/1 phase, 15 amp dedicated outlet. Cord and plug set included.

OPTIONAL FEATURES/ ACCESSORIES

(*upcharge & lead times may apply*)

- 6" (153 mm) standard legs.
- 6" (153 mm) seismic/flanged legs.
- 6" (153 mm) stainless steel legs.
- Field reversible hinge.
- Additional shelves.
- Stainless back. (STR, STA, STG)

SHELVING KIT OPTIONS

- STR series kits factory installed at no charge. STA & STG series kits field installed, upcharge applies, lead times may apply.
- Kit #1: Nine (9) sets of #1 type tray slides and pilasters (field installed), bottom support of one (1) 18" L x 26" D (458 mm x 661 mm) pan or two (2) 14" L x 18" D (356 mm x 458 mm) pans.
- Kit #2: One (1) set half-section #2 steel rod tray slides and pilasters (field installed), rim support of one (1) 18" L x 26" D (458 mm x 661 mm) pan.
- Kit #3: Six (6) sets of universal type tray slides and pilasters (field installed), bottom support of one (1) 18" L x 26" D (458 mm x 661 mm) pan, two (2) 14" L x 18" D (356 mm x 458 mm) pans or two (2) 12" L x 20" D (305 mm x 508 mm) pans.
- Kit #4: Three (3) chrome shelves 25" L x 27 3/4" D (635 mm x 705 mm). Optional wall mounted shelf support pilasters (field installed) with four (4) shelf clips per shelf available; adjustable on 1/2" (13 mm) increments (must order at time of cabinet order).
- Additional kit option components available individually.

WARRANTY*

Three year warranty on all parts and labor and an additional 2 year warranty on compressor. (U.S.A. only)

*RESIDENTIAL APPLICATIONS: TRUE assumes no liability for parts or labor coverage for component failure or other damages resulting from installation in non-commercial or residential applications.

METRIC DIMENSIONS ROUNDED UP TO THE NEAREST WHOLE MILLIMETER

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE



Model	Elevation	Right	Plan	3D	Back
ST()1R-2HS					

DESCRIPTION: OPEN NO.

OPEN NUMBER

CUSTOM FABRICATED BY KEC

- Stainless Steel**
- Millwork**

EXISTING EQUIPMENT

- Relocated by KEC**
- Remain In Place**

NOT IN KITCHEN EQUIPMENT CONTRACT (NIKEC)

- Equipment By Owner/Operator**
- Equipment By Vendor**
- Millwork By Architect/Interior Designer**
- Equipment by Others** _____.

REMARKS: _____

DESCRIPTION: OPEN NO.

OPEN NUMBER

CUSTOM FABRICATED BY KEC

- Stainless Steel**
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- Remain In Place**

NOT IN KITCHEN EQUIPMENT CONTRACT (NIKEC)

- Equipment By Owner/Operator**
- Equipment By Vendor**
- Millwork By Architect/Interior Designer**
- Equipment by Others** _____.

REMARKS: _____


INDIGO[®]

Indigo™ Series 906 Ice Cube Machine

Model: IR-0906A ID-0906A IY-0906A IR-0906W ID-0906W IY-0906W
 IR-0996N ID-0996N IY-0996N



Indigo Series i-906
Ice Machine on B-570 Bin

Specifications

BTU Per Hour:

12,700 (average)
14,800 (peak)

Refrigerant:

R-404A CFC-free

Operating Limits:

Ambient Temperature Range:
35° to 110°F (1.7° to 43.3°C)
Water Temperature Range:
35° to 90°F (1.7° to 32.2°C)

Water Pressure Ice Maker
Water In:
Min. 20 psi (137.9 kPa)
Max. 80 psi (551.1 kPa)

Ice Machine Electric

208-230/60/1
(208-230/60/3 and 230/50/1
also available)

Minimum circuit ampacity:

Air-cooled:	12.2 lph	9.7 3ph
Water-cooled:	11.2 lph	8.7 3ph
Remote:	12.2 lph	9.7 3ph

Maximum fuse size:

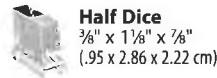
Air-cooled:	20 lph	15 3ph
Water-cooled:	20 lph	15 3ph
Remote:	20 lph	15 3ph

Designed for operators who know that ice is critical to their business, the Indigo™ Series ice machine's preventative diagnostics continually monitor itself for reliable ice production. Improvements in cleanability and programmability make your ice machine easy to own and less expensive to operate. New Levels of Performance—showcasing improved ice harvest along with reductions in energy consumption.

- **ENERGY STAR** – the i-906 exceeds ENERGY STAR standards and targets future energy efficiency standards.
- **Space-Saving Design** – Up to 901 lbs. (409 kg) daily ice production and only 30" (76.20 cm) wide.
- **Intelligent Diagnostics** – provide 24 hour preventative maintenance and diagnostic feedback for trouble free operation.
- **Acoustical Ice Sensing Probe** – for reliable operation in challenging water conditions.
- **EasyRead Display** – communicates operating status, cleaning reminders, and asset information through a blue illuminated display.
- **Programmable Ice Production** – by On/Off Time, Ice Volume or Bin Level (with accessory bin level control) further improves energy efficiency and savings.
- **Easy to Clean Foodzone** – Hinged front door swings out for easy access. Removable water-trough, distribution tube, curtain, and sensing probes for fast and efficient cleaning. Select components made with AlphaSan® antimicrobial.
- **DuraTech™ Exterior** – provides superior corrosion resistance. Stainless finish with innovative clear-coat resists fingerprints and dirt.
- Available **Luminice™ Growth Inhibitor** controls the growth of bacteria and yeast within the foodzone.



Ice Shape



Half Dice
3/8" x 1 1/8" x 7/8"
(.95 x 2.86 x 2.22 cm)



Dice
7/8" x 7/8" x 7/8"
(2.22 x 2.22 x 2.22 cm)



Regular
1 1/8" x 1 1/8" x 7/8"
(2.86 x 2.86 x 2.22 cm)



AHRI CERTIFIED

NSF

c UL

US LISTED

CE

AutoQuotes

COMPANY WITH
QUALITY SYSTEM
CERTIFIED BY DNV
= ISO 9001:2008 =

2110 South 26th Street
PO Box 1720
Manitowoc, WI 54221-1720 USA

Tel: 1.920.682.0161
Fax: 1.920.683.7589

www.manitowocice.com

Manitowoc

Indigo™ Series 906 Ice Cube Machine

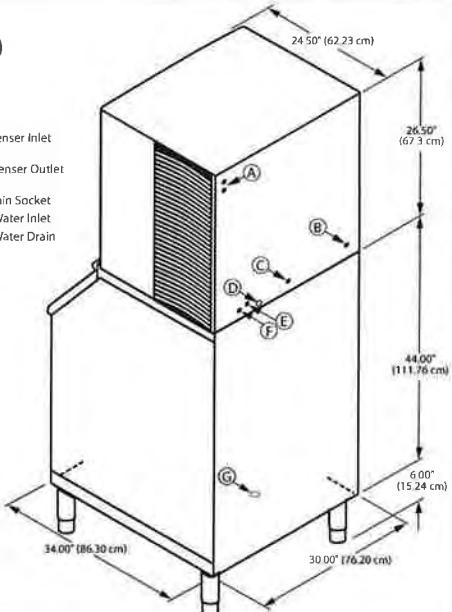


Indigo™ Series 906 Ice Cube Machine

i-906 on B-570 Storage Bin

- (A) Electrical Entrance (2) Options
- (B) 3/8" (0.95 cm) F.P.T. Water Condenser Inlet (water-cooled units)
- (C) 1/2" (1.27 cm) F.P.T. Water Condenser Outlet (water-cooled units)
- (D) 1/2" (1.27 cm) Auxiliary Base Drain Socket
- (E) 3/8" (0.95 cm) F.P.T. Ice Making Water Inlet
- (F) 1/2" (1.27 cm) F.P.T. Ice Making Water Drain
- (G) 3/4" (1.91 cm) Bin Drain

Installation Note
Minimum installation clearance:
Top/sides: 8" (20.32 cm);
Back: 5" (12.7 cm)



Space-Saving Designs



	i-906 B-570	i-906 B-970*
Height	76.50" 194.30 cm	76.50" 194.30 cm
Width	30.00" 76.20 cm	48.00" 121.92 cm
Depth	34.00" 86.30 cm	34.00" 86.30 cm
Bin Storage	430 lbs. 195 kgs.	710 lbs. 322.2 kgs.

Height includes adjustable bin legs 6.00" to 8.00" (15.24 to 20.32 cm) set at 6.00" (15.24 cm).

*For comparison purposes multiply ARI capacity by 1.3 (30%) to arrive at approximate "Application Rating Capacity."

Specifications

		Ice Production 24 Hours				Power Usage kWh/100 lbs. @ 90°F Air/70°F		Water Usage/100 lbs. 45.4 kgs. of Ice		ENERGY STAR®
Model	Ice Shape	70°F Air/ 50°F Water		90°F Air/ 70°F Water		1 Ph	3 Ph	Potable Water		
AIR-COOL	regular	797 lbs	362 kg	639 lbs	290 kg	5.33	5.33	19 Gal.	71.9 L	★
	dice	874 lbs	396 kg	664 lbs	301 kg	5.10	5.10	19 Gal.	71.9 L	★
	half-dice	901 lbs	409 kg	710 lbs	322 kg	5.02	5.02	19 Gal.	71.9 L	★
WATER-COOL	regular	773 lbs	351 kg	683 lbs	310 kg	4.20	4.20	19 Gal.	71.9 L	NA
	dice	839 lbs	381 kg	701 lbs	318 kg	4.35	4.35	19 Gal.	71.9 L	NA
	half-dice	879 lbs	399 kg	786 lbs	357 kg	4.04	4.04	19 Gal.	71.9 L	NA
* Water-cooled Condenser Water Usage / 100 lbs. / 45.4 kgs. Of Ice: 150 gal/568 L. * Water-cooled models are excluded from ENERGY STAR qualification.										
REMOTE-COOL	regular	753 lbs	342 kg	665 lbs	302 kg	5.29	5.29	19 Gal.	71.9 L	★
	dice	821 lbs	372 kg	727 lbs	330 kg	4.91	4.91	19 Gal.	71.9 L	★
	half-dice	855 lbs	388 kg	752 lbs	341 kg	4.90	4.90	19 Gal.	71.9 L	★

Order ice storage bin separately. Ice storage bin and JC-0995 remote condenser must be ordered separately. Consult remote condenser specification sheet for details.
To order 3 phase add "3" suffix to model # (ID-0906A3)

Accessories

LuminIce™ Growth Inhibitor
reduces yeast and bacteria growth for a cleaner ice machine.



Bin Level Control
Allows ice bin level to be automatically set. Built-in LED light illuminates bin.



Arctic Pure® Water Filters
Reduces sediment and chlorine odors for better tasting ice.



AuCS®
schedules and performs routine ice machine cleaning automatically.



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Manitowoc



F-Style Large Capacity Ice Storage Bins

Models

 F-700 F-1300 F-1325 F-1650 FC-1350

F-1300 Ice Storage Bin



FC-1350 Ice Storage Bin & Cart System

Standard Features

Manitowoc F-style large capacity ice storage bins are equipped with a sliding ice gate for increased employee safety, easier ice removal, and reduced spillage.

Choose a bin width from 30", 48" or 60", with relative ice storage capacities of 680 lbs., 1320 lbs. or up to 1660 lbs.

Sliding Ice Gate

- Controls ice flow into snout for easy removal with either scoop or shovel
- Returns easily to full down position

Quality Construction

- Stainless steel exterior
- Heavy-duty welded construction
- Non-CFC foamed-in-place insulation
- Impact-resistant sliding windows for easy bin inspection

Durable Polyethylene Lift Door

- Ball catch hinge holds bin door open when scooping ice
- Eliminates sharp corners and gaskets
- Provides outstanding durability
- Offers maximum access for fast, easy ice removal

Warranty

Bin & Accessories: 3-Year Parts & Labor

Carts: 2-Year Parts & Labor



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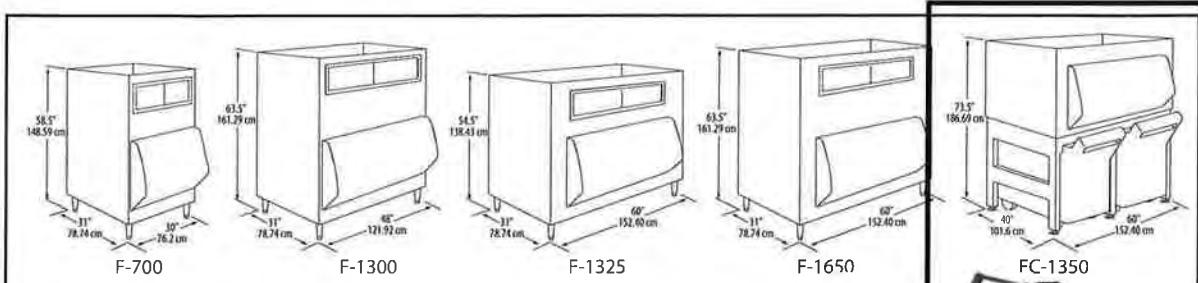


F-Style Large Capacity Ice Storage Bins

		Ice Machine										
Bin	Model	Ice Makers on Bin	i-300	i-450	i-500	i-606	i-906 i-1106 i-1200	i-686C i-976C i-1176C	i-1470C i-1870C i-2170C	i-1400 i-1800	RFS-0300 RFS-0650 RFS-1278C RFS-1279R	S-3070C S-3300
F-700	1	K-303000 Single Head Adapter (Included with Bin)								N/A	K-302200	N/A
F-1300	1	K-483048 Single Head Adapter (Included with Bin)								N/A	Adapter Not Required	
F-1325	1	K-603048 Single Head Adapter (Included with Bin)								N/A	K-604800	
	2*	K-603030 Side-by-Side 30" Head Adapter								N/A	K-00421 and K-603030	
F-1650	1	K-603048 Single Head Adapter (Included with Bin)								N/A	K-604800	
	2*	K-603030 Side-by-Side 30" Head Adapter								N/A	K-00421 and K-603030	
FC-1350	1	K-613048 Single Head Adapter (Included with Bin)								N/A	K-614800	
	2*	K-613030 Side-by-Side 30" Head Adapter								N/A	K-00421 and K-613030	

* Only for use with water-cooled and remote ice machines or machines with top air discharge option. Check ice machine clearance requirements.

4604D ©2014 Manitowoc 8/14 Continuing product improvement may necessitate change of specifications without notice



Standard Equipment

F-Series Bins Include: set of (4) 6" bin legs, ice scoop, stainless steel adapter for 30" or 48" Indigo Series Cubers (see chart)

FC-1350 Bin and Cart System Includes:

bin, base, (2) 240 lb. capacity carts with lids, set of (6) flanged legs, Ice Paddle, stainless steel adapter for 30" or 48" Indigo Series Cubers (see chart)

Accessories

Model # Description

K-00412 Paddle 46.5" (118.11 cm) length

3302593 82 oz. Scoop

K-00414 Shovel 36" (91.44 cm) Length

K-00416 Totes Ice Carrier, Set of 6 (25 lb. capacity per tote)

Totes for use with FC-1350 cart. One set of 6 required per cart.



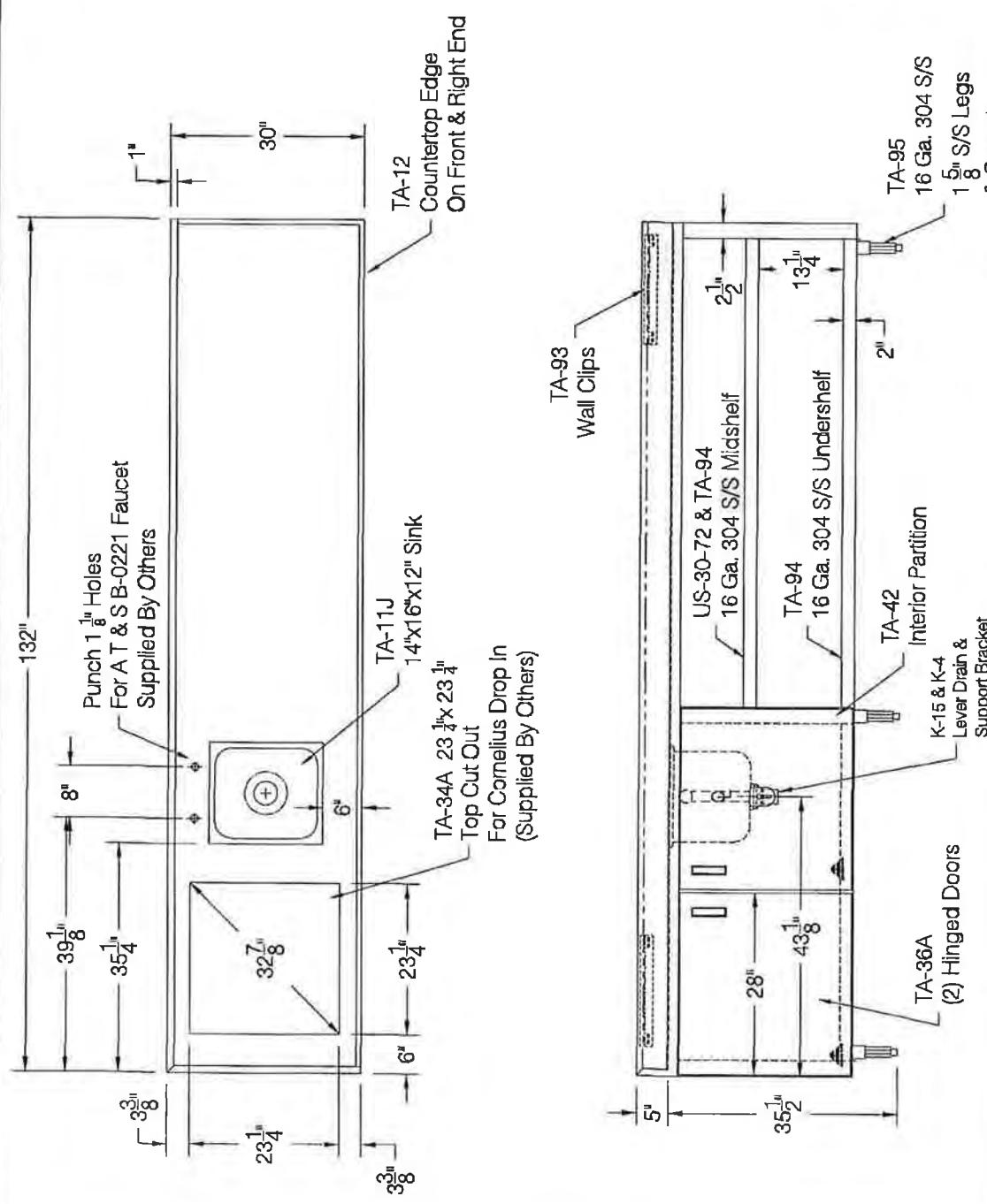
Storage Capacity

	Model	AHRI*	Lbs. / kg	Cu. Ft.
30"	F-700	680	308	20.3
		1320		
48"	F-1300	599	601	38.0
		1325		
60"	F-1325	601	1660	39.7
		753		
FC-1350		1350	612	47.7
		612		

*AHRI storage capacity for bins is based on 80% of total volume in cubic feet x 30 lb./ft.3 average density of ice.

Tech's (4/09/02)

Size and shape per plan.



JOB NAME:		PO# N/A	Order / Drawing# Typical Dwg	DATE: 07/07/08	NO. REVISIONS: 1	BY:	Print Approval
MODEL #:	Custom 1 (EK-SS-3011)	NSF	Top/Drainboard	Scale: 1/2=12	2	3	Accessory Locations MUST Be Verified Prior To Unit Being Fabricated
CUSTOMER:	FoodStrategy Inc	MATERIAL: 14 Ga. 304 S/S	DRAWN BY: T. Anderson	Item #: 0	6	4	Locations Verified By _____ Date _____
ADVANCED TABCO 200 HEARTLAND BLVD EDGEMOOR, NY 11717-4880 TEL: 800-846-3486 FAX: 631-242-4589					7	8	Print Approved By _____ Date _____



**STAINLESS STEEL & ALUMINUM
WALL SHELVES**



KD Wall Shelf



Item #: _____ **Qty #:** _____

Model #: _____

Project #: _____

FEATURES:

Furnished with a 1 1/2" sanitary rolled rim with a 1-1/4" turn-up edge on sides and rear.
Unit is easily assembled employing the slip-fit TAB-LOK design.

CONSTRUCTION:

Shelf and brackets are die stamped and die formed.

MATERIAL:

WS-KD Series - 18 gauge stainless steel polished to a satin finish.

AWS-KD Series - Heavy gauge aluminum.

S/S	ALUMINUM	length
WS-KD-24	AWS-KD-24	24"
WS-KD-36	AWS-KD-36	36"
WS-KD-48	AWS-KD-48	48"
WS-KD-60	AWS-KD-60	60"

Standard Wall Shelf

Weld support brackets to wall shelf

FEATURES:

Brackets can be positioned to accomodate wall studs.

Furnished with a 1 1/2" sanitary rolled rim with a 1-1/2" turn-up edge at rear. Ends are turned down square.

CONSTRUCTION:

Secured to wall by means of bolts through support brackets.

Units 7 ft. and larger are furnished with 3 brackets.

MATERIAL:

16 Gauge Series - 304 stainless steel polished to a satin finish.

18 Gauge Series - 430 stainless steel polished to a satin finish.



10" Wide		12" Wide		15" Wide		18" Wide		Approx. Wt.	Approx. Cubes
16 Ga.	18 Ga.								
WS-10-24-16	WS-10-24	WS-12-24-16	WS-12-24	WS-15-24-16	WS-15-24	WS-18-24-16	WS-18-24	10 lbs.	3
WS-10-36-16	WS-10-36	WS-12-36-16	WS-12-36	WS-15-36-16	WS-15-36	WS-18-36-16	WS-18-36	12 lbs.	4
WS-10-48-16	WS-10-48	WS-12-48-16	WS-12-48	WS-15-48-16	WS-15-48	WS-18-48-16	WS-18-48	14 lbs.	5
WS-10-60-16	WS-10-60	WS-12-60-16	WS-12-60	WS-15-60-16	WS-15-60	WS-18-60-16	WS-18-60	17 lbs.	6
WS-10-72-16	WS-10-72	WS-12-72-16	WS-12-72	WS-15-72-16	WS-15-72	WS-18-72-16	WS-18-72	19 lbs.	7
WS-10-84-16	WS-10-84	WS-12-84-16	WS-12-84	WS-15-84-16	WS-15-84	WS-18-84-16	WS-18-84	22 lbs.	8
WS-10-96-16	WS-10-96	WS-12-96-16	WS-12-96	WS-15-96-16	WS-15-96	WS-18-96-16	WS-18-96	26 lbs.	10
WS-10-108-16	WS-10-108	WS-12-108-16	WS-12-108	WS-15-108-16	WS-15-108	WS-18-108-16	WS-18-108	28 lbs.	11
WS-10-120-16	WS-10-120	WS-12-120-16	WS-12-120	WS-15-120-16	WS-15-120	WS-18-120-16	WS-18-120	31 lbs.	12
WS-10-132-16	WS-10-132	WS-12-132-16	WS-12-132	WS-15-132-16	WS-15-132	WS-18-132-16	WS-18-132	35 lbs.	13
WS-10-144-16	WS-10-144	WS-12-144-16	WS-12-144	WS-15-144-16	WS-15-144	WS-18-144-16	WS-18-144	38 lbs.	14

Length = 24" to 144" in 12" increments.



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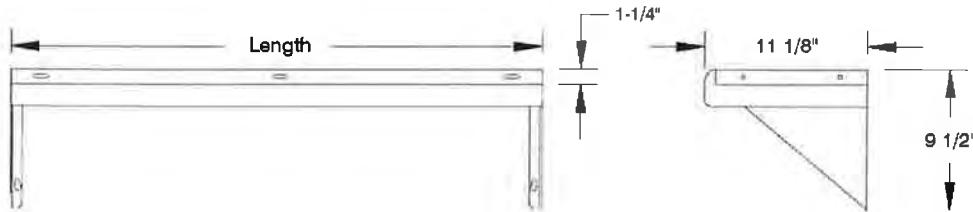
NEVADA
Fax: (775) 972-1578

DETAILS and SPECIFICATIONS

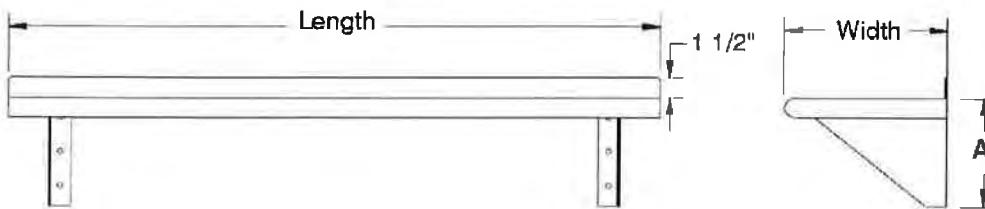
TOL $\pm .500"$

ALL DIMENSIONS ARE TYPICAL

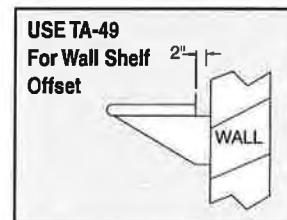
KD WALL SHELF



STANDARD WALL SHELF



Width	A
10"	8"
12"	10"
15"	10"
18"	10"



Requirements for NSF Installations

1. Install at least 60" above floor.
2. Limit to dry storage.
3. Avoid contact with liquids.
4. For "Ganging-Up" installation, allow at least 2" between units or mount units side by side and seal joints with an approved sealant.



ADVANCE TABCO is constantly engaged in a program of improving our products. Therefore, we reserve the right to change specifications without prior notice.



1.5 GALLON COFFEE BREWING SYSTEM

NIKEC/BY VENDOR

CBS 2150 TOUCHSCREEN SERIES



CBS-2151XTS
Single Station Brewer*



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The 1.5 Gallon CBS-2150 Touchscreen Series Coffee Brewers provide flexibility in medium-to-large sized venues such as Banquet Halls, Cafeterias and Restaurants. Simplify your daily operations and experience total control of this fully featured Extractor® Brewing System via an inviting touchscreen interface display that is intuitive, easy to read and simple to navigate.

Technical Specifications & Product Views**Water Specification**

Water Connection Inlet 1/4" Male Flare Fitting	Minimum Flow Rate 1 1/2 gpm [5.7 lpm]	Water Pressure 20-75 psig [138-517 kPa]
---	--	--

Electrical Configuration

Plastic Brew Basket Configuration Code	Stainless Steel Brew Basket Configuration Code	Heater Configuration	Voltage	Phase	Wires	KW	Electrical Connection	Max Amp Draw	Gallon [Liter] / Hour
E215251	E215251M	2 x 3.0 kW	208-240	1 ⁽²⁾	2+G	4.6-6.1	Hardwired	22.4-25.8	11.5-15.5 [43.7-58.9] ⁽¹⁾
		3 x 3.0 kW	208-240	3	3+G	6.9-9.1	Hardwired	19.5-22.5	17.4-23.0 [65.9-87.0] ⁽¹⁾
E215252	E215252M	2 x 5.0 kW	208-240	1 ⁽²⁾	2+G	7.6-10.1	Hardwired	36.9-42.5	19.3-25.7 [73.1-97.3] ⁽¹⁾
		3 x 5.0 kW	208-240	3	3+G	11.4-15.1	Hardwired	32.0-36.9	29.0-38.4 [109.4-145.3] ⁽¹⁾

(1) Based on standard factory settings: 5.5 minute brew time; 0% preheat; 200°F water. 1 1/2 gallon per batch.

(2) 1 or 3 phase configuration is field selectable by user. Sold factory configured for single phase 2 wire plus ground.

Measurements

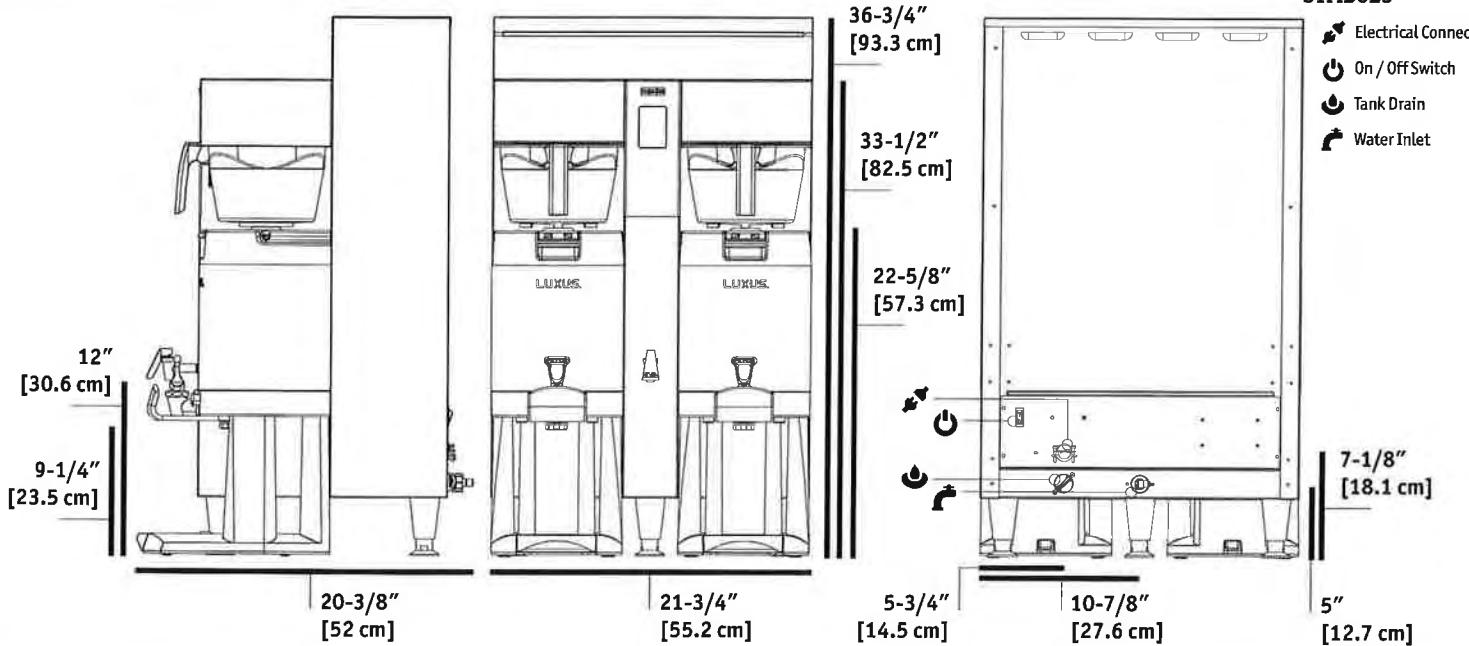
Height 36 3/4" [93 cm]	Width 21 3/4" [55 cm]	Depth 20 3/8" [51 cm]	Empty Weight 77 lbs [35 kg]	Filled Weight 174 lbs [78 kg]	Combined Filled Weight 220 lbs [99 kg] BREWER + 2 FILLED L30-15 DISPENSERS	Hot Water Tank Cap. 11.5 gal [43 l]	Shipping Weight: 90 lbs [41 kg]	Shipping Dimensions: 22" x 27" x 35" [55 x 68 x 88 cm]
------------------------------	-----------------------------	-----------------------------	-----------------------------------	-------------------------------------	--	---	---------------------------------------	--

Cups per Hour*8oz. **614**2oz. **410**16oz. **307**20oz. **246**

* Approximate based on maximum power setting.

Compatible DispensersL3D-15
1.5 Gallon LUXUS®
Thermal DispenserProduct DIMS:
Height: 22 7/8"
Width: 9"
Depth: 22 3/4"
Weight:
Empty: 10.5 lbs
Filled: 22.4 lbsTPD-15
1.5 Gallon LUXUS®
Portable Thermal
DispenserProduct DIMS:
Height: 22 7/8"
Width: 9 5/16"
Depth: 13 7/8"
Weight:
Empty: 12.8 lbs
Filled: 24.7 lbsL3S-15
1.5 Gallon LUXUS®
Thermal Server*Product DIMS:
Height: 14 1/2"
Width: 9"
Depth: 11 1/4"
Weight:
Empty: 7.2 lbs
Filled: 17.6 lbs* Must be used
with S3S Serving
Stations.**Paper Coffee Filters**#F001
15" x 5.5"
Paper Coffee Filter**Brew Baskets**#B015280BN2
16" x 6"
Plastic w/ Brown Insert#B001280B1
16" x 6"
Stainless Steel**Serving Stations**S3S-1 Single
Serving StationS3S-2 Twin
Serving StationS3S-3 Triple
Serving Station

Dimensional Views



Gallery



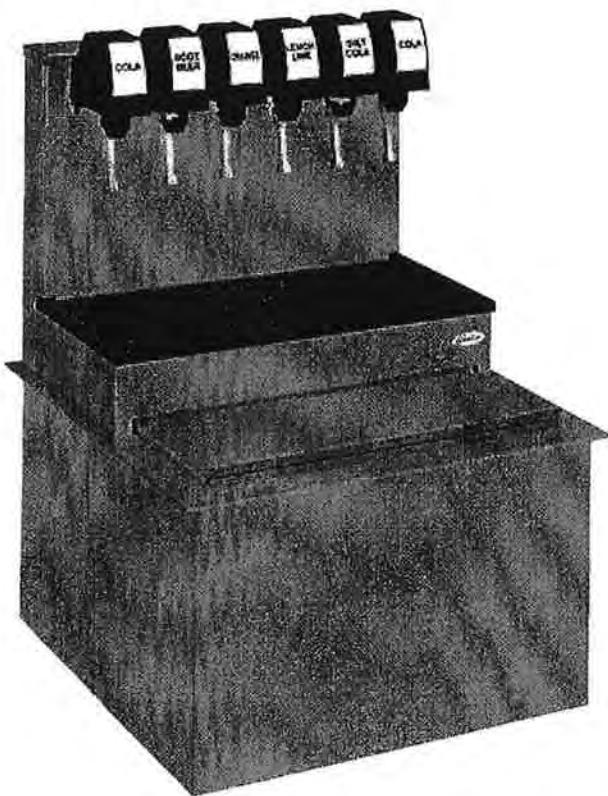
MANUFACTURED
★ IN THE USA ★



2323 Universal

Drop-In Post-Mix Dispenser

NIKEC / By Vendor



Features:

- Ice chest has 80 lb. capacity
- Foamed polyurethane insulation
- Key lock switch conveniently located on tower
- Large, extended drip tray provides extra room for cup staging and is removable for ease in cleaning
- High capacity 9/12 circuit sealed in 19" x 21" aluminum cold plate
- Comes standard with 5, 6 or 8 UF-1 fast flow electric valves (8 flavor requires two ambient syrups)
- Six 3/8" barb syrup fittings, one 3/8" for water, two 3/8" for carbonated water
- Front inlet fitting location
- Available with or without lighted merchandiser
- Available with a cabinet stand



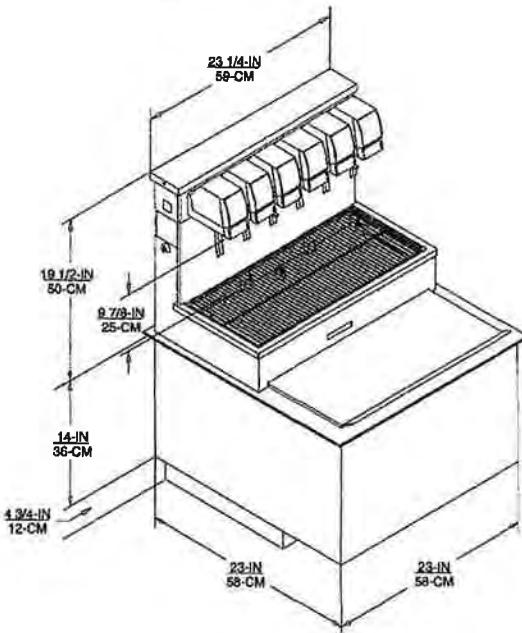
2323 Universal

Technical Specifications:

Drop-in Unit Countertop Cut-out: 23-1/4" x 23-1/4"

Electrical Rating: Dispensing valves 24 VAC (power supply requires 115V / 60 Hz / 1.5A)

Agency Listings:



Model No.	Part No.	Description	Shipping Weight
CB2323-AK5	631100048	Drop-in dispenser with five fast flow UF-1 valves, 80 lb. bin	200 lbs. / 91 kgs.
CB2323-AK6	631100049	Drop-in dispenser with six fast flow UF-1 valves, 80 lb. bin	200 lbs. / 91 kgs.
CB2323-AK8	631100050	Drop-in dispenser with eight fast flow UF-1 valves, 80 lb. bin	201 lbs. / 92 kgs.
CB2323	162111002	Drop-in ice chest with sealed in nine circuit cold plate slotted rim for mounting of Universal Tower	145 lbs. / 66 kgs
C-2123	162111004	Drop-in ice chest with sealed in nine circuit cold plate	145 lbs. / 66 kgs.
C-2123	162540000	Drop-in ice chest without sealed in cold plate	45 lbs. / 20 kgs.
	165492000	Cabinet stand – turns 2323 drop-in into a freestanding unit	61 lbs. / 28 kgs.



For more information or to place an order, contact your sales representative or authorized distributor.

In the US:

Phone: 1-800-238-3600

Fax: 1-800-535-4235

Outside the US:

Phone: 1-763-421-6120

Fax: 1-763-422-3297

IMI Cornelius Inc.
One Cornelius Place
Anoka, MN 55303-6234
USA

EXTRACTOR ICED TEA BREWER

NIKEC/BY VENDOR

TBS-2121 Touchscreen Series

3.5 Gallon Twin Brewer



Brew the most flavorful and refreshing iced teas with the **TBS-2121** Twin 3.5 Gallon Iced Tea Brewer from FETCO. Precision brew controls, modern style and expert craftsmanship come together to provide a complete iced beverage solution for the operator and an extraordinary taste experience for their customers.

Brewer shown with 2xen. 3.5 Gallon Iced Tea Dispenser (ITD-2130) sold separately.

Touchscreen Simplicity

A simple touch is all it takes to experience full control over the brew cycle.



Functional Design

New features and exclusive designs provide an extraordinary tea service experience for both operators and consumers.



Style

Modern European style elevates your iced tea service with an attractive, inviting self-serve atmosphere.



Solid Construction

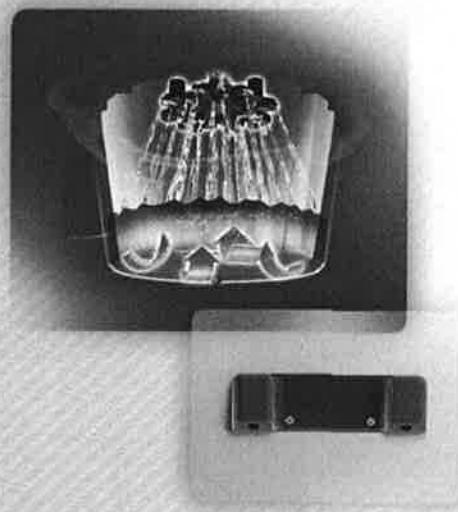
FETCO's reputation is second to none for precision craftsmanship and everlasting durability.

EXTRACTOR® TBS-2121 Twin 3.5 Gallon Iced Tea Brewer

The EXTRACTOR TBS-2121 Twin 3.5 Gallon Touchscreen Iced Tea Brewer is the latest high-quality product offering from FETCO. It combines the simplicity of a touchscreen with new features like the innovative "intelligent" brew basket for quick, efficient operation and for producing the most flavorful taste profiles from your teas.

User Friendly Operation

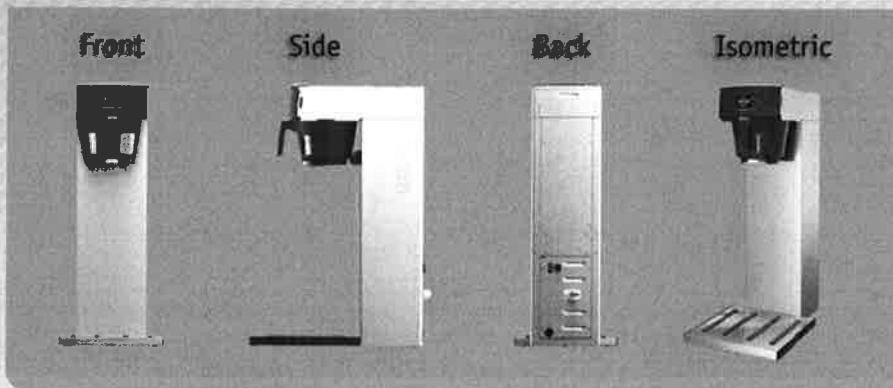
- Access all controls via an inviting touchscreen interface display that blends intuitive icons with dynamic time and volume data.
- Efficiently navigate set-up, programming, diagnostics and daily brewing modes.
- Customize the start screen to tie your equipment and product offerings into a consistent brand message.
- Create and display up to nine recipe names for easy access and reference.



Extract, Brew and Steep

- FETCO's patented Cascading Spray Dome water delivery system provides excellent coverage for loose leaf or prepackaged tea and will never clog!
 - Dual dilution spouts positioned above the container dispense water directly from the inlet. The right-side spout can also deliver liquid sweetener (if so equipped).
- Program the exact steep time for precise control over flavor extraction.

Product Views





Intelligent Design

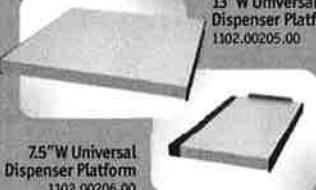
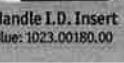
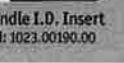
- » Brew Side Sensors automatically detect which side brewing will occur and displays the matching recipes on the touchscreen.
- » Adjustable Orifice and Filter Screen System features a drain cap that removes for easy changing of up to 7 different orifice sizes and filter screen mesh patterns.
- » Expandable Dispenser Base with front-to-back guide rails keep dispensers properly aligned with brew basket.



Space Savings

- » Slim profile brewer takes up minimal counter space.
- » Slim profile dispensers can be filled and placed in any area to make an instant serving station.
- » Optional dispenser station add-on platforms are available in single and dual sizes for the right amount of dispenser space you need.

Accessories & Options

Dispenser Platforms	Brew Basket and Inserts	Optional Graphics
 7.5" W for ITD Dispensers 1102.00202.00	 Brew Basket for TBS-2121 15" Dia. x 5 1/2" D #B01300082	 #064W112
 13" W Universal Dispenser Platform 1102.00206.00	 Handle I.D. Insert Blue: 1023.00180.00	 Handle I.D. Insert Red: 1023.00190.00
	 Handle I.D. Insert Green: 1023.00191.00	 Handle I.D. Insert Orange: 1023.00192.00

Technical Specifications

Water Specification

Water Inlet
1/4" Male Flare Fitting

Minimum Flow Rate
1.5 gpm [5.7 lpm]

Water Pressure
35-50 psig [241-345 kPa]

Electrical Configuration

Configuration Code	Heater Configuration	Voltage	Phase	Wires	KW	Electrical Connection	Max Amp Draw	Gallon [Liter]/Hour
US / CANADA T212101	1 x 1680 W	120	1	2+G	1.7	NEMA 5-15P/5-20P-C	14.0	12.0 [46] ⁽¹⁾
WITH LIQUID SWEETENER INFUSION PUMP (AVAILABLE IN US MARKET ONLY) T212211	1 x 1680 W	120	1	2+G	1.8	NEMA 5-20P	14.5	12.0 [46] ⁽¹⁾

(1) Based on standard factory settings: 5.5 minute brew time; 0% prewet; 200°F water.

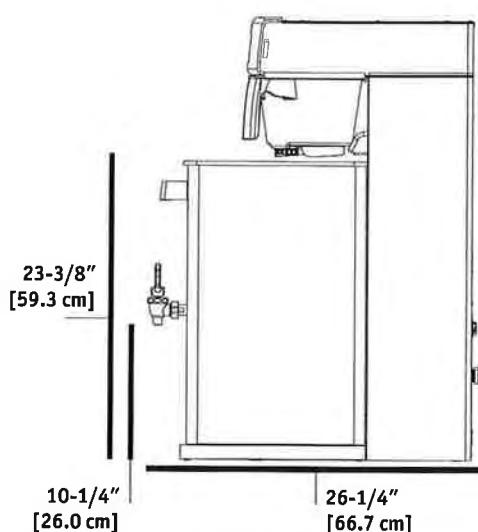
Measurements

Model	Height	Width	Depth	Empty Weight	Filled Weight	Shipping Weight
TBS-2121	34" [87 cm]	13 1/2" [25.4 cm]	26 1/4" [67 cm]	35 lbs [15.9 kg]	44 lbs [20 kg]	46 lbs [21 kg]
TBS-2121-S ⁽²⁾	34" [87 cm]	13 1/2" [25.4 cm]	26 1/4" [67 cm]	40 lbs [18.1 kg]	60 lbs [28 kg]	51 lbs [24 kg]

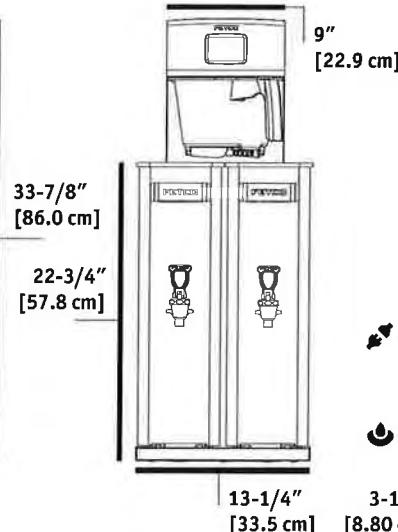
(2) With Liquid Sweetener Infusion Pump.

Dimensional Views

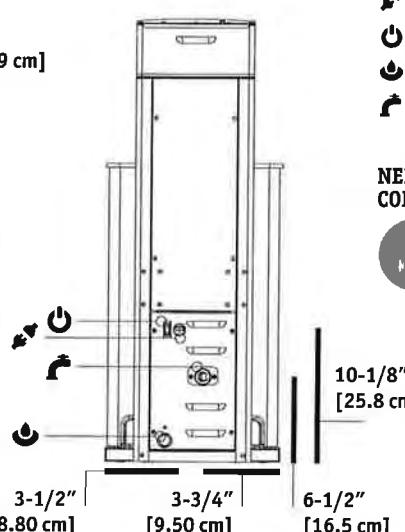
SIDE VIEW



FRONT VIEW



BACK VIEW



SYMBOLS

- ☛ Electrical Connector
- ☛ On / Off Switch
- ☛ Tank Drain
- ☛ Water Inlet

NEMA PLUGS CONFIGURATIONS



Cups per Hour*

8oz.	288
12oz.	192
16oz.	144
20oz.	115

Compatible Dispensers

- ITD-2135
3.5G Iced Tea Dispenser
(#D064)

ITD-2135
3.5G Iced Tea Dispenser
with Iced Tea Color Graphic
(#D064W112)



Product DIMS:
Height: 21 1/2" [55 cm]
Width: 6 3/4" [18 cm]
Depth: 16 3/4" [43 cm]
Weight:
Empty: 9 lbs [4.1 kg]
Filled: 34 lbs [16 kg]

Paper Filters



* Approximate based on maximum power setting.

FETCO® is an active member of



Patents: 6,148,717 & 6,565,906 & 6,576,282. Other Patents pending.

FETCO

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FoodStrategy, Inc.

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Model:

TUC-27

**Undercounter:
Solid Door Refrigerator**

Project Name: _____

AIA #

Location: _____

SIS #

Item #: _____ Qty: _____

Model #: _____



Scan code
for video

TUC-27

- ▶ True's undercounter units are designed with enduring quality that protects your long term investment.
- ▶ Designed using the highest quality materials and components to provide the user with colder product temperatures, lower utility costs, exceptional food safety and the best value in today's food service marketplace.
- ▶ Oversized, environmentally friendly (134A) forced-air refrigeration system holds 33°F to 38°F (.5°C to 3.3°C).
- ▶ All stainless steel front, top and ends. Matching aluminum finished back.
- ▶ Front breathing.
- ▶ Heavy duty PVC coated wire shelves.
- ▶ Foamed-in-place using Ecomate. A high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).

ROUGH-IN DATA

Specifications subject to change without notice.
Chart dimensions rounded up to the nearest $\frac{1}{8}$ " (millimeters rounded up to next whole number).

Model	Doors	Shelves	Cabinet Dimensions (inches) (mm)			HP	Voltage	Amps	NEMA Config.	Cord Length (total ft.) (total m)	Crated Weight (lbs.) (kg)
			L	Dt	H*						
TUC-27	1	2	27 $\frac{5}{8}$ 702	30 $\frac{1}{8}$ 766	29 $\frac{3}{4}$ 756	$\frac{1}{6}$ $\frac{1}{4}$	115/60/1 230-240/50/1	3.9 2.9	5-15P ▲	7 2.13	195 89

† Depth does not include 1" (26 mm) for rear bumpers.

* Height does not include 6 $\frac{1}{4}$ " (159 mm) for castors or 6" (153 mm) for optional legs.

▲ Plug type varies by country.



10/14

Printed in U.S.A.

APPROVALS:

AVAILABLE AT:

Model:
TUC-27

Undercounter: Solid Door Refrigerator



STANDARD FEATURES

DESIGN

- True's commitment to using the highest quality materials and oversized refrigeration systems provides the user with colder product temperatures, lower utility costs, exceptional food safety and the best value in today's food service marketplace.

REFRIGERATION SYSTEM

- Factory engineered, self-contained, capillary tube system using environmentally friendly (CFC free) 134A refrigerant.
- Oversized, factory balanced refrigeration system with guided airflow to provide uniform product temperatures.
- Extra large evaporator coil balanced with higher horsepower compressor and large condenser; maintains cabinet temperatures of 33°F to 38°F (.5°C to 3.3°C) for the best in food preservation.
- Sealed, cast iron, self-lubricating evaporator fan motor(s) and larger fan blades give True undercounter units a more efficient, low velocity, high volume airflow design. This unique design ensures faster temperature recovery and shorter run times in the busiest of food service environments.
- Condensing unit access in back of cabinet, slides out for easy maintenance.

CABINET CONSTRUCTION

- Exterior - stainless steel front, top and ends. Matching aluminum finished back.
- Interior - attractive, NSF approved, white aluminum liner. Stainless steel floor with coved corners.

- Insulation - entire cabinet structure and solid door are foamed-in-place using Ecomate. A high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).
- 5" (127 mm) diameter stem castors - locks provided on front set. 36" (915 mm) work surface height.

DOOR

- Stainless steel exterior with white aluminum liner to match cabinet interior.
- Door fitted with 12" (305 mm) long recessed handle that is foamed-in-place with a sheet metal interlock to ensure permanent attachment.
- Positive seal self-closing door with 90° stay open feature. Door swing within cabinet dimensions.
- Magnetic door gasket of one piece construction, removable without tools for ease of cleaning.

SHELVING

- Two (2) adjustable, heavy duty PVC coated wire shelves 23 1/4" L x 16" D (591 mm x 407 mm). Four (4) chrome plated shelf clips included per shelf.
- Shelf support pilasters made of same material as cabinet interior; shelves are adjustable on 1/2" (13 mm) increments.

MODEL FEATURES

- Evaporator is epoxy coated to eliminate the potential of corrosion.
- NSF-7 compliant for open food product.

ELECTRICAL

- Unit completely pre-wired at factory and ready for final connection to a 115/60/1 phase, 15 amp dedicated outlet. Cord and plug set included.



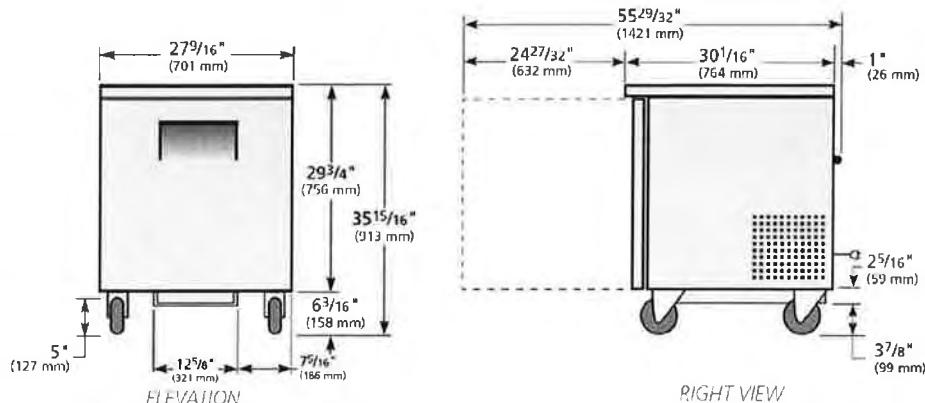
115/60/1
NEMA-5-15R

OPTIONAL FEATURES/ACCESSORIES

Upcharge and lead times may apply.

- 230 - 240V / 50 Hz.
- 6" (153 mm) standard legs.
- 6" (153 mm) seismic/flanged legs.
- 2 1/2" (64 mm) diameter castors.
- Barrel lock (factory installed).
- Single overshel.
- Double overshel.
- TUC-27 Stacking collar.
- 30" (762 mm) deep, 1/2" (13 mm) thick, white polyethylene cutting board. Requires "L" brackets.
- 30" (762 mm) deep, 1/2" (13 mm) thick, composite cutting board. Requires "L" brackets.
- Heavy duty, 16 gauge tops.
- Exterior rectangular digital temperature display (factory installed).
- ADA compliant models with 34" (864 mm) work surface height.
- Low profile models with 31 7/8" (810 mm) work surface height.
- Remote cabinets (condensing unit supplied by others; system comes standard with 404A expansion valve and requires R404A refrigerant). Consult factory technical service department for BTU information. All remote units must be hard wired during installation.

PLAN VIEW



WARRANTY*

Three year warranty on all parts and labor and an additional 2 year warranty on compressor.
(U.S.A. only)

RESIDENTIAL APPLICATIONS: TRUE assumes no liability for parts or labor coverage for component failure or other damages resulting from installation in non-commercial or residential applications.

METRIC DIMENSIONS ROUNDED UP TO THE NEAREST WHOLE MILLIMETER

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE



Model	Elevation	Right	Plan	3D	Back
TUC-27	TFQY01E	TFQY01S	TFQY01P	TFQY013	



EV9437-10
High Flow CSR Quad-MC² System

Delivers premium quality water for combination applications

NIKEC/BY VENDOR



High Flow CSR Quad-MC² System: EV9437-10

MC² Replacement Cartridge: EV9612-56

EC210 Prefilter Cartridge: EV9534-26

SS-IMF Cartridge: EV9799-32

BENEFITS

One system provides premium quality water to high flow fountain, coffee and ice machines

New and improved Micro-Pure II media inhibits the growth of bacteria

Reduces chlorine taste and odor and other offensive contaminants that can adversely affect the taste of beverages

Preclean submicron technology reduces dirt and particles as small as 1/2 micron in size and reduces health contaminants such as cysts

Increases the overall efficiency of foodservice equipment

20" prefilter captures larger dirt particles

SR-X with SS-IMF cartridge inhibits scale buildup in ice machines and coffee brewers

Sanitary cartridge replacement is simple, quick and clean. Internal filter parts are never exposed to handling or contamination

NSF Certified under NSF/ANSI Standards 42 and 53

INSTALLATION TIPS

Choose a mounting location suitable to support the full weight of the system when operating

Use 3/4" water line

Fountain equipment connections are made to the outlet part of the system before the SR-X system

Coffee brewer and ice machine connections are made after the SR-X feeder; a tee is required

Install vertically with cartridges hanging down. Allow 2-1/2" clearance below the cartridge for easy cartridge replacement

Flush cartridges by running water through flushing valve for five minutes at full flow

OPERATION TIPS

Change cartridges on a regular 6 month preventative maintenance program

Change cartridges when capacity is reached or when pressure falls below 10 psi

Change SS-IMF cartridge before Hydroblend™ compound is completely used up

Change prefilter cartridge when excessively dirty

Always flush the filter cartridge at time of installation and cartridge change

APPLICATION/SIZING

For multiple equipment and combination applications

High volume installations

Up to 4 carbonators combined with a 4 pot coffee brewer and 1,200 lb. ice machine

Rated Capacity: 36,000 gallons

High Flow CSR Quad-MC² System

SPECIFICATIONS

Overall Dimensions:
25.69" H x 34" W x 6.75" D

Inlet connection: 3/4"

Outlet connection: 3/4"

Service Flow Rate:
Maximum 6.7 gpm (25.4 Lpm)

Rated Capacity: 36,000 gallons

Pressure Requirements:
10 - 125 psi (0.7 – 8.6 bar), non-shock

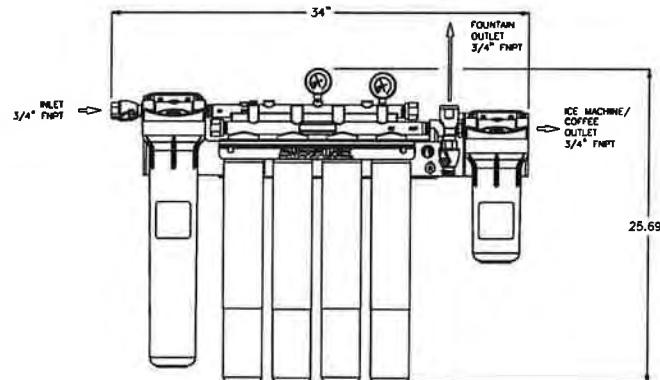
Temperature: 35 - 100°F (2 - 38°C)

No electrical connection required

Shipping Weight: 43 lbs.

Operating Weight: 58 lbs.

The contaminants or other substances removed or reduced by this drinking water system are not necessarily in your water. Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system. Systems certified for cyst reduction may be used with disinfected water that may contain filterable cysts.



WARRANTY

Everpure water treatment systems (excluding replaceable elements) are covered by a limited warranty against defects in material and workmanship for a period of five years after date of purchase. Everpure replaceable elements (filter cartridges and water treatment cartridges) are covered by a limited warranty against defects in material and workmanship for a period of one year after date of purchase. See printed warranty for details. Everpure will provide a copy of the warranty upon request.



System Tested and Certified by NSF International against NSF/ANSI Standard 42 and 53 for the reduction of:

Standard No. 42: Aesthetic Effects
Chemical Unit
Taste and Odor Reduction
Chlorine Reduction
Mechanical Filtration Unit
Particulate Reduction, Class I:
99.9+% reduction of particles
one-half micron and larger in size
Standard No. 53: Health Effects
Mechanical Filtration Unit
Turbidity Reduction
Cyst Reduction
Asbestos Reduction

EVERPURE

EVERPURE, LLC
1040 Muirfield Drive
Hanover Park, Illinois 60133
Toll Free (800) 323-7873
Tel (630) 307-3000
Fax (630) 307-3030
<http://www.everpure.com>

In Europe:
N.V. EVERPURE (EUROPE) S.A.
INDUSTRIEPARK WOLFSTEE
TOEKOMSTLAAN 30
B-2200 HERENTALS
BELGIUM
TEL 32-14-283500
FAX 32-14-283505

In Japan:
EVERPURE JAPAN LLC
HASHIMOTO MN BLDG. 7F
3-25-1 HASHIMOTO SAGAMIHARA-SHI
KANAGAWA 229-1103
JAPAN
TEL 81-(0)42-775-3011
FAX 81-(0)42-775-3015

Everpure, LLC
1040 Muirfield Drive
Hanover Park, IL 60133
Ph: 630-307-3000 Fax: 630-307-3030



EV9324-21

Insurice Single PF-i2000² System

Delivers premium quality water for ice applications



Connect to CW
on Item K48, Ice
Maker

Insurice Single PF-i2000² System: EV9324-21

i2000² Replacement Cartridge: EV9612-22

EC210 Prefilter Cartridge: EV9534-26

BENEFITS

Reduces water-related ice machine problems caused by scale build-up from dirt and dissolved minerals

New and improved Micro-Pure II media inhibits the growth of bacteria

Reduces chlorine taste and odor and other offensive contaminants

Self-contained scale inhibitor feed keeps ice machines functioning at full capacity

Reduces maintenance and service costs by reducing scale and clogging of distribution lines, evaporator plate and pump

Preclean submicron technology reduces dirt and particles as small as 1/2 micron in size and reduces possible health contaminants such as cysts

20" prefilter reduces dirt and particles

Sanitary cartridge replacement is simple, quick and clean. Internal filter parts are never exposed to handling or contamination

INSTALLATION TIPS

Choose a mounting location suitable to support the full weight of the system when operating

Never use saddle valve for connection

Use 3/8" water line

Do not connect system to water-cooled condenser

Install vertically with cartridges hanging down and allow 2-1/2" clearance below the cartridge for easy cartridge replacement

Flush cartridges by running water through system for five minutes at full flow

OPERATION TIPS

Change cartridges on a regular 6 month preventative maintenance program

Change cartridges when capacity is reached or when pressure falls below 10 psi

Service flow rate must not exceed 1.67 gpm

Always flush the filter cartridge at time of installation and cartridge change

Inspect EC210 cartridge periodically to determine dirt load

Replace EC210 cartridge when dirt has penetrated through to the inner core of the cartridge

APPLICATION/SIZING

For ice machine applications

Most cubers up to 750 lbs./day

Most flakers up to 1,500 lbs./day

Rated Capacity: 9,000 gallons

Insurice Single PF-i2000² System

SPECIFICATIONS

Overall Dimensions:
28"H x 20"W x 6"D

Inlet connection: 3/8"

Outlet connection: 3/8"

Service Flow Rate:
Maximum 1.67 gpm (6.3 Lpm)

Rated Capacity: 9,000 gallons

Pressure Requirements:
10 - 125 psi (0.7 – 8.6 bar), non-shock

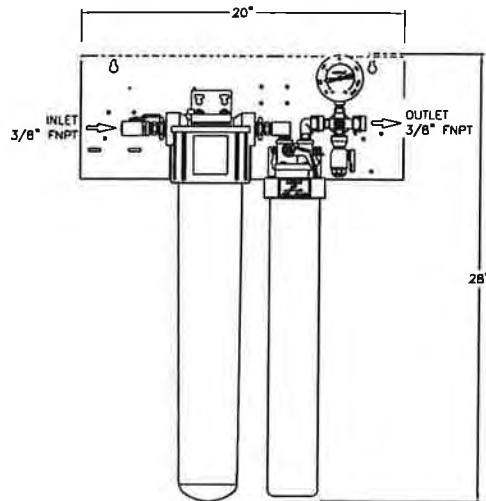
Temperature: 35 - 100°F (2 - 38°C)

No electrical connection required

Shipping Weight: 18 lbs.

Operating Weight: 24 lbs.

The contaminants or other substances removed or reduced by this drinking water system are not necessarily in your water. Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system. Systems certified for cyst reduction may be used with disinfected water that may contain filterable cysts.



WARRANTY

Everpure water treatment systems (excluding replaceable elements) are covered by a limited warranty against defects in material and workmanship for a period of five years after date of purchase. Everpure replaceable elements (filter cartridges and water treatment cartridges) are covered by a limited warranty against defects in material and workmanship for a period of one year after date of purchase. See printed warranty for details. Everpure will provide a copy of the warranty upon request.

EVERPURE

EVERPURE, LLC
1040 Muirfield Drive
Hanover Park, Illinois 60133
Toll Free (800) 323-7873
Tel (630) 307-3000
Fax (630) 307-3030
<http://www.everpure.com>

In Europe:
N.V. EVERPURE (EUROPE) S.A.
INDUSTRIEPARK WOLFSTEE
TOEKOMSTLAAN 30
B-2200 HERENTALS
BELGIUM
TEL 32-14-283500
FAX 32-14-283505

In Japan:
EVÉRPURE JAPAN LLC
HASHIMOTO MN BLDG. 7F
3-25-1 HASHIMOTO SAGAMIHARA-SHI
KANAGAWA 229-1103
JAPAN
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FAX 81-(0)42-775-3015

Everpure, LLC
1040 Muirfield Drive
Hanover Park, IL 60133
Ph: 630-307-3000 Fax: 630-307-3030



STAINLESS STEEL

MOP SINK CABINET

9-OPC-84

Item #: _____ **Qty #:** _____

Model #: _____

Project #: _____



Cabinet Includes
Floor Mop Sink

FEATURES:

- 16" x 20" x 12" Sink Bowl with drain
- Louvered Side Panels for ventilation
- Single Left-Hinged Door
- Fixed Stainless Steel Utility Shelf
- 2 Mop Holders (1 on each side)

CONSTRUCTION:

- All TIG welded.
- Welded areas blended to match adjacent surfaces and to a satin finish.

MATERIAL:

- 16 gauge type "304" Series Sink Bowl
- 18 gauge type "304" Series Sink Bowl Apron
- 18 gauge type "430" Series Stainless Steel Cabinet

OPTIONAL:

- TA-46** - Door Lock
- K-240** - Service Faucet
- K-94-CAB** - 18 gauge type "304" Stainless Steel Cabinet Upgrade
- Right-hand Door Swing
(please specify when ordering)

Net Weight: 238 lbs.



Customer Service Available To Assist You 1-800-645-3166 8:30 am - 8:00 pm E.S.T.

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TEXAS

Fax: (972) 932-4795

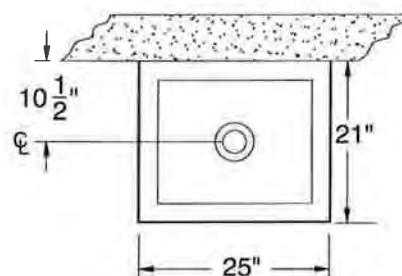
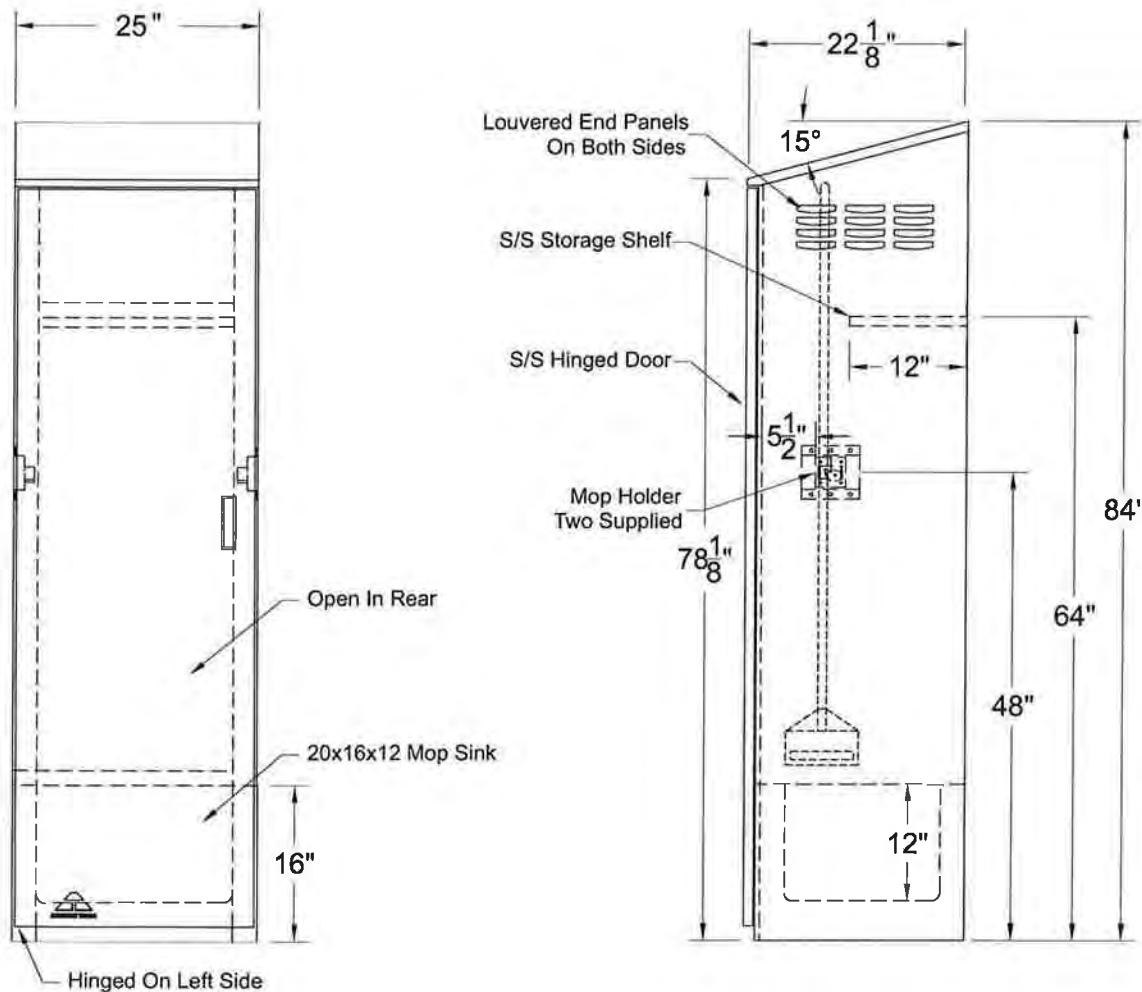
NEVADA

Fax: (775) 972-1578

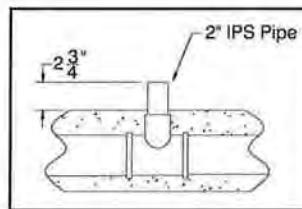
ADVANCE TABCO is constantly engaged in a program of improving our products. Therefore, we reserve the right to change specifications without prior notice. © ADVANCE TABCO, APRIL 2013 **E-10**

DIMENSIONS and SPECIFICATIONS

ALL DIMENSIONS ARE TYPICAL

TOL $\pm .500"$ 

Mop Sink Detail



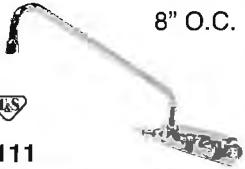
Drain Detail



ADVANCE TABCO is constantly engaged in a program of improving our products. Therefore, we reserve the right to change specifications without prior notice.



SPLASH MOUNTED FAUCETS

Splash Mount Swivel Gooseneck  Single Hole K-121	AC/DC powered Hands-Free Gooseneck AC & Battery Operated!  K-175	3-1/2" Gooseneck  4" O.C. K-59	HEAVY DUTY Gooseneck  4" O.C. K-69
6" Extended Spout  4" O.C. K-123	6" Extended Spout with Wrist Handles  4" O.C. K-206	12" Swing Spout  8" O.C. K-1	14" Swing Spout  8" O.C. K-11
8" Swing Spout 8" O.C.  K-101	HEAVY DUTY 14" Swing Spout 8" O.C.  K-105	HEAVY DUTY 14" Swing Spout (T&S)  8" O.C. K-111	HEAVY DUTY 12" Swing Spout (T&S) 8" O.C.  K-112
16" Swing Spout 8" O.C.  K-119	3-1/2" Gooseneck Spout  8" O.C. K-159	6" D-Style Extended Spout  8" O.C. K-160	HEAVY DUTY Extra Long Faucet  K-211
HEAVY DUTY Pre-Rinse Faucet DTA-53  K-114 Replacement Spray Head & Handle	HEAVY DUTY Pre-Rinse Faucet (T&S) K-116  K-114 Replacement Spray Head & Handle	12" Swing Spout Add-A-Faucet  K-117	Service Faucet <p>Does not meet Federal Lead Free Standards as it is not intended for potable water.</p>  K-240



Customer Service Available To Assist You **1-800-645-3166** 8:30 am - 8:00 pm E.S.T.

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Fax: (770) 775-5625

TEXAS

Fax: (972) 932-4795

NEVADA

Fax: (775) 972-1578

DESCRIPTION: OPEN NO.

OPEN NUMBER

CUSTOM FABRICATED BY KEC

- Stainless Steel**
- Millwork**

EXISTING EQUIPMENT

- Relocated by KEC**
- Remain In Place**

NOT IN KITCHEN EQUIPMENT CONTRACT (NIKEC)

- Equipment By Owner/Operator**
- Equipment By Vendor**
- Millwork By Architect/Interior Designer**
- Equipment by Others** _____.

REMARKS: _____

DESCRIPTION: OPEN NO.

OPEN NUMBER

CUSTOM FABRICATED BY KEC

- Stainless Steel**
- Millwork**

EXISTING EQUIPMENT

- Relocated by KEC**
- Remain In Place**

NOT IN KITCHEN EQUIPMENT CONTRACT (NIKEC)

- Equipment By Owner/Operator**
- Equipment By Vendor**
- Millwork By Architect/Interior Designer**
- Equipment by Others** _____

REMARKS: _____



Model SM-651R

Order Guide:

Model Number	Voltage	Peak Power	Plug Type
SM-651R (US)	110-120	650 Watts	NEMA 5-15
SM-653R (Int'l)	220-240	650 Watts	CEE7/7 Schuko Plug
SM-653RU	220-240	650 Watts	BS1363 UK Plug

Short Form Specification:

Unit to be a Spring USA **MAX Induction™** SM-____ (Specify 651R, 653R or 653RU) Model, Built-In, Flush Mountable (Hold-Only) Induction Heating Unit, with installation-ready modular flanged base with 5 mm thick tempered glass hot top with (optional) mounting frame bracket; and separate control panel with 44" (1.1 m) cable, providing four (4) temperature settings with a light-up temperature indicator control box; plus all the features listed.

Construction & Performance Features:

- Sealed induction base with flanged cooking surface, for easy drop-in mounting
- Separate control panel with 44" (1.1 m) cable for easy front mounting
- Rugged 5 mm thick, easy to clean tempered glass cook top
- Mounting Frame Bracket
- 100% Silicon rubber protective top seal
- Energy saving 650-watt model for product holding (**Holding Only**)
- Choice of four (4) hold temperature settings
- 5' (1.52 m) Power cord with standard plug

Project: _____

Item #: _____ Quantity: _____

Model #: _____

**Built-In (Hold-Only) Induction Warmer**

- SM-651R (110-120 Volt/US)
- SM-653R (220-240 Volt/International)
- SM-653RU (220-240 Volt/UK)

Simple, Solid State Controls With:

- Power ON/OFF Touch Pad
- Power ON/Pan-Present Indicator Lights
- Four-Position Set-Hold Temperature Control
- Lighted Temperature Indicator

Low	Low-Med	Med-High	High
145 - 155° F	156 - 165° F	166 - 175° F	176 - 185° F
61 - 71° C	72 - 76° C	77 - 82° C	83 - 87° C

- Over/Under Voltage Protection Standard
- Tempered, Black Glass Control Panel Overlay

Standard Warranty:

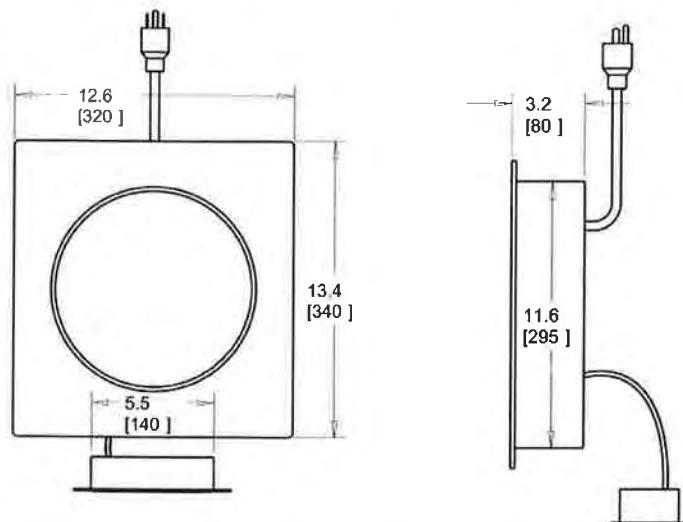
- One Year, Parts & Labor

Agency Listings:

- FCC
- ETL
- ETL-Sanitation to NSF-4
- CETL

Available Accessories/Alternate Configurations:

- Universal flush mounting flange/adapter plate [PN: P1826]
- Induction-Ready Pans [Spring USA Catalog]
- AF350 Under-Counter Air Filter Ranges [See Spec.SIR-7]
- Built-In, High Power Induction Ranges [See Spec.SIR-3]
- Countertop, Portable Induction Ranges [See Spec.SIR-1]
- Countertop (Hold-Only) Induction Hot Plate [Spec.SIR-2]
- Mobile & Custom Configurations [Contact Spring USA]


MAXX INDUCTION™


Project: _____

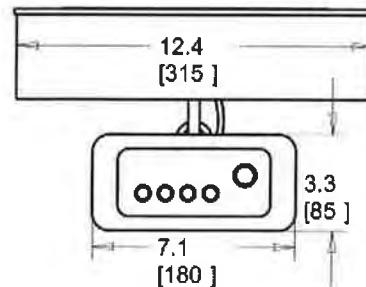
Item #: _____ Quantity: _____

Model #: _____

Built-In (Hold-Only) Induction Warmer:**Model: SM-651R (110-Volt/US)**

SM-653R (220-240 Volt/Int'l)

SM-653RU (220-240 Volt/UK)



Range Cut Out
13.5" L x 12.625" W
342 mm L x 322 mm W

Control Panel Cutout
5.75" L x 2.71" W
146 mm L x 69 mm W

[EC] Electric Requirements:

Model	Voltage	Phase	Hertz	Watts	Amps	Plug
SM-651R	110-120	1	50-60	650	5.4	NEMA 5-15P
SM-653R	220-240	1	50-60	650	2.7	CEE 7/7 Schuko Plug
SM-653RU	220-240	1	50-60	650	2.7	BS1363 UK Plug

Key Dimensions & Shipping Information:

Model	Unit Width	Unit Length	Unit Height	Weight *	Single Unit Shipping Carton *		
					Width	Depth	Height
SM-651R	12.6"	13.4	3.20	Unit: 11 lbs (5 kg)	18"	17"	7"
SM-653R	320 mm	340 mm	80 mm	*Shipping: 13 lbs. (5.8 kg)	457 mm	432 mm	178 mm
SM-653RU	320 mm	340 mm	80 mm				

* Two Unit Case Pack: Weight = 29 lbs. (13.1 kg); Length = 22" (559 mm); Width = 19" (483 mm); Height = 15" (381 mm)

Notes & Conditions:

This induction range must be flush mounted (by others) in a heat resistant countertop (2"/51 mm thick maximum) or base cabinet with the control module mounted vertically on the front of that enclosure [See cutout dimensions above]. For optimum performance, allow 4" (102 mm) clearance from front and sides; and 7" (178 mm) below unit for good air circulation. **Cabinet ventilation must be provided.** The inside temperature of the cabinet must not exceed 90°F / 32°C. Actual range temperature may vary due to a number of variables, such as ambient temperature in the immediate surrounding area, content and volume of food being heated or cooked, and whether or not you are using a lid on the serving vessel.

This induction range requires use of ferrous metal, induction-ready cookware.

Due to continuous product improvement, specifications are subject to change without notice

127 Ambassador Drive, Suite 147 • Naperville, IL 60540 • Phone (800) 535-8974 • Fax (630) 527-8677

www.springusa.com



Indigo™ Series 322 Ice Cube Machine

Model: ID-0322A IY-0324A ID-0323W IY-0325W



Filtered water
from item G3,
water filter

Indigo Series i-322
Ice Machine on B-320 Bin

Designed for operators who know that ice is critical to their business, the Indigo™ Series ice machine's preventative diagnostics continually monitor itself for reliable ice production. Improvements in cleanability and programmability make your ice machine easy to own and less expensive to operate.

- Space-Saving Design** – Up to 350 lbs. (159 kgs.) daily ice production and only 22" (55.88 cm) wide.
- Intelligent Diagnostics** – provide 24 hour preventative maintenance and diagnostic feedback for trouble free operation.
- Acoustical Ice Sensing Probe** – for reliable operation in challenging water conditions.
- EasyRead Display** – communicates operating status, cleaning reminders, and asset information through a blue illuminated display.
- Programmable Ice Production** – by On/Off Time, Ice Volume or Bin Level (with accessory bin level control) further improves energy efficiency and savings.
- Easy to Clean Foodzone** – Hinged front door swings out for easy access. Removable water-trough, distribution tube, curtain, and sensing probes for fast and efficient cleaning. Select components made with AlphaSan® antimicrobial.
- DuraTech™ Exterior** – provides superior corrosion resistance. Stainless finish with innovative clear-coat resists fingerprints and dirt.
- Available Luminice™ Growth Inhibitor** controls the growth of bacteria and yeast within the foodzone.

Ice Machine Electric

115/60/1 standard.

(208-230/60/1 and 230/50/1 also available)

Minimum circuit ampacity:
Air-cooled: 11.5 1ph
Water-cooled: 10.7 1ph

Maximum fuse size:
Air-cooled: 15 amps
Water-cooled: 15 amps

Specifications

BTU Per Hour:

3,300 (average) 4,500 (peak)

Refrigerant:

R-404A CFC-free

Operating Limits:

- Ambient Temperature Range: 35° to 110°F (1.7° to 43.3°C)
- Water Temperature Range: 35° to 90°F (1.7° to 32.2°C)
- Water Pressure Ice Maker Water In:
Min. 20 psi (137.9 kPa)
Max. 80 psi (551.1 kPa)



Ice Shape



Half Dice
3/8" x 1 1/8" x 7/8"
(.95 x 2.86 x 2.22 cm)



Dice
7/8" x 7/8" x 7/8"
(2.22 x 2.22 x 2.22 cm)



COMPANY WITH
QUALITY SYSTEM

2110 South 26th Street
PO Box 1720
Manitowoc, WI 54221-1720 USA

Tel: 1.920.682.0161
Fax: 1.920.683.7589

www.manitowocice.com



Indigo™ Series 322 Ice Cube Machine

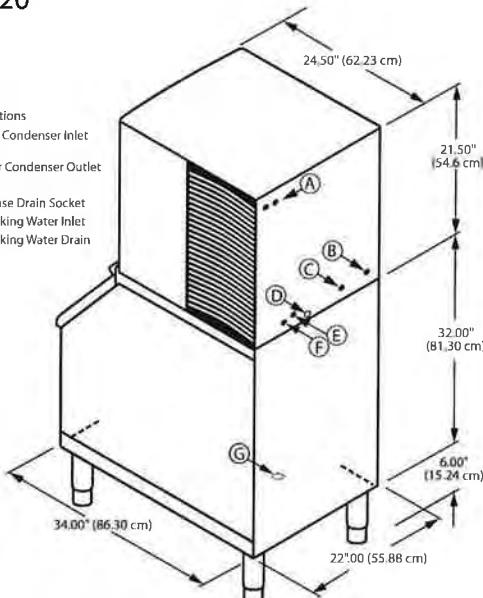


Indigo™ Series 322 Ice Cube Machine

i-322 on B-320 Storage Bin

- (A) Electrical Entrance (2) Options
- (B) 3/8" (0.95 cm) F.P.T. Water Condenser Inlet (water-cooled units)
- (C) 1/2" (1.27 cm) F.P.T. Water Condenser Outlet (water cooled units)
- (D) 1/2" (1.27 cm) Auxiliary Base Drain Socket
- (E) 3/8" (0.95 cm) F.P.T. Ice Making Water Inlet
- (F) 1/2" (1.27 cm) F.P.T. Ice Making Water Drain
- (G) 3/4" (1.91 cm) Bin Drain

Installation Note
Minimum installation clearance:
Top/side: 12" (30.50 cm)
Back is 5" (12.7 cm)



Space-Saving Designs



	i-322 B-320	i-322 B-420
Height	59.50" 151.13 cm	71.50" 181.61 cm
Width	22.00" 55.88 cm	22.00" 55.88 cm
Depth	34.00" 86.30 cm	34.00" 86.30 cm
Bin Storage	210 lbs. 95 kgs.	310 lbs. 141 kgs.

Height includes adjustable bin legs 6.00" to 8.00", (15.24 to 20.32 cm) set at 6.00" (15.24 cm).

Specifications

	Model	Ice Shape	Ice Production 24 Hours		Power Usage kWh/100 lbs. @90°F Air/70°F	Water Usage/100 lbs. 45.4 kgs. of ice	ENERGY STAR®
			70°F Air/ 50°F Water	90°F Air/ 70°F Water			
AIR-COOL	ID-0322A	dice	335 lbs.	225 lbs.	7.49	23.9 Gal.	NA
			152 kgs.	102 kgs.		90.5 L	
WATER-COOL	IY-0324A	half-dice	350 lbs.	230 lbs.	7.32	23.9 Gal.	NA
			150 kgs.	104 kgs.		90.5 L	
	ID-0323W	dice	330 lbs.	270 lbs.	6.19	23.9 Gal.	NA
			150 kgs.	122 kgs.		90.5 L	
	IY-0325W	half-dice	350 lbs.	290 lbs.	5.94	23.9 Gal.	NA
			159 kgs.	132 kgs.		90.5 L	

* Water-cooled Condenser Water Usage / 100 lbs. /45.4 kgs. Of Ice: 193 gal/731 L.

* Water-cooled models are excluded from ENERGY STAR qualification.

Order ice storage bin separately.

.442 GPM of
CTW required

Accessories

Luminice™ Growth Inhibitor
reduces yeast and bacteria growth for a cleaner ice machine.



Bin Level Control
Allows ice bin level to be automatically set. Built-in LED light illuminates bin.



Arctic Pure® Water Filters
Reduces sediment and chlorine odors for better tasting ice.



AuCS®
schedules and performs routine ice machine cleaning automatically.





SPA-160 • SFA-191 Ice Dispensers

Model

SPA-160 SFA-191

ONLY 22" WIDE



SPA Model

Designed for ice bucket filling in hotels, motels, and resorts

Ice only dispense, with coin-op and room card dispensing control options



SFA Model

Designed for "large" container ice filling. Accepts up to 10.5" (26.67 cm) high container

Built-in water valve



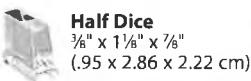
Standard Features

- 120 lbs. (54.4 kgs.) ice storage capacity. Accepts 22" (55.88 cm) wide Manitowoc ice machine.
- Only 22" (55.88 cm) wide, 31" (78.7 cm) deep, and 75.5" high (191.77 cm).
- Patented rocking chute dispense mechanism reduces in-flight ice and ice spillage with quick on/off activation.
- Efficient built-in agitator assures 100% dispensing. Oversized drain pan collects larger quantity of ice overflow.
- DuraTech™ exterior provides superior corrosion resistance. Stainless finish with innovative clear-coat resists fingerprints and dirt.

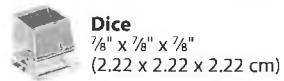
Warranty

- 5-year parts and 5-year labor coverage on ice machine evaporator.
- 5-year parts and 3-year labor coverage on ice machine compressor.
- 3-year parts-and-labor coverage on all other ice machine and dispenser components.

Ice Shape



Half Dice
¾" x 1½" x ⅜"
(.95 x 2.86 x 2.22 cm)



Dice
⅜" x ⅜" x ⅜"
(2.22 x 2.22 x 2.22 cm)



QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
ISO 9001:2008

2110 South 26th Street
PO Box 1720
Manitowoc, WI 54221-1720 USA

Tel: 1.920.682.0161
Fax: 1.920.683.7589

www.manitowocice.com



SPA-160 • SFA-191 Ice Dispensers



SPA-160 • SFA-191 Ice Dispensers

Installation Note - Dispensers have no minimum clearance, when installing an ice machine/dispenser combination follow the clearance requirements for the ice machine being installed.

Series 322 (115 volt)		Series 522 (115 volt)			
Model	Ice Shape	Ice Production 24 Hours			
		70°Air/50°F Water		90°Air/70°F Water	
ID-0322A	dice	335	152	225	102
ID-0323W	dice	330	150	270	122
IY-0324A	half-dice	350	159	230	104
IY-0325W	half-dice	350	159	290	132

Luminice™ Growth Inhibitor reduces yeast and bacteria growth for a cleaner ice machine.

Options for SPA-160:

- Room Card SRA-164
- Coin-Op SCA-163 25-cent coin standard.

Ice Machine Electric

Note: Dispenser will accept single 22" wide ice machine. Ice machine ordered separately. Choose Dice or Half Dice cube size. Refer to ice machine specification sheet for electrical and complete AHRI standard ratings.

Dispenser Electric:
115/60/1. (208-230/60/1 and 230/50/1 also available.)

Maximum Circuit Fuse Size:
15.0 amps. HACR-type circuit breakers can be used in place of fuses.

Dispenser Electrical Connection:
6' power cord, rated 125 VAC, 16-3 conductors with standard 3-prong, straight-blade, ground-type plug (NEMA configuration 5-15P).

Motor:
1.6 amps maximum. Permanently lubricated.

Service Access:
Dispenser door removes easily to access components.

Model Options:
SPA-160 push-for-ice rocking chute, SCA-163 coin-op and SRA-164 room card control available. To field-convert SPA-160 to SRA-164, call factory for information, SFA-191 has a water valve option.

2110 South 26th Street
PO Box 1720
Manitowoc, WI 54221-1720 USA

Tel: 1.920.682.0161
Fax: 1.920.683.7589
www.manitowocice.com

 <p>EV9324-01</p> <h2>Insurice Single-i2000² System</h2>		
<p>Delivers premium quality water for ice applications</p>		CW to item G1, ice maker
 <p>i2000²</p> <p>Insurice Single-i2000² System: EV9324-01</p> <p>i2000² Replacement Cartridge: EV9612-22</p>		<p>BENEFITS</p> <p>Reduces water-related ice machine problems caused by scale build-up from dirt and dissolved minerals</p> <p>New and improved Micro-Pure II media inhibits the growth of bacteria</p> <p>Reduces chlorine taste and odor and other offensive contaminants</p> <p>Self-contained scale inhibitor feed keeps ice machines functioning at full capacity</p> <p>Reduces maintenance and service costs by reducing scale and clogging of distribution lines, evaporator plate and pump</p> <p>Preclean submicron technology reduces dirt and particles as small as 1/2 micron in size and reduces possible health contaminants such as cysts</p> <p>Sanitary cartridge replacement is simple, quick and clean. Internal filter parts are never exposed to handling or contamination</p> <p>NSF Certified under NSF/ANSI Standards 42 and 53</p>
INSTALLATION TIPS	OPERATION TIPS	APPLICATION/SIZING
<p>Choose a mounting location suitable to support the full weight of the system when operating</p> <p>Never use saddle valve for connection</p> <p>Use 3/8" water line</p> <p>Do not connect system to water-cooled condenser</p> <p>Install vertically with cartridges hanging down and allow 2-1/2" clearance below the cartridge for easy cartridge replacement</p> <p>Flush cartridges by running water through system for five minutes at full flow</p>	<p>Change cartridges on a regular 6 month preventative maintenance program</p> <p>Change cartridges when capacity is reached or when pressure falls below 10 psi</p> <p>Service flow rate must not exceed 1.67 gpm</p> <p>Always flush the filter cartridge at time of installation and cartridge change</p>	<p>For ice machine applications</p> <p>Most cubers up to 750 lbs./day</p> <p>Most flakers up to 1,500 lbs./day</p> <p>Rated Capacity: 9,000 gallons</p>

Insurice Single-i2000² System

SPECIFICATIONS

Overall Dimensions:
27.38" H x 6" W x 4" D

Inlet connection: 3/8"

Outlet connection: 3/8"

Service Flow Rate:
Maximum 1.67 gpm (6.3 Lpm)

Rated Capacity: 9,000 gallons

Pressure Requirements:
10 - 125 psi (0.7 – 8.6 bar), non-shock

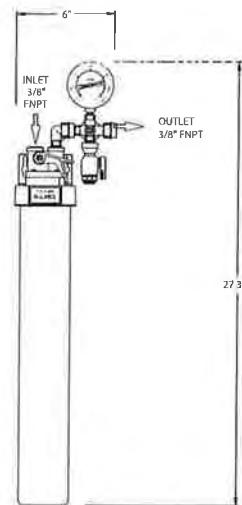
Temperature: 35 - 100°F (2 - 38°C)

No electrical connection required

Shipping Weight: 6 lbs.

Operating Weight: 9 lbs.

The contaminants or other substances removed or reduced by this drinking water system are not necessarily in your water. Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system. Systems certified for cyst reduction may be used with disinfected water that may contain filterable cysts.



WARRANTY

Everpure water treatment systems (excluding replaceable elements) are covered by a limited warranty against defects in material and workmanship for a period of five years after date of purchase. Everpure replaceable elements (filter cartridges and water treatment cartridges) are covered by a limited warranty against defects in material and workmanship for a period of one year after date of purchase. See printed warranty for details. Everpure will provide a copy of the warranty upon request.

System Tested and Certified by NSF International against NSF/ANSI Standard 42 and 53 for the reduction of:

Standard No. 42: Aesthetic Effects
 Chemical Unit
 Taste and Odor Reduction
 Chlorine Reduction
 Mechanical Filtration Unit
 Particulate Reduction, Class I:
 99.9+% reduction of particles
 one-half micron and larger in size
 Standard No. 53: Health Effects
 Mechanical Filtration Unit
 Turbidity Reduction
 Cyst Reduction
 Asbestos Reduction

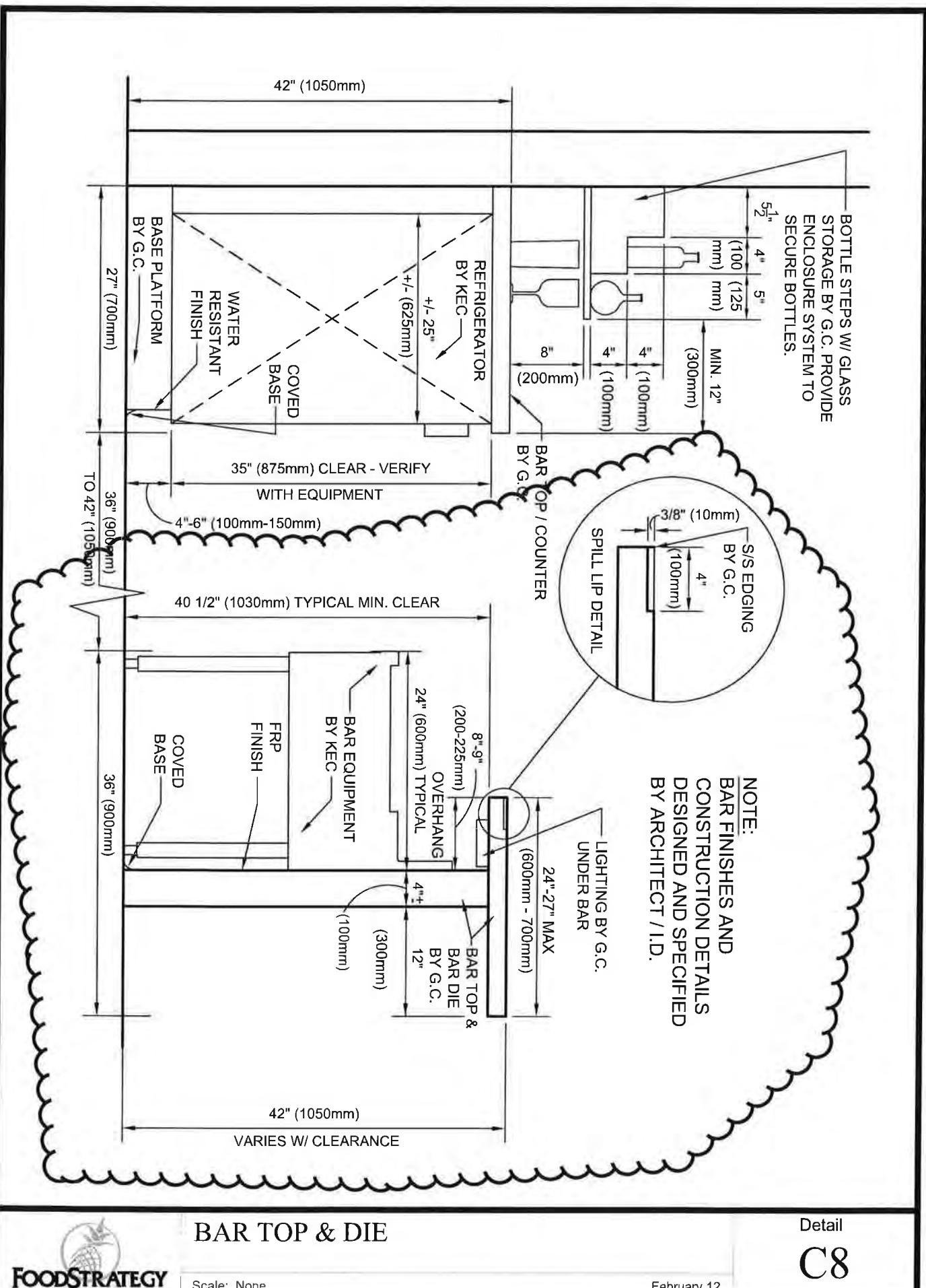
EVERPURE

EVERPURE, LLC
1040 Muirfield Drive
Hanover Park, Illinois 60133
Toll Free (800) 343-7873
Tel (630) 307-3000
Fax (630) 307-3030
<http://www.everpure.com>

In Europe:
N.V. EVERPURE (EUROPE) S.A.
INDUSTRIEPARK WOLFSTEE
TOEKOMSTLAAN 30
B-2200 HERENTALS
BELGIUM
TEL 32-14-283500
FAX 32-14-283505

In Japan:
EVERPURE JAPAN LLC
HASHIMOTO MN BLDG. 7F
3-25-1 HASHIMOTO SAGAMIHARA-SHI
KANAGAWA 229-1103
JAPAN
TEL 81-(0)42-775-3011
FAX 81-(0)42-775-3015

Everpure, LLC
1040 Muirfield Drive
Hanover Park, IL 60133
Ph: 630-307-3000 Fax: 630-307-3030



STANDARD ICE CHESTS WITH COLD PLATE

**MODELS**

TS Series

 TS24IC10 TS30IC10 TS36IC10 TS42IC10 TS48IC10**MODELS**

TSD Series

 TSD24IC10 TSD30IC10 TSD36IC10 TSD42IC10 TSD48IC10

- Model BW6-36 Bottle Wells, plastic, 6-bottle capacity, (3) wells on each side
- Model SR-SL36 locking speed rail, factory installed
- Model TS6SGA soda gun filler section

Perlick Features

- Patented design conceals cold plate under liner for improved sanitation
- Dent resistant ABS top ledge
- Stainless steel legs install without tools and have "Rust Free" thermoplastic feet



GENERATIONS OF
EXCELLENCE

Form No. IC01
Rev.01.17.2012

Perlick

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Toll Free 800.558.5592 • E-Mail perlick@perlick.com • www.perlick.com

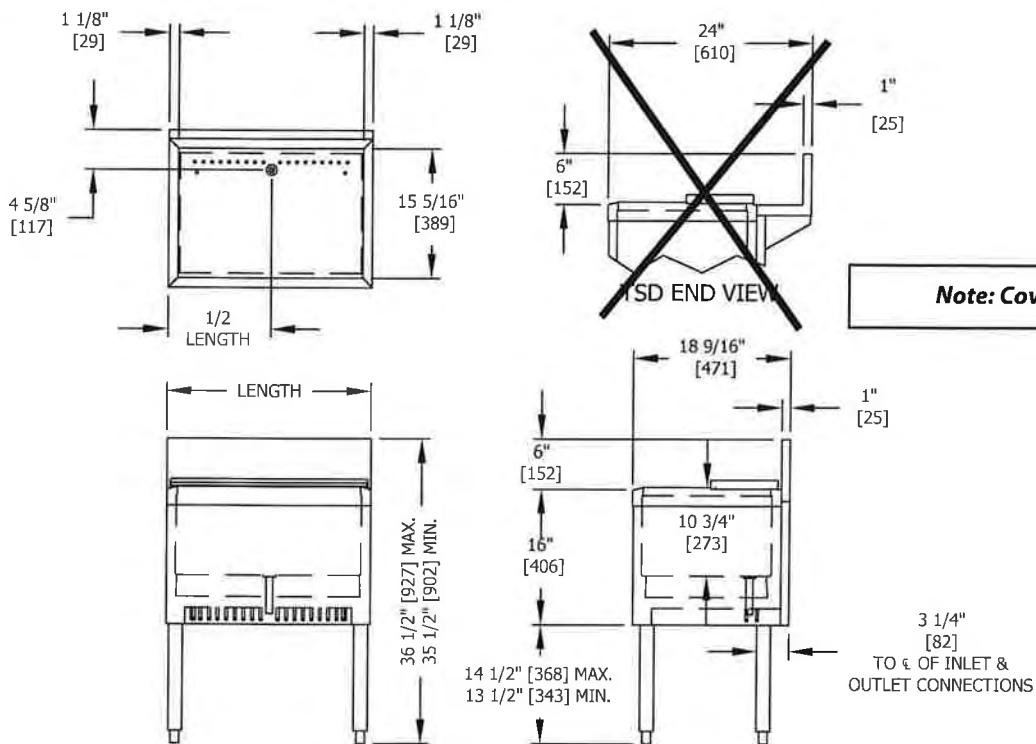
Size and Specifications

Standard Ice Chests with Cold Plate



Job _____
 Area _____
 Item No. _____
 Model No. _____

MODEL NOS.	TS(D)24IC10	TS(D)30IC10	TS(D)36IC10	TS(D)42IC10	TS(D)48IC10
LENGTH IN. (mm)	24" (610)	30" (762)	36" (914)	42" (1067)	48" (1219)
ICE CAP. lbs. (kg)	50 (22.7)	70 (31.8)	85 (38.6)	100 (45.4)	115 (52.2)
SHIP WT. lbs. (kg)	166 (75.3)	191 (86.6)	201 (91.2)	211 (95.7)	221 (100.2)
FRONT & SIDES	Stainless steel, top rim ABS				
BACKSPLASH	General and TS Series: Stainless steel 6" high (4" optional) with 1" return at top, mechanically fastened and sealed to ice chest top with steel support brackets TSD Series: Backlash and rear deck stainless steel				
BACK & BOTTOM	Galvanized steel				
INTERIOR	Stainless steel with 1/4" radius corners, welded and sealer with non-exposed cold plate. Interiors can be divided with accessory freestanding ice dividers				
INSULATION	Foamed-in-place polyurethane				
LEGS (optional)	1-5/8" tubular, stainless steel with 1" adjustable thermoplastic foot				
PLUMBING	Drain connection- 1/2" NPS male				
COLD PLATE	Cast aluminum plate concealed under ice chest liner. Cold plate has 2 full-length circuits and 8 half-length circuits. Connections- 5/16" O.D. stainless steel tubing with swaged end to accept standard 1/4" I.D. beverage tubing				
OPERATING SPECIFICATIONS	Each full circuit will deliver four, 6oz drinks per minute at 40° continuously, or 40oz every three minutes in a single draw (Flow rate 2oz/sec, 75° product)				



TS END VIEW

Form No. IC01
 Rev. 01.17.2012

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UNDERBAR ACCESSORIES

ICE CHESTS

Job _____
 Area _____
 Item No. _____
 Model No. _____

BOTTLE WELLS and COVER ASSEMBLIES

BOTTLE WELLS	Black high impact polypropylene. Inside dimensions of each cup is 4" x 4" x 5 3/4" deep.				
COVERS	Two piece, stainless steel. NOTE: Thru-the-bar has a four piece cover assembly.				

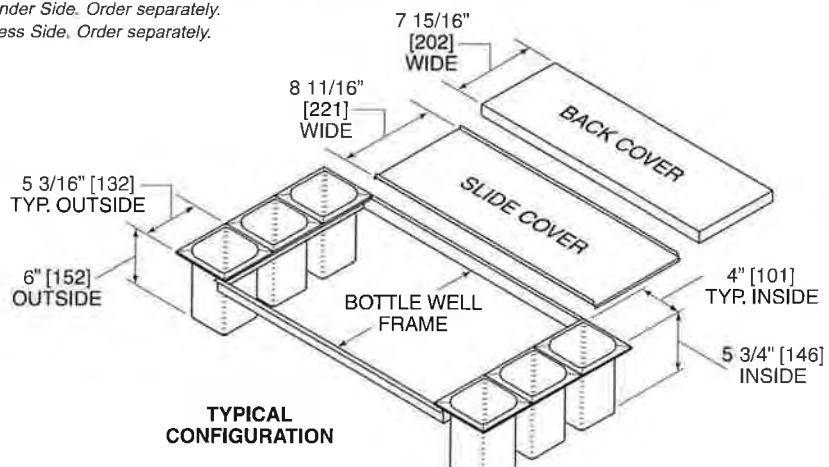
MODEL NUMBERS

Standard	TS24IC(8)	TS30IC(8)	TS36IC(8)	TS42IC(8)	TS48IC(8)	
Extra Deep	7055A62/64					
Thru-the-Bar						7055A70/73
	BW3-24 (CC5*)	BW3-30 (CC7*)	BW3-36 (CC7*)	N/A	N/A	N/A
	BW6-24 (CC4*)	BW6-30 (CC6*)	BW6-36 (CC6*)	BW6-42 (CC7*)	BW6-48 (CC7*)	N/A
	N/A	BW9-30 (CC4*)	BW9-36 (CC7*)	BW9-42 (CC7*)	BW9-48 (CC7*)	N/A
	N/A	N/A	BW12-36 (CC4*)	BW12-42 (CC6*)	BW12-48 (CC7*)	N/A
	N/A	N/A	N/A	N/A	N/A	BW6PT (CC4**) (CC7†)

* Maximum optional Condiment Rack Applicable. Order separately.

** Maximum optional Condiment Rack Applicable on Bartender Side. Order separately.

† Maximum optional Condiment Rack Applicable on Waitress Side. Order separately.



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Form No. ACC-01
 Rev. 03.30.05

UNDERBAR ACCESSORIES

SPEED RAILS

Job _____
 Area _____
 Item No. _____
 Model No. _____

STANDARD SPEED RAILS

LENGTH INS. (mm)	PART NO.
12" (305)	SR-S12
18" (457)	SR-S18
24" (610)	SR-S24
28" (711)	SR-S28
30" (762)	SR-S30
36" (914)	SR-S36
42" (1067)	SR-S42
48" (1219)	SR-S48
54" (1372)	SR-S54
60" (1524)	SR-S60
66" (1676)	SR-S66
72" (1829)	SR-S72
78" (1981)	SR-S78
84" (2134)	SR-S84
90" (2286)	SR-S90
96" (2438)	SR-S96

For Field Installed: Add "R" suffix to part number.

HANG-ON SPEED RAILS

LENGTH INS. (mm)	PART NO.
12" (305)	SR-H12
18" (457)	SR-H18
24" (610)	SR-H24
28" (711)	SR-H28
30" (762)	SR-H30
36" (914)	SR-H36

For use on Locking Bottle Rails: Add "N" suffix to part number.

DUAL SPEED RAILS

LENGTH INS. (mm)	PART NO.
12" (305)	SR-D12
18" (457)	SR-D18
24" (610)	SR-D24
28" (711)	SR-D28
30" (762)	SR-D30
36" (914)	SR-D36
42" (1067)	SR-D42
48" (1219)	SR-D48

For Field Installed: Add "R" suffix to part number.

LOCKING SPEED RAILS

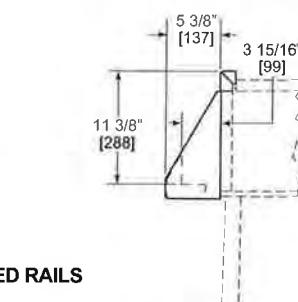
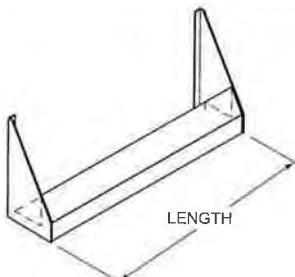
LENGTH INS. (mm)	PART NO.
18" (457)	SR-SL18
24" (610)	SR-SL24
30" (762)	SR-SL30
36" (914)	SR-SL36
42" (1067)	SR-SL42
48" (1219)	SR-SL48

For Field Installed: Add "R" suffix to part number.

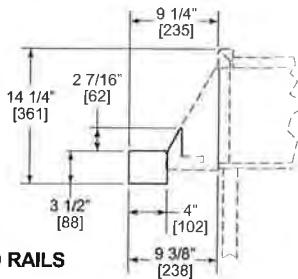
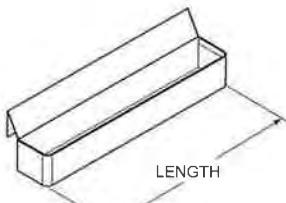
DUAL LOCKING SPEED RAILS

LENGTH INS. (mm)	PART NO.
18" (457)	SR-DL18
24" (610)	SR-DL24
30" (762)	SR-DL30
36" (914)	SR-DL36

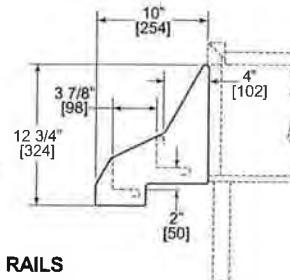
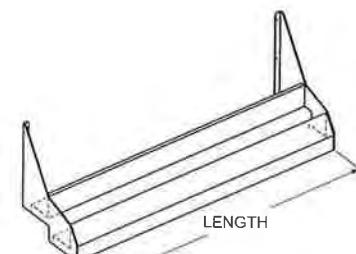
For Field Installed: Add "R" suffix to part number.



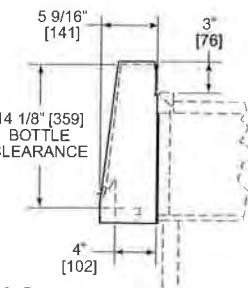
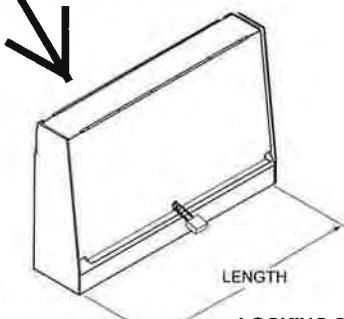
STANDARD SPEED RAILS



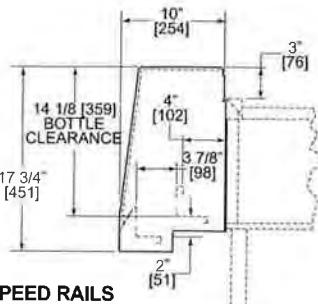
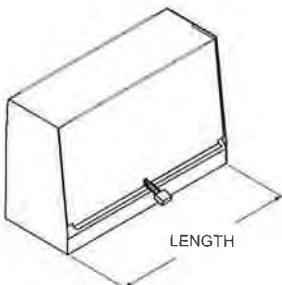
HANG-ON SPEED RAILS



DUAL SPEED RAILS



LOCKING SPEED RAILS



DUAL LOCKING SPEED RAILS



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Form No. ACC-03
 Rev. 03.06.06

TS & TSF SODA GUN FILLER SECTIONS

Perlick Features

- All stainless steel construction
- Designed for use with Wunder-Bar® and Schroeder America™ 8-14 product soda gun/manifold
- Top Cover and Manifold Mounting Bracket for both Wunder-Bar® and Schroeder America™ are included on 6" long fillers
- Manifold mounts to side panel for easy access and service
- Soda beverage tubing not visible to customers
- Drip cup/cradle mounts to cover
- Thumbscrews provide tool-less access for maintenance

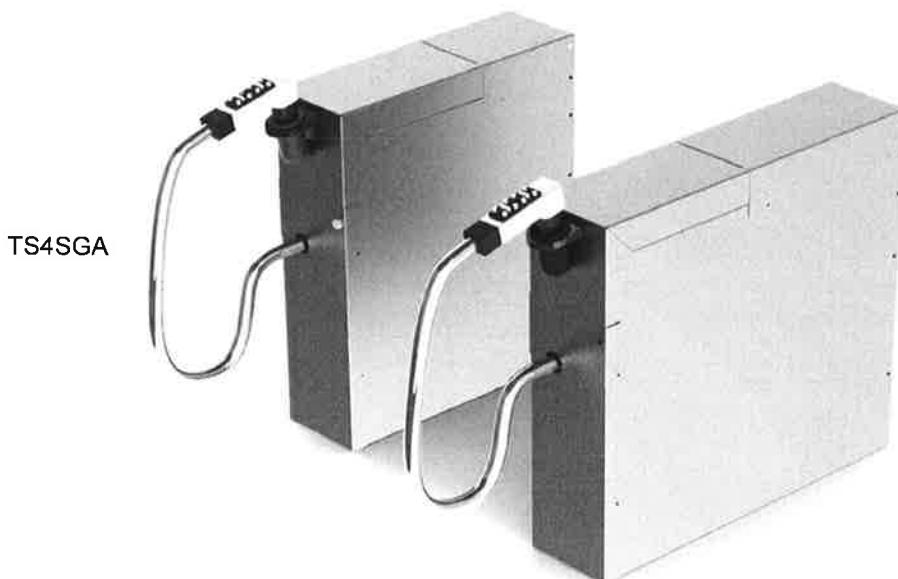
MODELS

TS Series

 TS4SGA**X** TS6SGA

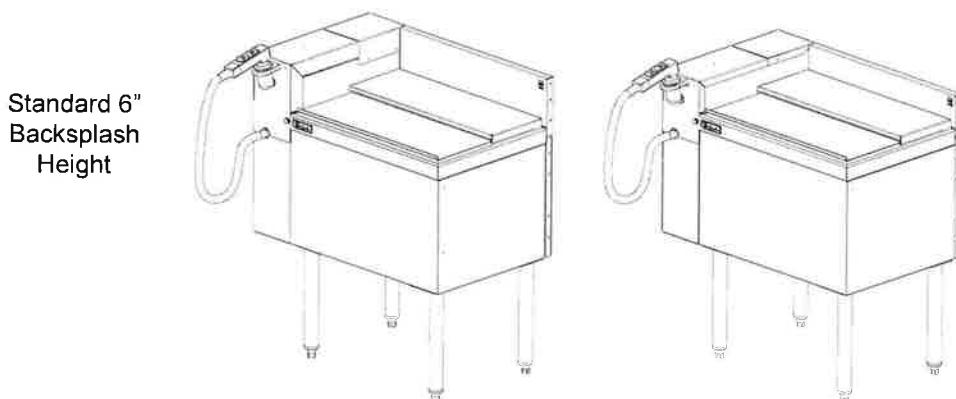
MODELS

TSF Series

 TSF4SGA TSF6SGA

Soda Gun systems
NOT included. Shown
for clarity only.

TSF4SGA



GENERATIONS OF
EXCELLENCE

Form No. FS03
Rev. 02.06.2012

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Size and Specifications

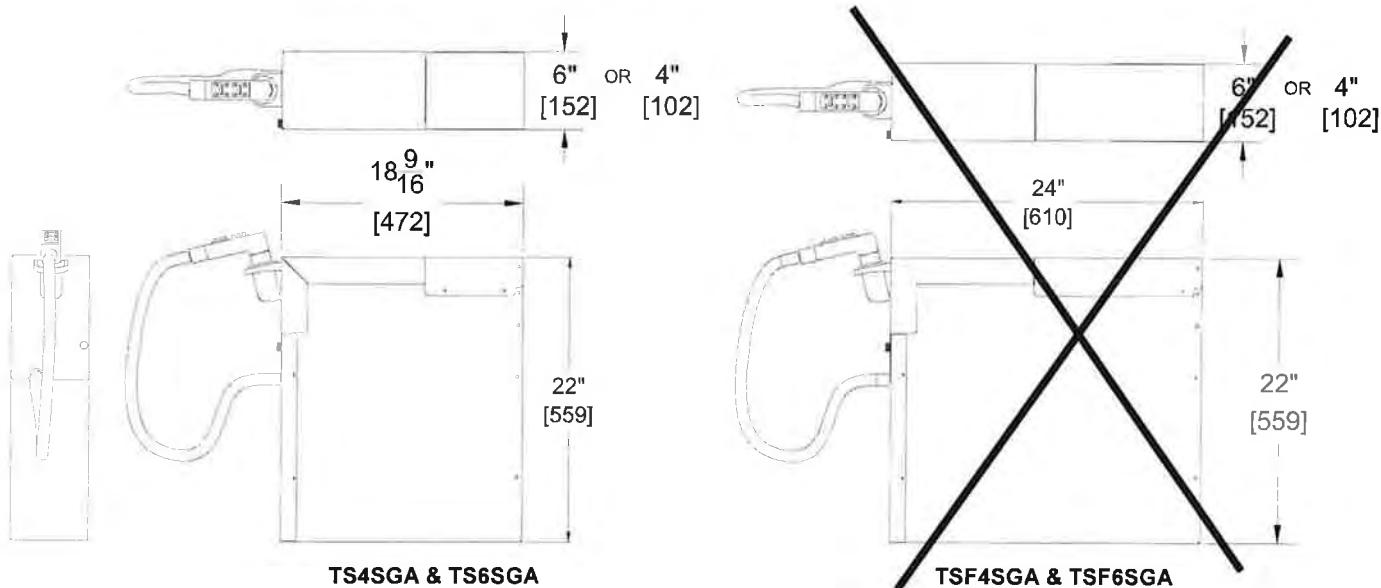
TS & TSF Soda Gun Filler Sections



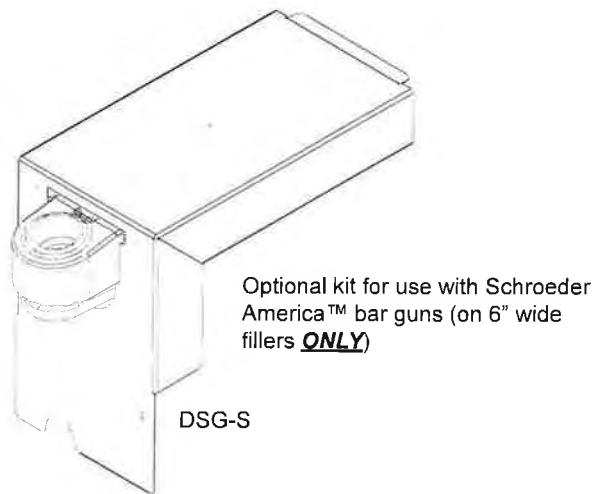
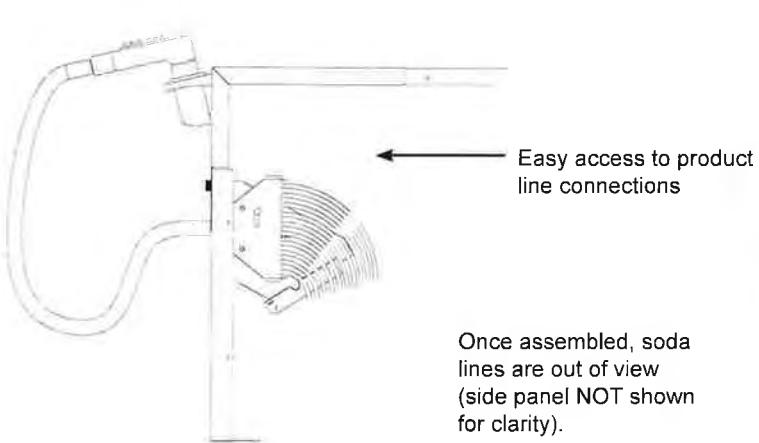
Job _____
 Area _____
 Item No. _____
 Model No. _____

MODEL NOS.	TS4SGA	TS6SGA	TSF4SGA	TSF6SGA
LENGTH IN. (mm)	4" (102)	6" (152)	4" (102)	6" (152)
DEPTH IN. (mm)	18-9/16" (472)	18-9/16" (472)	24" (610)	24" (610)
SHIP WT. LB. (kg)	18 (8.16)	18 (8.16)	18 (8.16)	18 (8.16)
CONSTRUCTION	Stainless steel			
SODA GUN CAPACITY	(Qty. 1) 8-14 button soda gun and manifold (not included)			

NOTE: Requires support by adjacent equipment.



*Soda gun systems NOT included.
Shown for clarity only.*



Form No. FS03
Rev. 02.06.2012



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NIKEC/BY VENDOR

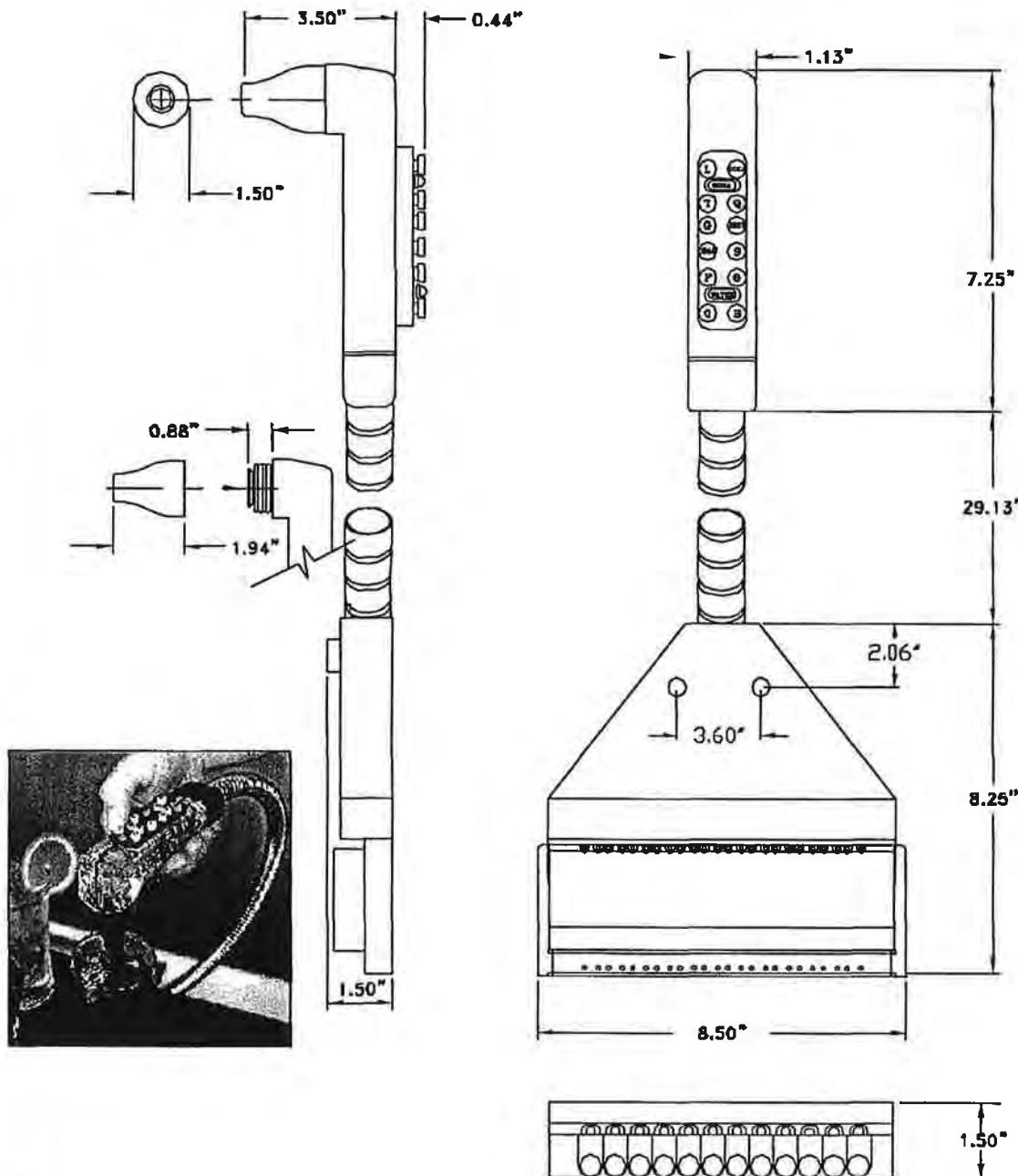
*Wunder-Bar*Food & Beverage
Dispensing Systems

JOB:

ITEM #:

MODEL:

WBM-14660

14 BUTTON, STANDARD
DISPENSER

AUTOMATIC BAR CONTROLS, INC.
790 EUBANKS DRIVE
VACAVILLE, CA 95688

PHONE: (707) 448-5151
FAX : (707) 448-1521
WWW.WUNDERBAR.COM



STORAGE BINS FOR LIQUOR

Perlick Features

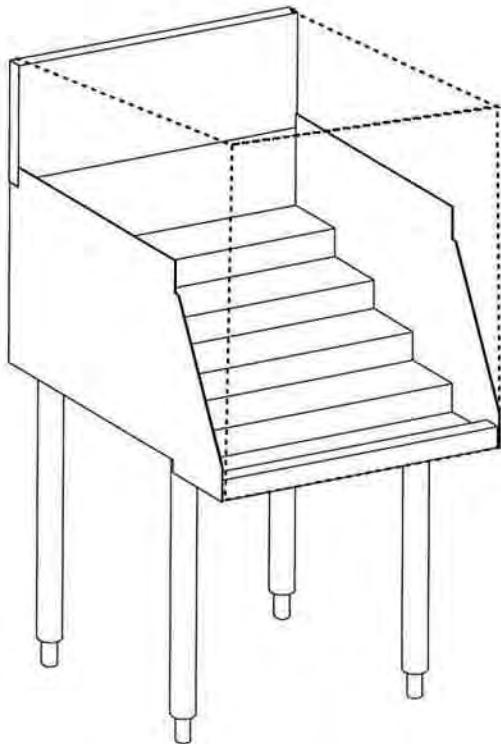
- Solid stainless steel steps without gaps.

MODEL NOS.

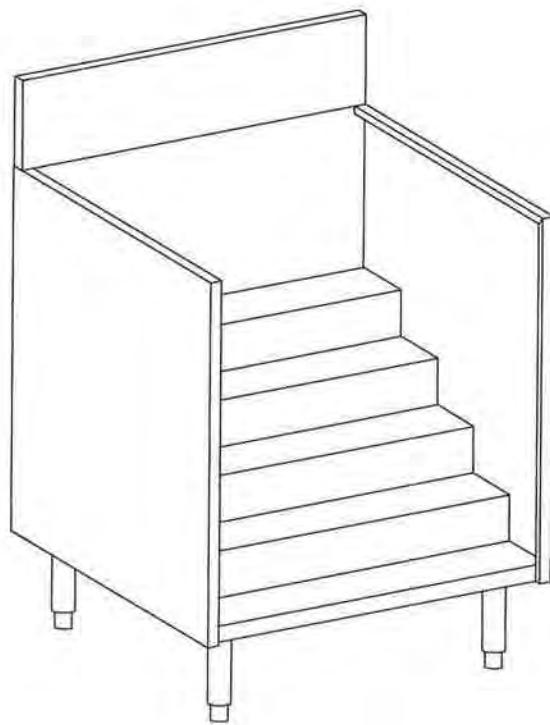
- TS12LS
- TS18LS
- TS24LS
- 7055A3

Model BG12 Bottle Guard Rail Set

Model CM1852 locking cover



TS18LS



7055A3



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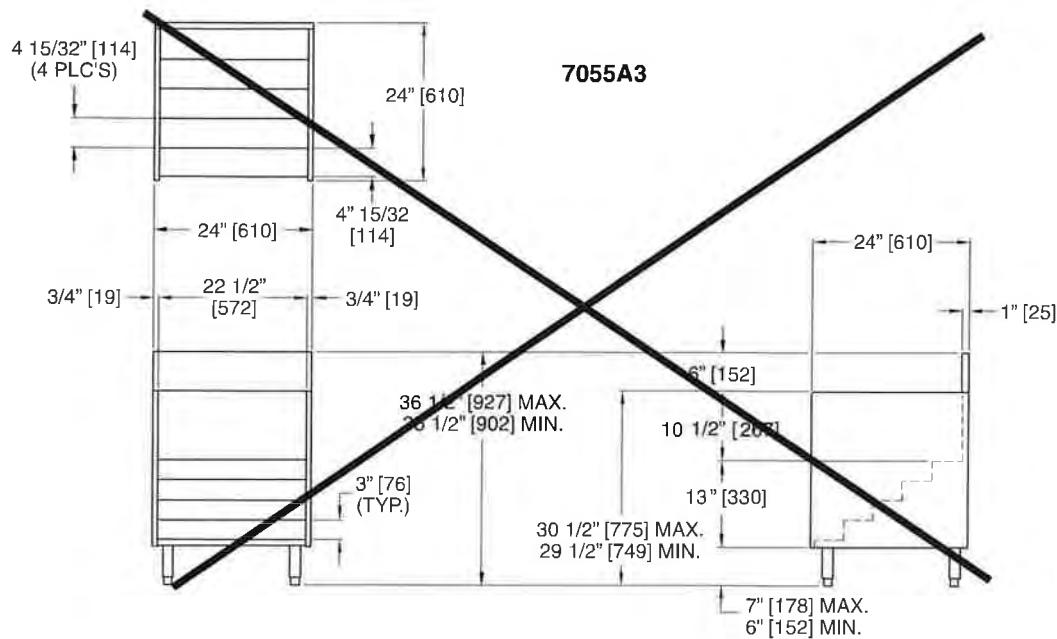
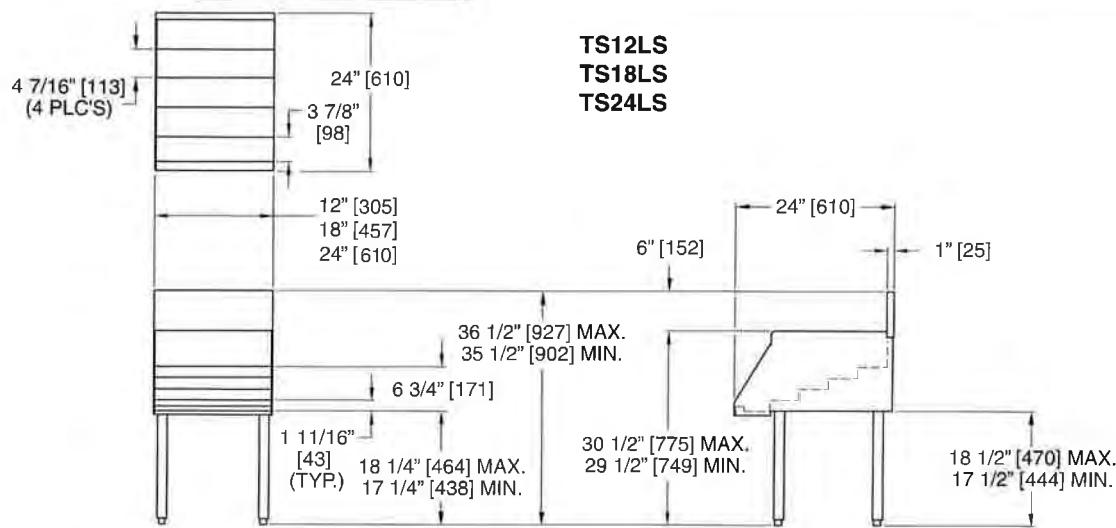
Form No. SB02
Rev. 03.30.09



Sizes and Specifications Storage Bins for Liquor

Job _____
 Area _____
 Item No. _____
 Model No. _____

MODEL NOS.	TS12LS	TS18LS	TS24LS	7055A3
Length Ins. (mm)	12" (305)	18" (457)	24" (610)	24" (610)
Ship wt lbs. (kg)	30 (14)	35 (16)	40 (18)	40 (18)
general PARTS	Sainless steel.			
Backsplash		Stainless steel 6" high (4" high optional) with 1" return at top, mechanically fastened and sealed with steel support brackets.		
Legs			Models TS12LS, TS18LS and TS24LS: 15/8" tubular, stainless steel with 1" adjustable thermoplastic foot. Model 7055A3: 15/8" tubular, stainless steel with 1" adjustable stainless steel foot.	



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Form No. SB02
 Rev. 03.30.09

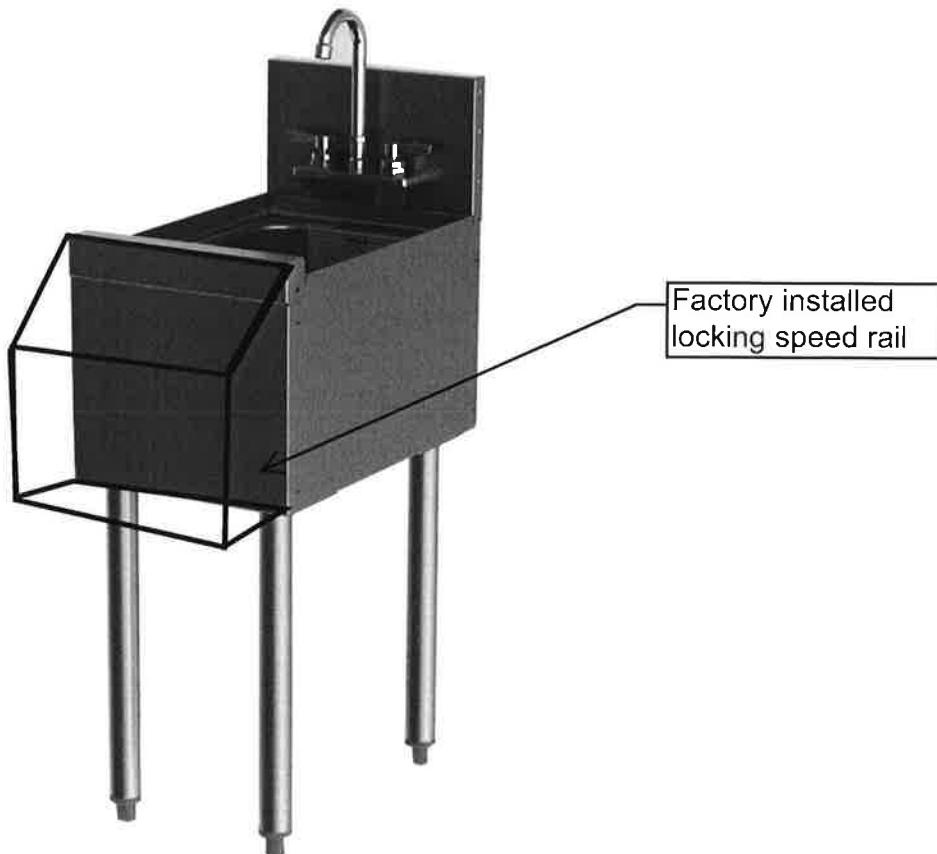
ONE TANK SINKS – STAINLESS STEEL BOWL

**MODELS**

TS Series

 TS12HS**MODELS**

TSD Series

 TSD12HS**Perlick Features**

- Deep drawn stainless steel bowl
- NSF listed, commercial grade hot/cold water faucet (must be ordered separately)
- Underside is sound-deadened
- Stainless steel legs install without tools and have "Rust Free" thermoplastic feet



GENERATIONS OF
EXCELLENCE

Form No. SK02
Rev. 09.19.2011



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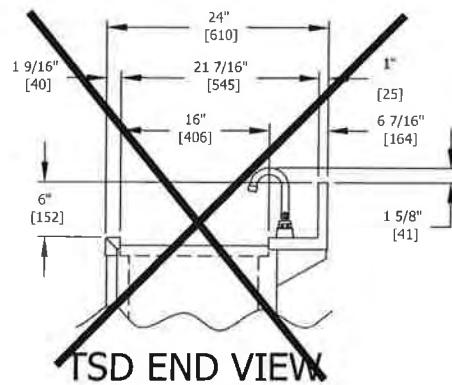
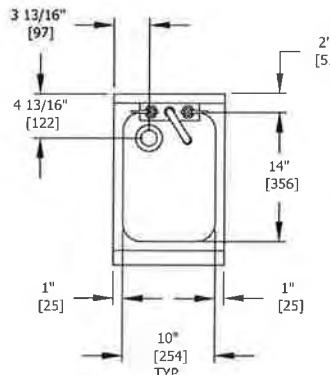
Size and Specifications

One Tank Sink – Stainless Steel Bowl

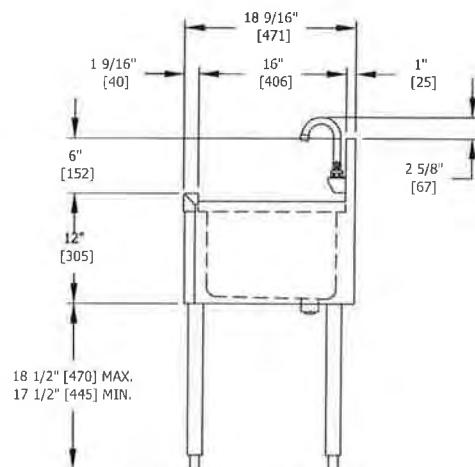
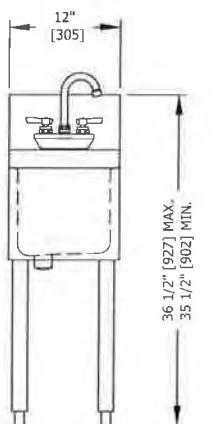


Job _____
 Area _____
 Item No. _____
 Model No. _____

MODEL NO.	TS12HS	TSD12HS
LENGTH IN. (mm)	12" (305)	12" (305)
SHIP WEIGHT LB. (kg)	45 (20)	45 (20)
TOP & SIDES		Stainless steel
BACK & BOTTOM		Stainless steel
BACKSPLASH	Stainless steel 6" high (4" high optional) with 1" return at the top, mechanically fastened and sealed to hand sink top with steel support brackets. TSD Series: Stainless steel rear deck	
LEGS	1-5/8" tubular, stainless steel with 1" adjustable thermoplastic foot.	
BOWL	Stainless steel with sound deadening. 10"x14"x9-1/4" deep. All horizontal and vertical edges 1-1/2" radius with balled corners. Furnished with 1-1/2" stainless steel drain socket. 8-1/2" standpipe.	
WATER FAUCET	Chrome plated, hot and cold, goose neck swing spout faucet. Heavy-duty all brass construction. Must be ordered separately. Lead free faucet also available.	
PLUMBING	Drain connection: 1-1/2" NPS male. Hot and cold water connection, 3/8" copper supply tubes	Drain connection: 1-1/2" NPS male. Hot and cold water connection, 1/2" IPS shanks and nuts



*Faucet shown for clarity;
must be ordered separately



Form No. SK02
 Rev. 09.19.2011



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 Toll Free 800.558.5592 • E-Mail perlick@perlick.com • www.perlick.com

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UNDERBAR ACCESSORIES

SPEED RAILS

Job _____
 Area _____
 Item No. _____
 Model No. _____

STANDARD SPEED RAILS

LENGTH INS. (mm)	PART NO.
12" (305)	SR-S12
18" (457)	SR-S18
24" (610)	SR-S24
28" (711)	SR-S28
30" (762)	SR-S30
36" (914)	SR-S36
42" (1067)	SR-S42
48" (1219)	SR-S48
54" (1372)	SR-S54
60" (1524)	SR-S60
66" (1676)	SR-S66
72" (1829)	SR-S72
78" (1981)	SR-S78
84" (2134)	SR-S84
90" (2286)	SR-S90
96" (2438)	SR-S96

For Field Installed: Add "R" suffix to part number.

HANG-ON SPEED RAILS

LENGTH INS. (mm)	PART NO.
12" (305)	SR-H12
18" (457)	SR-H18
24" (610)	SR-H24
28" (711)	SR-H28
30" (762)	SR-H30
36" (914)	SR-H36

For use on Locking Bottle Rails: Add "N" suffix to part number.

DUAL SPEED RAILS

LENGTH INS. (mm)	PART NO.
12" (305)	SR-D12
18" (457)	SR-D18
24" (610)	SR-D24
28" (711)	SR-D28
30" (762)	SR-D30
36" (914)	SR-D36
42" (1067)	SR-D42
48" (1219)	SR-D48

For Field Installed: Add "R" suffix to part number.

LOCKING SPEED RAILS

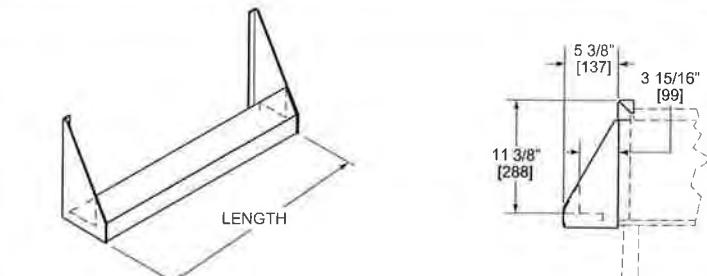
LENGTH INS. (mm)	PART NO.
18" (457)	SR-SL18
24" (610)	SR-SL24
30" (762)	SR-SL30
36" (914)	SR-SL36
42" (1067)	SR-SL42
48" (1219)	SR-SL48

For Field Installed: Add "R" suffix to part number.

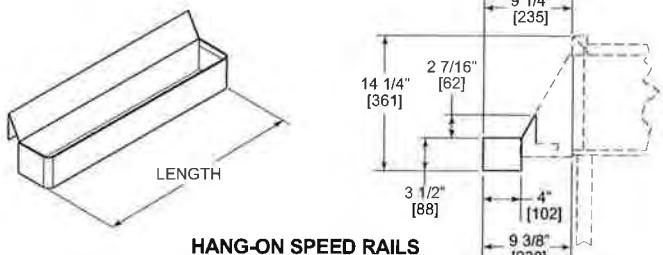
DUAL LOCKING SPEED RAILS

LENGTH INS. (mm)	PART NO.
18" (457)	SR-DL18
24" (610)	SR-DL24
30" (762)	SR-DL30
36" (914)	SR-DL36

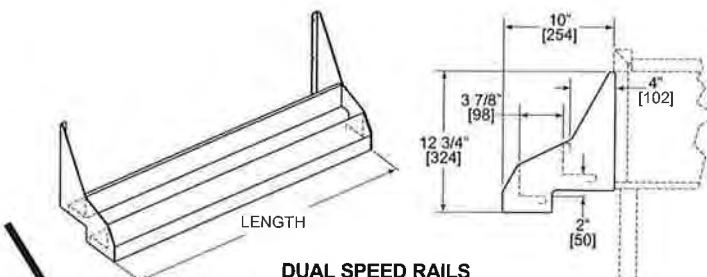
For Field Installed: Add "R" suffix to part number.



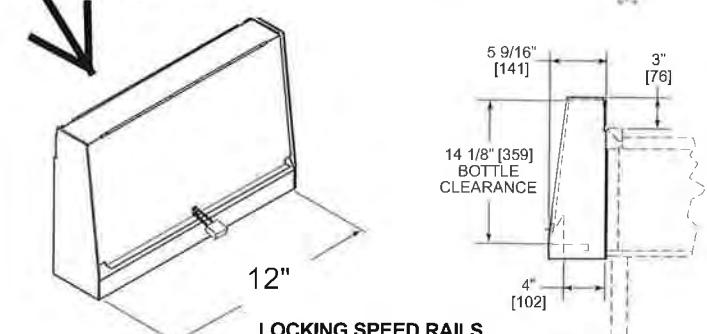
STANDARD SPEED RAILS



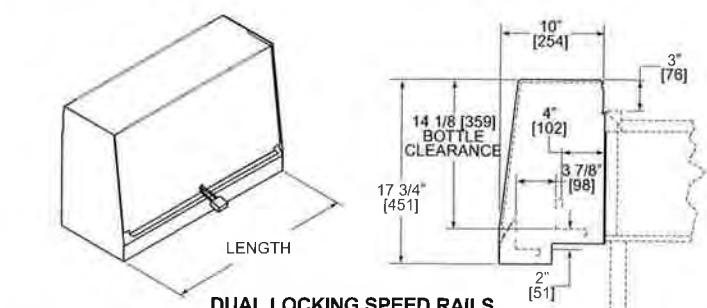
HANG-ON SPEED RAILS



DUAL SPEED RAILS



LOCKING SPEED RAILS



DUAL LOCKING SPEED RAILS



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Form No. ACC-03
 Rev. 03.06.06



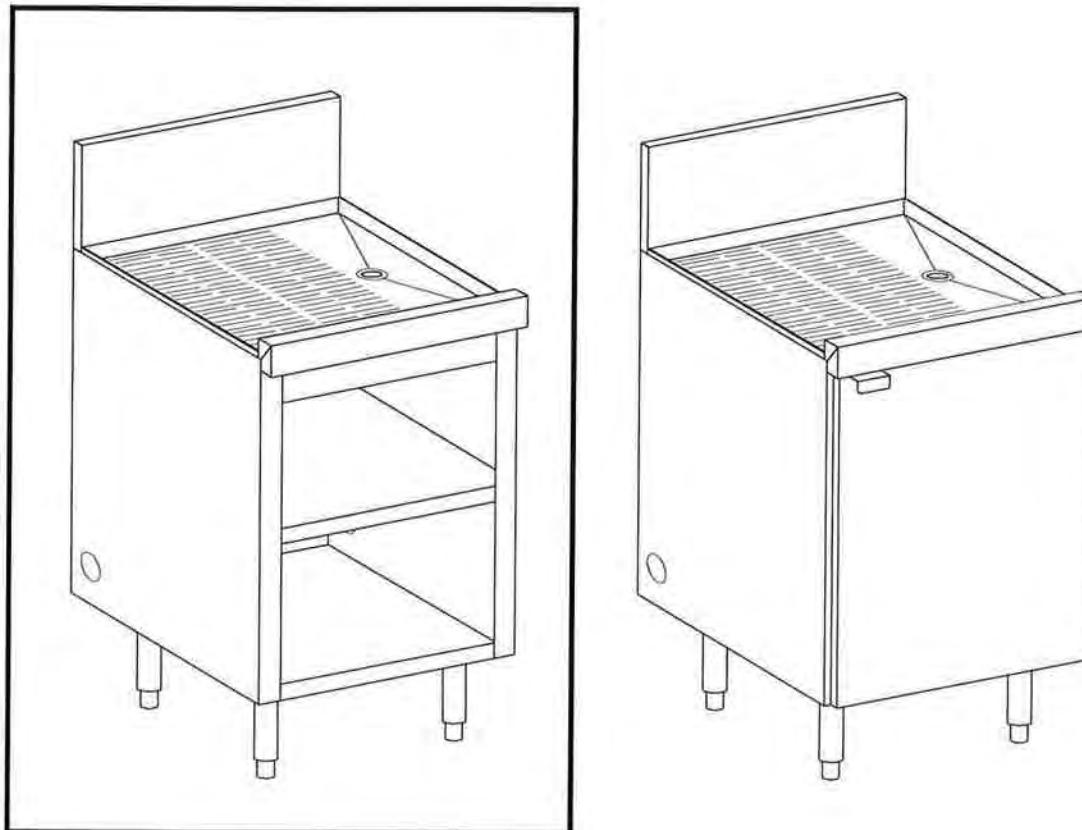
STORAGE CABINETS WITH FULL DRAINBOARD TOP (TSD DEPTH)

Perlick Features

- Embossed stainless steel drainboard.
- Adjustable stainless steel shelf.
- Optional door(s).

MODEL NOS.

- SC12
- SC18
- SC24
- SC30
- SC36
- SC48



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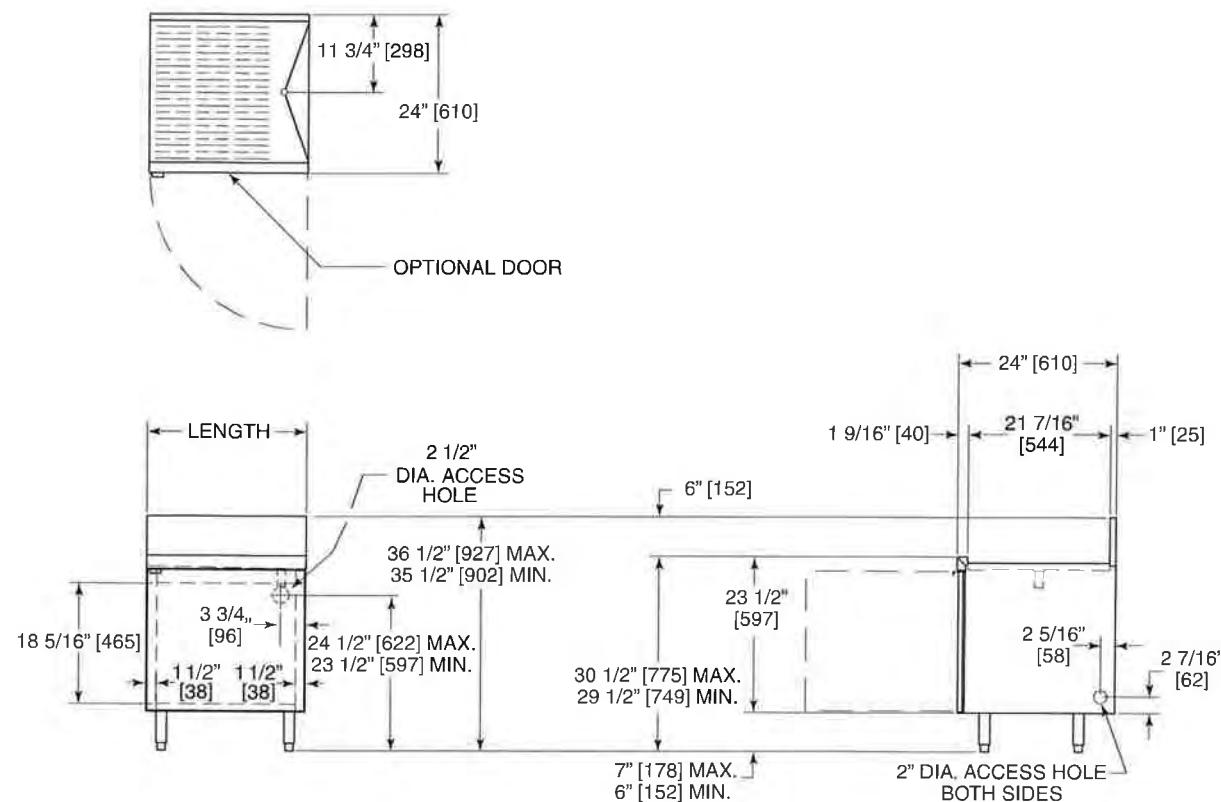
Form No. SB03
Rev. 08.15.07



Sizes and Specifications Storage Cabinets with Full Drainboard Top (TSD Depth)

Job _____
 Area _____
 Item No. _____
 Model No. _____

MODEL NOS.	SC12	SC18	SC24	SC30	SC36	SC48
LENGTH INS. (mm)	12" (305)	18" (457)	24" (610)	30" (762)	36" (914)	48" (1219)
Ship wt lbs. (kg)	30 (14)	40 (18)	65 (30)	80 (36)	100 (45)	120 (54)
GENERAL PARTS	Stainless steel.					
BACKSPLASH	Stainless steel 6" high (4" high optional) with 1" return at top, mechanically fastened and sealed with steel support brackets.					
DRAINBOARD	Embossed stainless steel, 21 ⁷ / ₁₆ " deep front to back. All horizontal and vertical edges 1/4" radius with balled corners. Underside reinforced with welded brackets. Stainless steel drain socket.					
SHELF	Adjustable shelf is reinforced stainless steel.					
LEGS	1 ⁵ / ₈ " tubular, stainless steel with 1" adjustable stainless steel foot.					
PLUMBING	Drain connection - 1 ¹ / ₂ " NPS Male.					
DOOR(S) - OPTIONAL	Stainless steel outer and inner door panels. Dual magnetic catches per door. Note: Cabinets 30" or longer have two doors.					



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Form No. SB03
 Rev. 08.15.07



Waste > Indoor Utility

3540-60 Slim Jim® with Venting Channels

GRAY



Features innovative patent-pending solutions that increase efficiency and improve worker well-being.

- Integrated, patent-pending venting channels take the strain out of liner removal.
- Space-saving profile fits virtually anywhere.
- Four patent-pending can liner cinches improve productivity.
- Molded-in handles and base grips make lifting and emptying easier.
- Available with Universal Recycling Symbol, SKU# 3540-07.
- Custom imprinting available; contact Rubbermaid Customer Service at (800) 347-9800 for details.

Slim Jim® Containers, Tops and Trolley System

Item #	Description	Length	Width	Height	Mass Capacity	Volume Capacity	Price US
2673-60	Slim Jim® Swing Lid for Slim Jim® Containers	20 1/2 in	11 3/8 in	5 in			\$37.80
2674	Slim Jim® Hinge Lid for Slim Jim® Containers	21 7/8 in	13 1/2 in	1 1/4 in			\$45.30
2688-88	Slim Jim® Handle Top for Slim Jim® Containers	20 3/8 in	11 5/16 in	2 3/4 in			\$38.80
2692-88	Slim Jim® Bottle and Can Recycling Top for Slim Jim® Containers	20 3/8 in	11 5/16 in	2 3/4 in			\$38.80
2703-88	Slim Jim® Paper Recycling Top for Slim Jim® Containers	20 3/8 in	11 5/16 in	2 3/4 in			\$38.80
3540	Slim Jim® Waste Container	20 in	11 in	30 in	23 gal	\$60.20	
→ 3540-60	Slim Jim® with Venting Channels GRAY	22 in	11 in	30 in	23 gal	\$61.10	
• 3541	Slim Jim® Waste Container with Handles	23 1/8 in	11 in	24 7/8 in	15 7/8 gal	\$45.60	
3542-20	Slim Jim® Combo: 3541 (1) Light Gray; 2688-88 (1) Light Gray						\$82.40
3551-88	Slim Jim® Trolley for 3540, 3541 and 3554 Containers	23 7/16 in	15 in	10 13/16 in	200 lb		\$74.00
3553	Slim Jim® Stainless Steel Dolly for Slim Jim® Containers	20.3 in	8.9 in	6.4 in	120 lb		\$158.00
3554	Slim Jim® Waste Container with Handles	23 1/8 in	11 in	30 in	23 gal		\$63.20

Accessories for 3540-60:

No.	Description	Price US
2688-88	Slim Jim® Handle Top for Slim Jim® Containers	\$38.80
2692-88	Slim Jim® Bottle and Can Recycling Top for Slim Jim® Containers	\$38.80
2703-88	Slim Jim® Paper Recycling Top for Slim Jim® Containers	\$38.80
9W16	Slim Jim® Confidential Document Container Lids for 3540, 3541 and 3554 Containers	\$49.80
2673-60	Slim Jim® Swing Lid for Slim Jim® Containers	\$37.80
2674	Slim Jim® Hinge Lid for Slim Jim® Containers	\$45.30
3553	Slim Jim® Stainless Steel Dolly for Slim Jim® Containers	\$158.00

Work Smarter.

Rubbermaid Commercial Products, LLC
3124 Valley Avenue, Winchester, VA 22601
www.rcpworksmaarter.com

DESCRIPTION: OPEN NO.

OPEN NUMBER

CUSTOM FABRICATED BY KEC

- Stainless Steel**
- Millwork**

EXISTING EQUIPMENT

- Relocated by KEC**
- Remain In Place**

NOT IN KITCHEN EQUIPMENT CONTRACT (NIKEC)

- Equipment By Owner/Operator**
- Equipment By Vendor**
- Millwork By Architect/Interior Designer**
- Equipment by Others** _____.

REMARKS: _____

DESCRIPTION: OPEN NO.

OPEN NUMBER

CUSTOM FABRICATED BY KEC

- Stainless Steel**
- Millwork**

EXISTING EQUIPMENT

- Relocated by KEC**
- Remain In Place**

NOT IN KITCHEN EQUIPMENT CONTRACT (NIKEC)

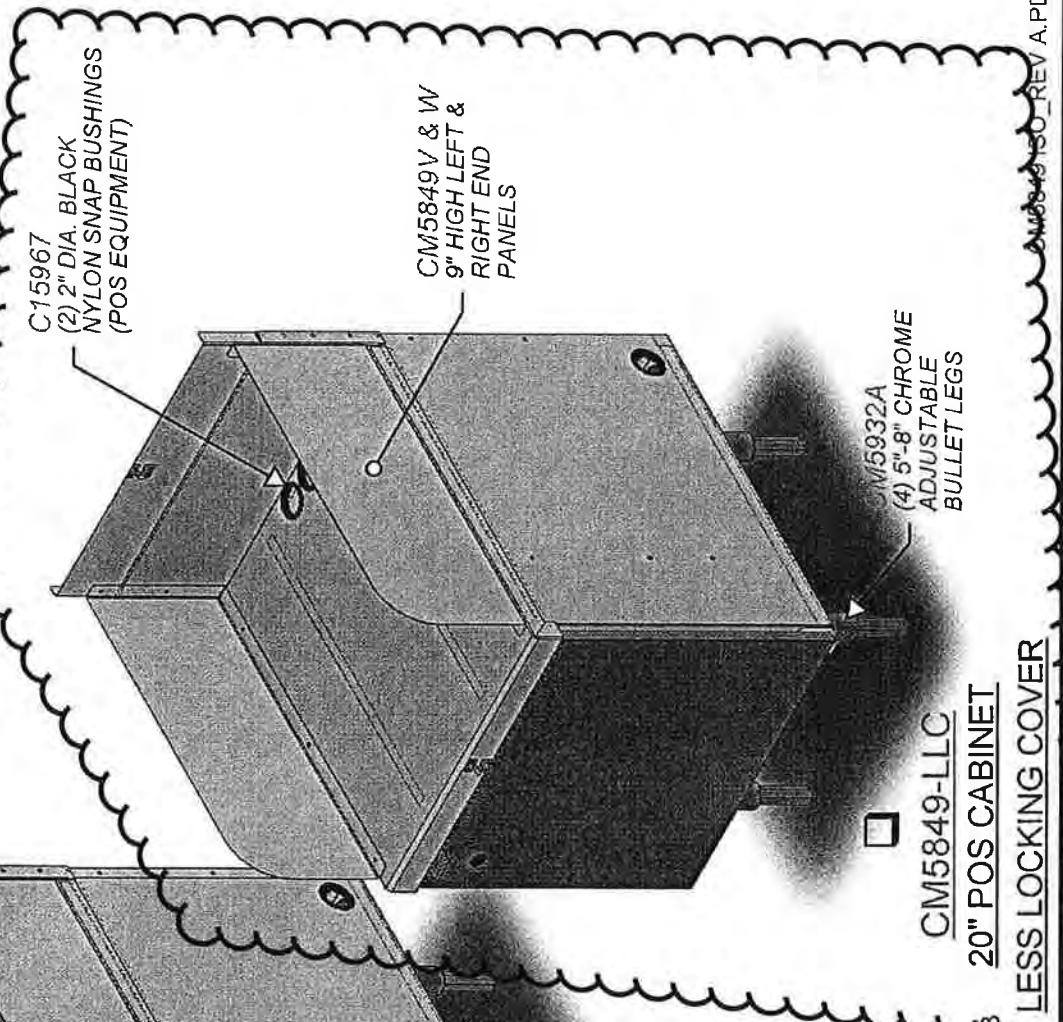
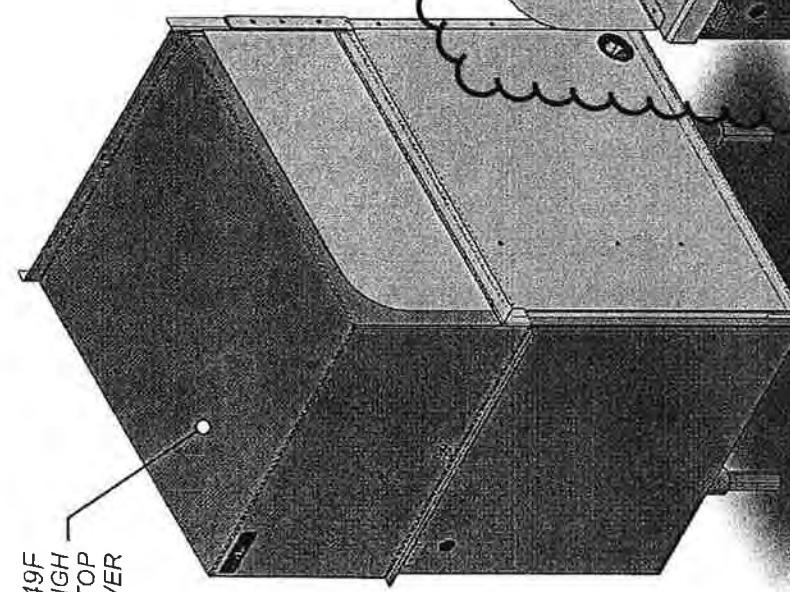
- Equipment By Owner/Operator**
- Equipment By Vendor**
- Millwork By Architect/Interior Designer**
- Equipment by Others** _____.

REMARKS: _____

CM5849 & CM5849-LLC

- ~ 20" WIDE X 24" DEEP POS STORAGE CABINET
- ~ 29" MAX. - 26" MIN. WORKING HEIGHT
- ~ 3" ADJUSTABLE LEGS - 8" MAX. - 5" MIN.
- ~ FLAT ST. STL. TOP, SHELF ASSEMBLY, RIGHT HINGED DOOR, SIDE SPLASHES WITH OR LESS LOCKING COVER

CM5849F
10" HIGH
LOCKING TOP
COVER



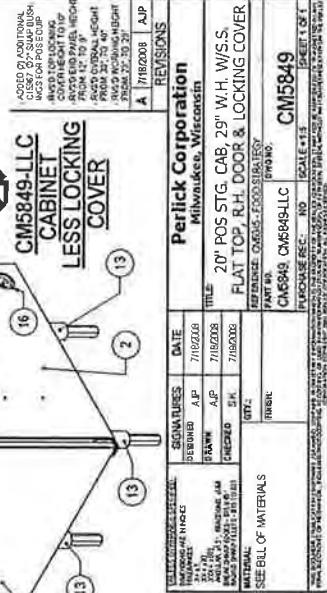
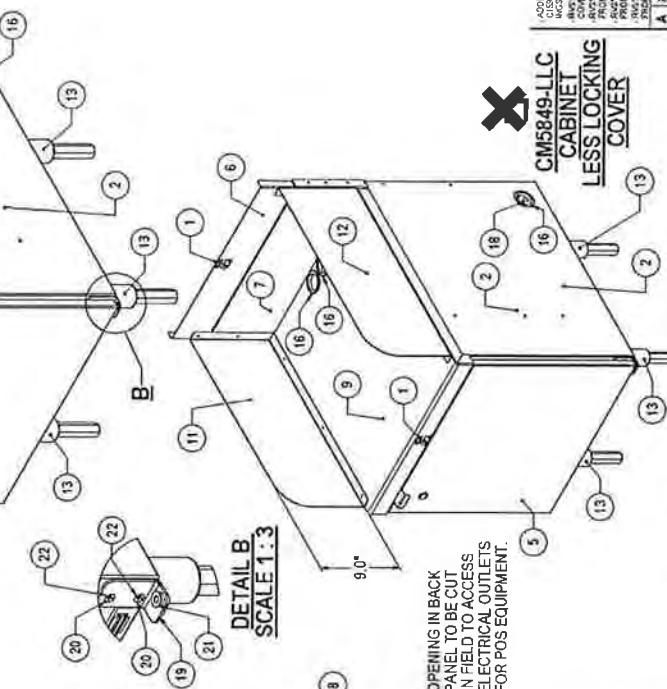
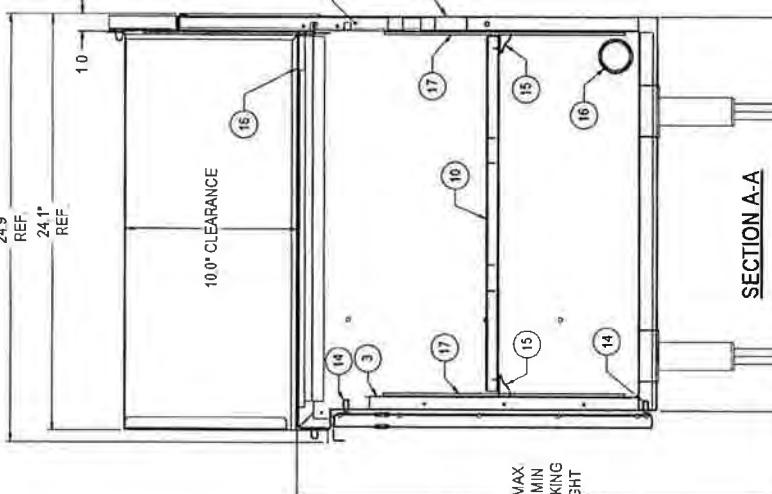
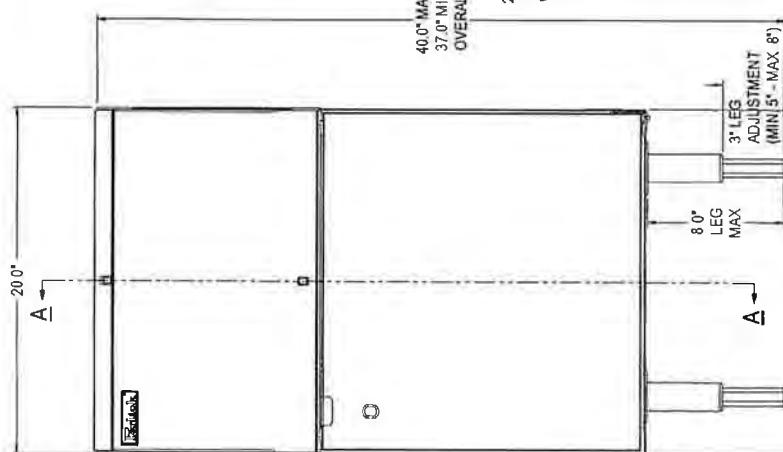
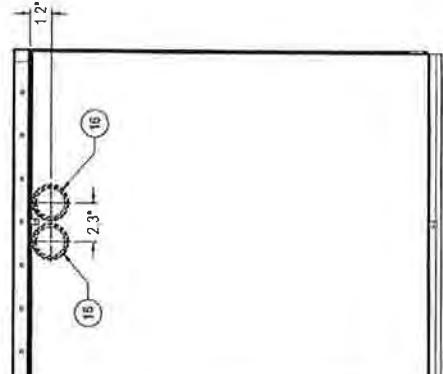
CM5849
20" POS CABINET WITH
LOCKING COVER

Perlick
CORPORATION

PERLICK CORPORATION
8300 W. GOOD HOPE ROAD
MILWAUKEE, WISCONSIN 53223
www.perlick.com

CM5849-LLC
20" POS CABINET
LESS LOCKING COVER

ITEM NO.	PART NUMBER	CITY	DESCRIPTION	MATERIAL
1	CM6564F	2	HASP FOR LOCKING BOTTLE RAIL	(M55038-18)
2	CM6549A	1	STORAGE CABINET SUB-ASSEMBLY, 20", PANEL, INTERIOR FRONT FINISHING,	(M55037-20)
3	CM6549E	1	COVER, TOP-LOCKING SS20, NWBD.	(M55038-18)
4	CM6549F	1	DOOR ASSEMBLY, RIGHT-HINGED, 20".	(M55037-20)
5	CM6549G	1	BRACKET, HASP MOUNTING, SS18.	(M55034-18)
6	CM6549L	1	BACKSPLASH, TS NWBD, 12", 20".	(M55037-20)
7	CM6549P	1	BRACKET, BACKSPLASH, GA18, NWBD	(M55038-18)
8	CM6549D	2	TOP ASSEMBLY, FLAT, 20", NWBD.	(M55037-20)
9	CM6549R	1	SHELF ASSEMBLY, 20", SS20, NWBD.	(M55037-20)
10	CM6549U	1	END SPLASH, LEFT, 9", SS18, NWBD	(M55037-18)
11	CM6549V	1	END SPLASH, RIGHT, 9", SS18, NWBD	(M55037-18)
12	CM6549W	1	LEG, 5"-8" ADJUSTABLE	C1282DA
13	CM6531A	4	MAGNETIC CATCH, HIGH IMPACT	H1 THERMOPLASTIC
14	C15381A	4	SHELF CLIP W/HL LUG	S.S. ALLOY
15	C15675	4	SNAP BUSHING, 2.00" NYLON BLACK	NYLON
16	C15676	4	PILEASTER 14"	ALUMINUM ALLOY
17	C19539-1	4	PLUG BUTTON, 2.00" DIAMETER,	ZINC PLATED STEEL
18	C22336	1	RIGHT-HINGE ASSEMBLY PERLUCK	12GA CR S
19	C31526	1	LOCKWASHER, #10 COUNTERSUNK, EXT	
20	M00593-077	2	WASHER, #14 FLAT, BRASS, 3/16"	BRASS
21	M00593-081	1	SCREW, SHEET METAL, #10 x 1/2"	STEEL
22	M00566-122	2	NAMEPLATE, PERLUCK "3-316SS X 1"	
23	57596-1	1		



SW J:\D\w\j\CM\5601-6000\CM5849\CM5849

DESCRIPTION: POS Terminal

OPEN NUMBER

CUSTOM FABRICATED BY KEC

- Stainless Steel**
- Millwork**

EXISTING EQUIPMENT

- Relocated by KEC**
- Remain In Place**

NOT IN KITCHEN EQUIPMENT CONTRACT (NIKEC)

Equipment By Owner/Operator

- Equipment By Vendor**
- Millwork By Architect/Interior Designer**
- Equipment by Others**

REMARKS: _____

Quad. Recept.

Electrical: 120/1 phase 15Amps



DROP DOWN DRAINBOARDS

Perlick Features

- Embossed stainless steel drainboard.

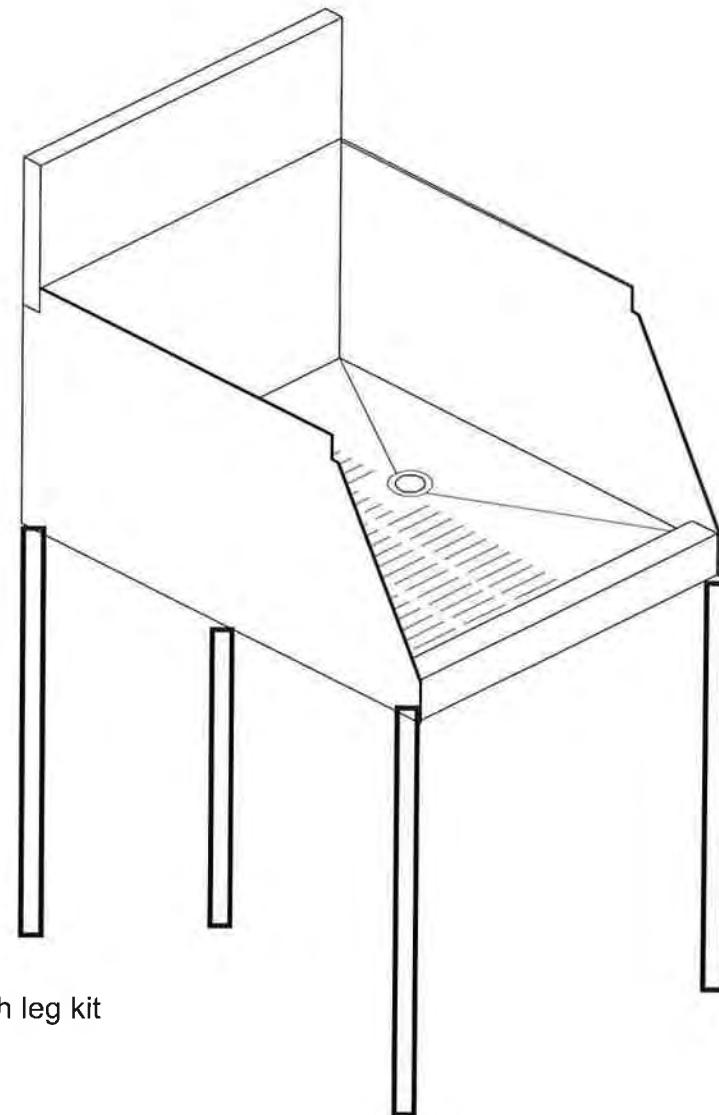
MODEL NOS.

TS Series

TS12DD

TS18DD

TS24DD



With leg kit



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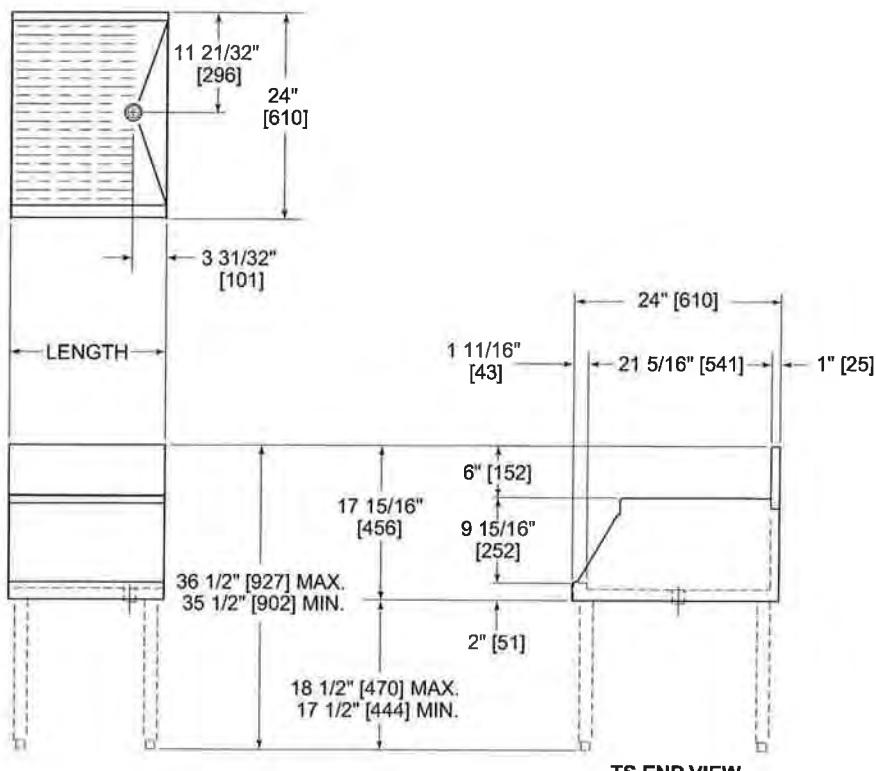
Form No. DB02
Rev. 03.30.05



Sizes and Specifications Drop Down Drainboards

Job _____
 Area _____
 Item No. _____
 Model No. _____

MODEL NOS.	TS12DD	TS18DD	TS24DD
LENGTH INS. (mm)	12" (305)	18" (457)	24" (610)
SHIP WT lbs. (kg)	30 (14)	35 (16)	40 (18)
FRONT & SIDES	Stainless steel.		
BACKSPLASH	General and TS Series: Stainless steel 6" high (4" high optional) with 1" return at top, mechanically fastened and sealed with steel support brackets.		
LEGS	Not provided. Requires adjacent support. Accessory leg kit available.		
DRAINBOARD	Embossed stainless steel, 21" deep front to back. Stainless steel drain socket.		
PLUMBING	Drain-connection - 1½" NPS Male.		



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Form No. DB02
 Rev. 03.30.05

NIKEC/BY VENDOR

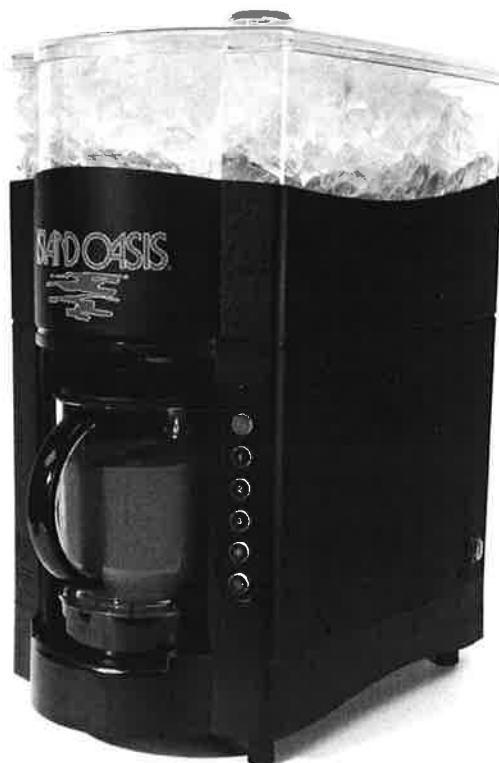
Island Oasis handles a variety of frozen beverage equipment to fit any application. Our patented SB2100 Ice Shaver Blender has magnetic technology that completely eliminates the clutch. This machine can make a variety of drinks in just seconds.

Island Oasis SB2100**Ice Shaver Blender:**

The SB2100 dispenses and blends the exact amount of shaved ice for each drink no matter what size glass you are using in just 10 seconds and can be calibrated for 3 different drink sizes. Simply pour the mix (and liquor for cocktails) into the blender cup, push a button, and fill your customer's glass. It's quick and easy with minimal amount of clean-up. It operates on a regular 110V outlet and only draws 6.5 amps. With a drink every 10 seconds the volume output is tremendous.

Specs:

- 12.25" wide
18" deep
23.5" high
- Weight approximately
35 lbs.
- System must be
sanitized daily
- Ideal for all Island Oasis
drink recipes which
includes Piña Coladas,
Daiquiris, Mudslides
and all Smoothie
applications.



The Taste of Paradise™

DESCRIPTION: OPEN NO.

OPEN NUMBER

CUSTOM FABRICATED BY KEC

- Stainless Steel**
- Millwork**

EXISTING EQUIPMENT

- Relocated by KEC**
- Remain In Place**

NOT IN KITCHEN EQUIPMENT CONTRACT (NIKEC)

- Equipment By Owner/Operator**
- Equipment By Vendor**
- Millwork By Architect/Interior Designer**
- Equipment by Others** _____.

REMARKS: _____

ONE TANK SINKS – STAINLESS STEEL BOWL

MODELS

TS Series

X TS12HSN**Perlick Features**

- Deep drawn stainless steel bowl
- NSF listed, commercial grade hot/cold water faucet (must be ordered separately)
- 16 oz. pump soap dispenser
- Underside is sound-deadened
- Stainless steel legs install without tools and have "Rust Free" thermoplastic feet

Form No. SK07
Rev. 04.04.2013

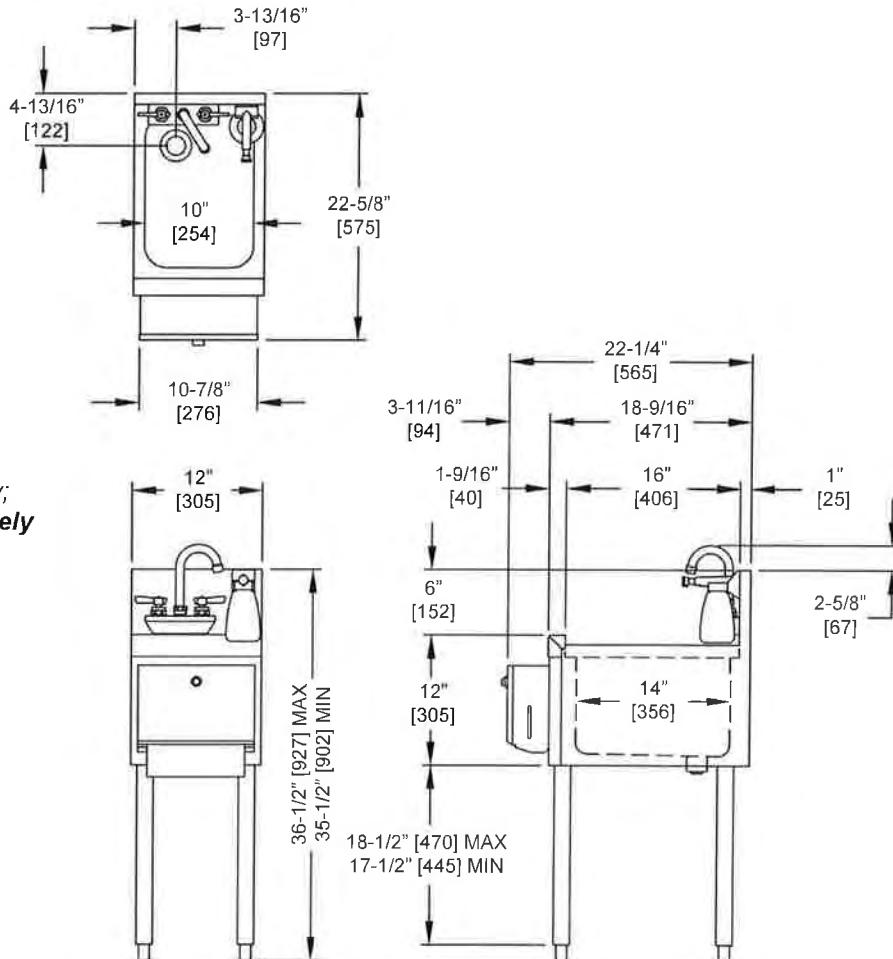
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Toll Free 800.558.5592 • E-Mail perlick@perlick.com • www.perlick.com

Size and Specifications

One Tank Sink – Stainless Steel Bowl

Job _____
 Area _____
 Item No. _____
 Model No. _____

MODEL NO.	TS12HSN
LENGTH IN. (mm)	12" (305)
SHIP WEIGHT LB. (kg)	50 (23)
TOP & SIDES	Stainless steel
BACK & BOTTOM	Stainless steel
BACKSPLASH	Stainless steel 6" high (4" high optional) with 1" return at the top, mechanically fastened and sealed to hand sink top with steel support brackets.
LEGS	1-5/8" tubular, stainless steel with 1" adjustable thermoplastic foot.
BOWL	Stainless steel with sound deadening. 10"x14"x9-1/4" deep. All horizontal and vertical edges 1-1/2" radius with balled corners. Furnished with 1-1/2" stainless steel drain socket. 8-1/2" standpipe.
WATER FAUCET	Chrome plated, hot and cold, goose neck swing spout faucet. Heavy-duty all brass construction. Must be ordered separately. Lead free faucet also available.
PLUMBING	Drain connection: 1-1/2" NPS male. Hot and cold water connection



*Faucet shown for clarity;
must be ordered separately

Form No. SK07
 Rev. 04.04.2013

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GLASS AND CHEMICAL STORAGE CABINETS

CABINETS WITH SINK

**MODELS** 7057-1 7057-3**Perlick Features**

- Wet waste sink with removable dump box
- NSF listed, commercial grade hot/cold water faucet (must be ordered separately)
- Convenient chemical storage compartment with convenient removable water tight pan that keeps chemical containers off the floor.
- Free-standing station can be used wherever efficient waste disposal, glass handling or chemical storage is needed.



GENERATIONS OF
EXCELLENCE

Form No. SB06
Rev. 09.19.2011

Perlick®

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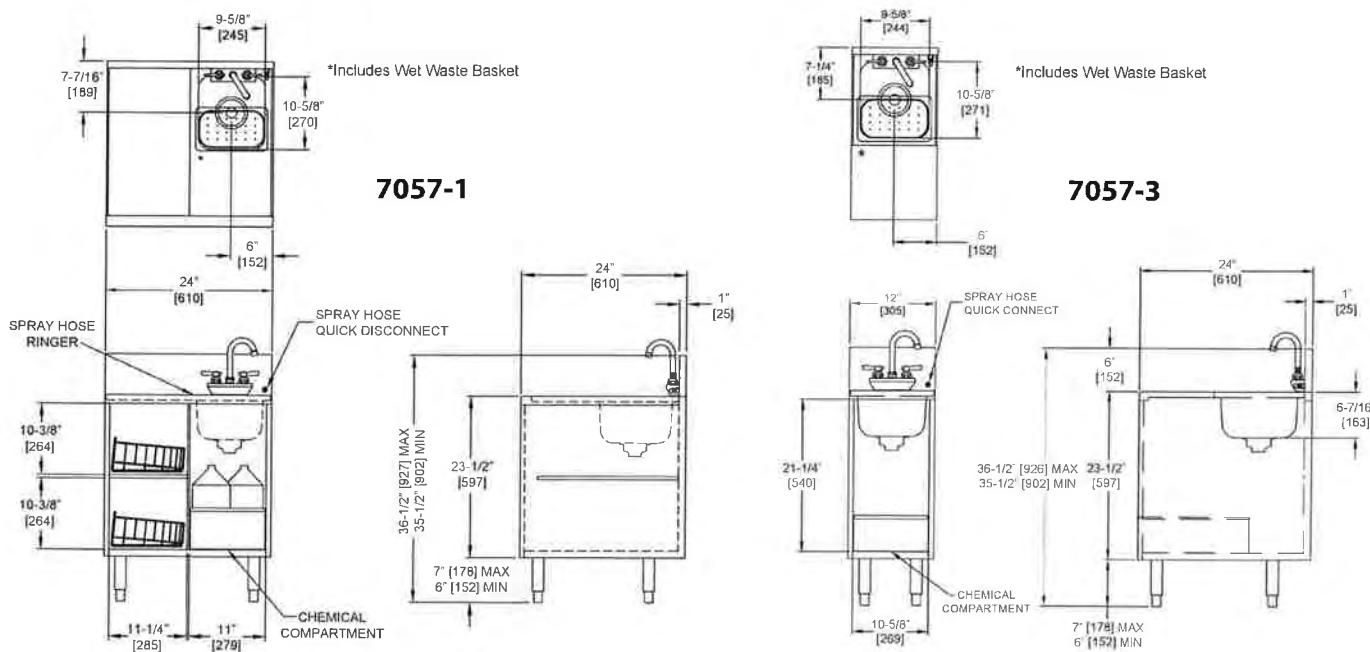
Size and Specifications

Cabinets with Sink



Job _____
 Area _____
 Item No. _____
 Model No. _____

MODEL NOS.	7057-1	7057-3
LENGTH IN. (mm)	24" (610)	12" (305)
DEPTH IN. (mm)		24" (610)
HEIGHT IN. (mm)		36-1/2" (926) max.-35-1/2" (901) min.
SHIP WT. lbs. (kg)	91 (42)	58 (26)
EXTERIOR	All exterior parts are made from stainless steel	
BACKSPLASH	Stainless steel 6" with 1" return at top, mechanically fastened and sealed with steel support brackets	
TOP	All horizontal and vertical edges 1/4" radius with balled corners. Underside reinforced with welded brackets.	
SINK	All horizontal and vertical edges 1-3/4" radius with balled corners. Furnished with 1-1/2" stainless steel drain socket and duo-strainer. 10-5/8"x9-5/8"x6". Underside sound deadened.	
WATER FAUCET	Chrome plated, hot and cold, goose-neck faucet. Heavy-duty all brass construction, Must be ordered separately . Lead free faucet also available.	
SPRAY HOSE	Black, plastic spray head with four foot reinforced vinyl hose and quick disconnect fitting	
CHEMICAL COMPARTMENT	Removable stainless steel chemical pan	
LEGS	1-5/8" tubular, stainless steel with 1" adjustable stainless steel foot	
PLUMBING	Drain connection- 1-1/2" NPS Male. Hot and cold water connection- 3/8" O.D. copper supply tubes. Spray Hose- 3/8" O.D. copper supply tube.	
OPTIONAL ACCESSORIES	Glass racks (Part No. 50470-2)	N/A



*Faucet shown for clarity;
must be ordered separately

Form No. SB06
 09.19.2011

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Toll Free 800.558.5592 • E-Mail perlick@perlick.com • www.perlick.com

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GLASSWASHERS

Perlick Features

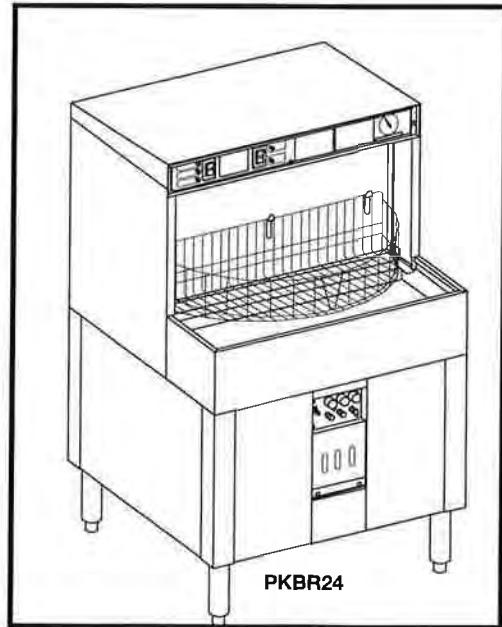
- All stainless steel construction.
- Easy to clean and maintain.
- Convenient top-mounted instrument panel is easy to see and use.
- Upper and lower wash arms with fan-spray nozzles clean glasses inside and out.
- Fill and dump cycle provides clean water for each wash cycle.
- Wash tank heater maintains water temperature between cycles.
- Pitched, vinyl-coated glass racks help drain excess water off glassware and are removable for more efficient glass handling.
- Metal divider separates the load and wash areas eliminating the need for curtains.
- Divider safety switch stops wash cycle when divider is rotated.
- Peristaltic metering pumps with hand adjusted controls dispense detergent, sanitizer, and rinse aid.
- Illuminated sight glasses permit visual inspection of chemical flows during the wash cycle.

MODEL NOS.

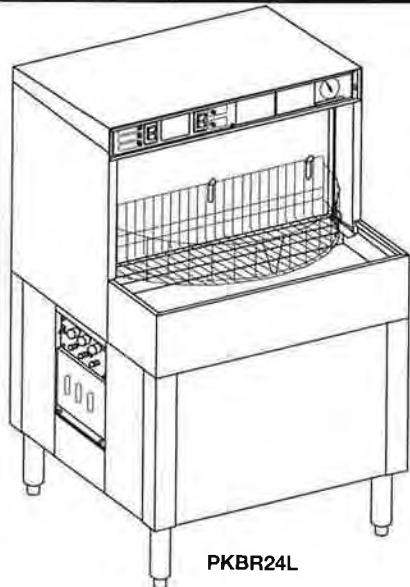
PKBR24

PKBR24L

PKBR24R



PKBR24



PKBR24L

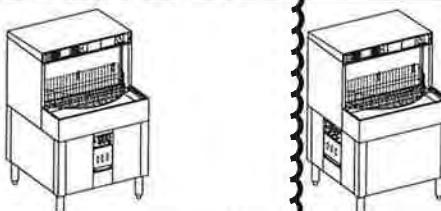


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Form No. 021497
Rev. 05.30.10

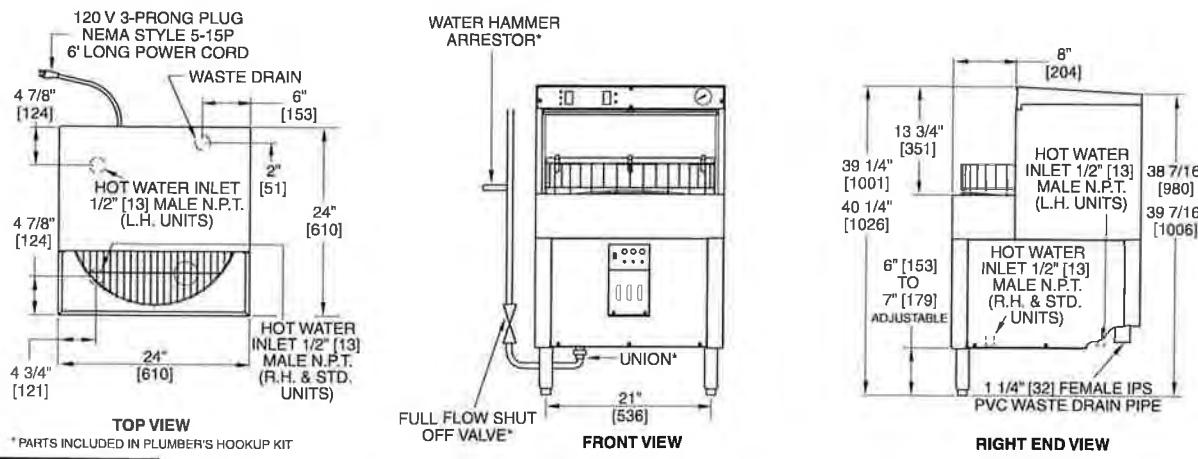
Sizes and Specifications PKBR24 Glasswashers

Job _____
Area _____
Item No. _____
Model No. _____



MODEL NOS.		PKBR24	PKBR24L	PKBR24R
CABINET DIMENSIONS	Length - Inches (mm)	24" (610)	24" (610)	24" (610)
	Depth - Inches (mm)	24" (610)	24" (610)	24" (610)
	Height - Inches (mm)	39 1/4" (1001) / 40 1/4" (1026)	39 1/4" (1001) / 40 1/4" (1026)	39 1/4" (1001) / 40 1/4" (1026)
WASH TANK CAPACITY (gallons.)		1	1	1
CYCLE TIME (seconds)		120	120	120
WASH TIME (seconds)		60	60	60
SANITIZER TIME (seconds)		35	35	35
GLASSES WASHED PER HR. (2 1/4" Dia.)		720	720	720
TANK HEATER (watts)		650	650	650
WASH PUMP CAPACITY (gals./min.)		24	24	24
DRAIN FLOW (gals./min.)		1.67	1.67	1.67
EXHAUST REQUIREMENTS		None	None	None
MAXIMUM GLASS HEIGHT		10"	10"	10"
SHIP WT lbs. (kg)		225 (103)	225 (103)	225 (103)
ELECTRICAL	120 Volt, 60 Hz., single phase AC. 5.4 amps, furnished with 6 foot power cord and standard 3 prong NEMA style 5-15P.			
PLUMBING	Hot Water Inlet Connection: 1/2" NPTM. Incoming Hot Water: 130–140° F, at 30–60 psi with a flow rate of 4.0 gal/min. Drain: 1 1/4 IPS PVC socket connection to include an air gap. Plumbers Hookup Kit: Includes water hammer arrestor, stop valve and union. Important: Failure to install the Glasswasher with Plumbers Hookup Kit can damage the hot water solenoid valve. Machine failure due to improper installation is not covered by Perlick's warranty.			
WATER HARNESS	Water containing more than 15 GPG will require a water softener. Caution: Parts failure caused by hard water are not covered under Perlick's warranty.			
DETERGENT, SANITIZER and RINSE AID	Detergent: A heavy-duty liquid warewashing detergent containing water conditioners. Chlorine Sanitizer: Any EPA registered chlorine can be used. The EPA marking can be found on the container label. Rinse Aid: A low-foaming warewashing rinse aid containing water conditioners. Note: To ensure maximum glasswasher performance. It is important to select the appropriate detergent and rinse aid for specific water conditions. These chemicals can be purchased from a local chemical supplier or food service distributor.			
OPTIONAL ACCESSORIES	<ul style="list-style-type: none"> Low sanitizer shut down kit - #61945 Glass rack - #50470-2 			

All plumbing and chemical lines must be routed so that the glasswasher can be pulled out for service.



PARTS INCLUDED IN PLUMBER'S HOOKUP KIT

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Form No. 021497
Rev. 05.30.10

GLASS AND CHEMICAL STORAGE CABINETS

CABINETS WITH RECESSED OR FLAT TOP

**MODELS** 7057-2 7057-4**Perlick Features**

- Free-standing station can be used wherever efficient glass handling or chemical storage is needed.



Form No. SB07



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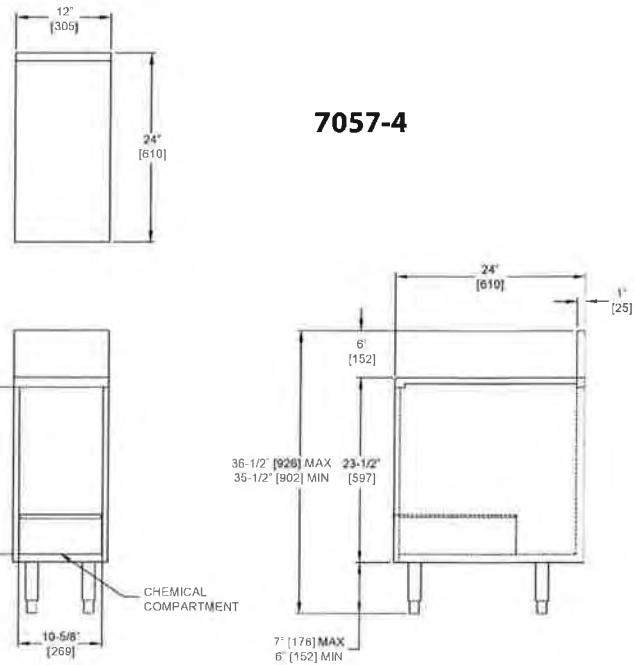
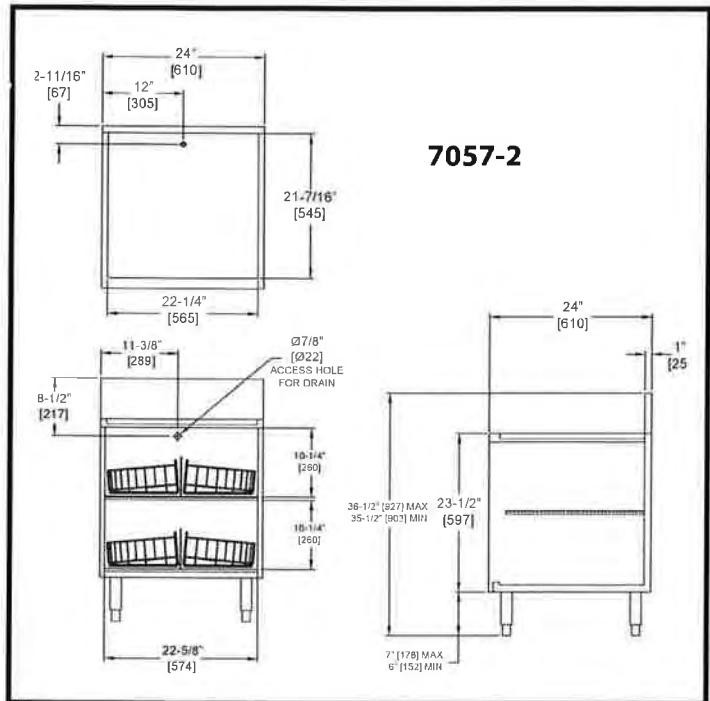
Size and Specifications

Cabinets with Recessed or Flat top



Job _____
 Area _____
 Item No. _____
 Model No. _____

MODEL NOS.	7057-2	7057-4
LENGTH IN. (mm)	24" (610)	12" (305)
DEPTH IN. (mm)	24" (610)	24" (610)
HEIGHT IN. (mm)	36-1/2" (926) max.-35-1/2" (901) min.	36-1/2" (926) max.-35-1/2" (901) min.
SHIP WT. lbs. (kg)	86 (40)	55 (25)
EXTERIOR	All exterior parts are made from stainless steel	
BACKSPLASH	Stainless steel 6" with 1" return at top, mechanically fastened and sealed with steel support brackets	
TOP	All horizontal and vertical edges 1/4" radius with balled corners. Underside reinforced with welded brackets.	
LEGS	1-5/8" tubular, stainless steel with 1" adjustable stainless steel foot	
PLUMBING	Recessed Top Panel: Drain fitting at rear for 1/2" I.D. flexible hose	N/A
CHEMICAL COMPARTMENT	N/A	Removable stainless steel chemical pan
OPTIONAL ACCESSORIES	Glass racks (Part No. 50470-2)	N/A



Form No. SB07

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CORNER FILLER SECTIONS INSIDE CORNER DRAINBOARDS



Perlick Features

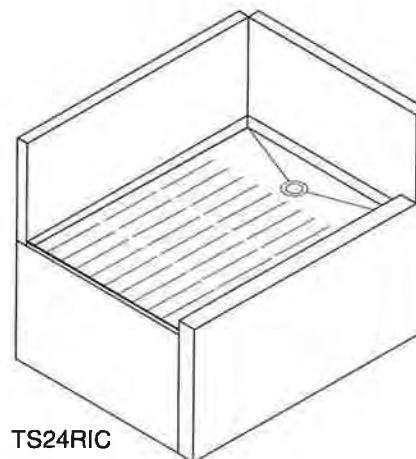
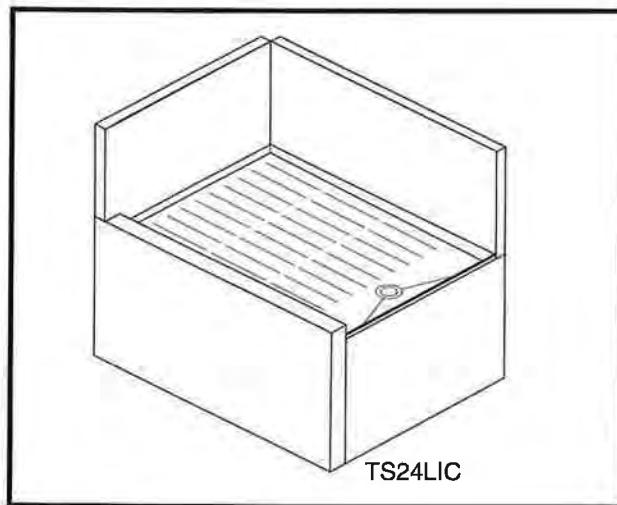
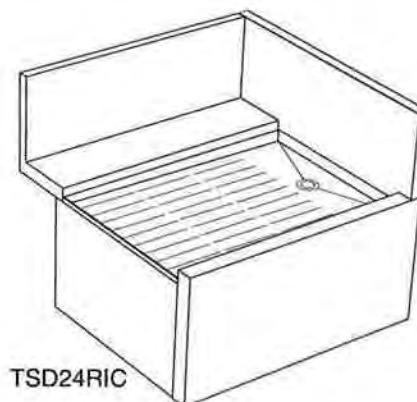
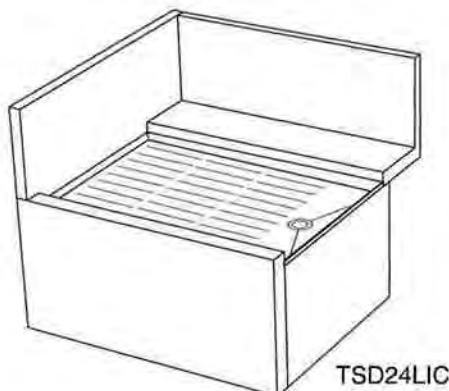
- Embossed stainless steel drainboard.
- Underside reinforced.

MODEL NOS. MODEL NOS.

TS Series

 TS24LIC TS24RIC

TSD Series

 TSD24LIC TSD24RIC

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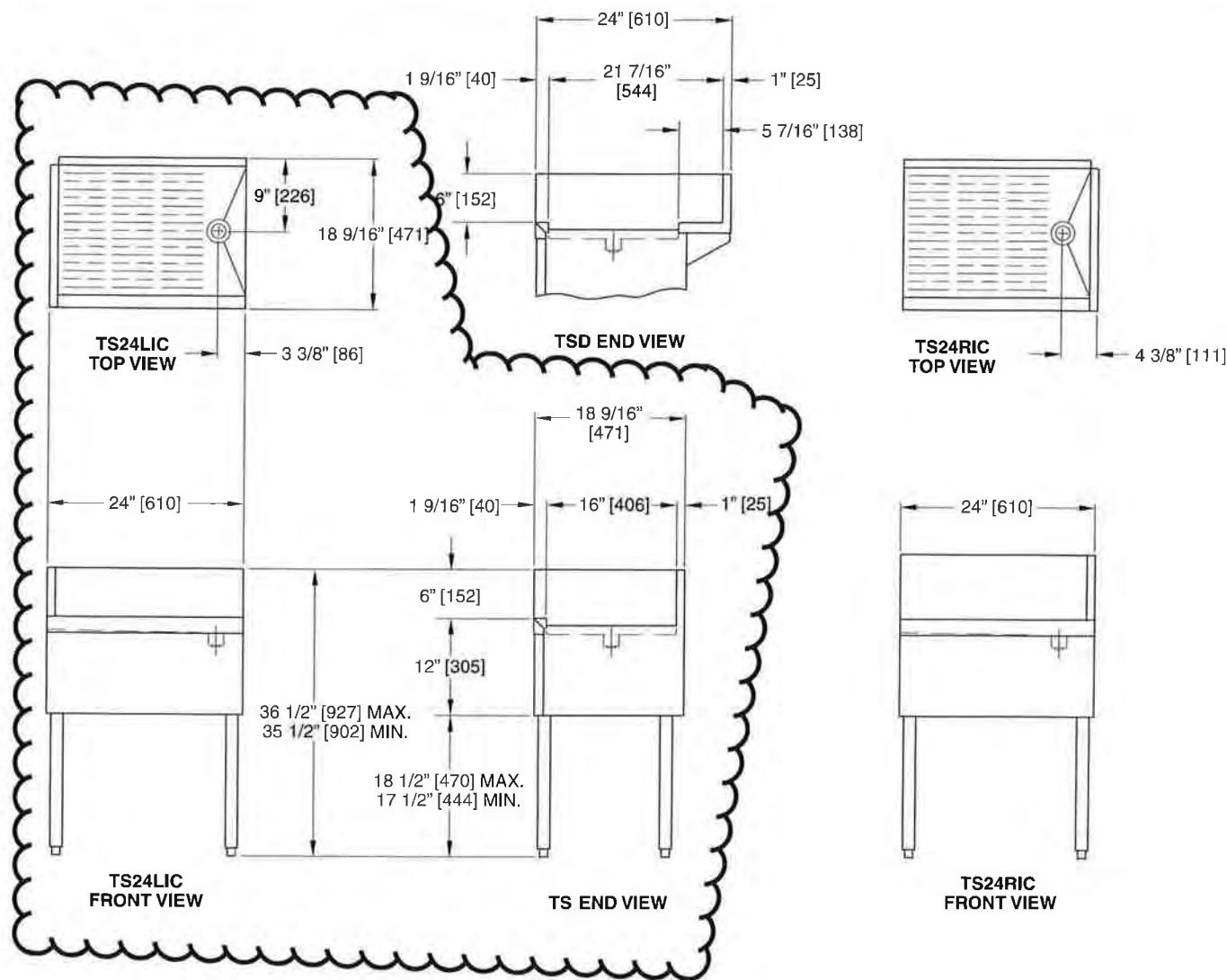
Form No. CF05
Rev. 03.30.05



Sizes and Specifications - Corner Filler Sections Inside Corner Drainboards

Job _____
 Area _____
 Item No. _____
 Model No. _____

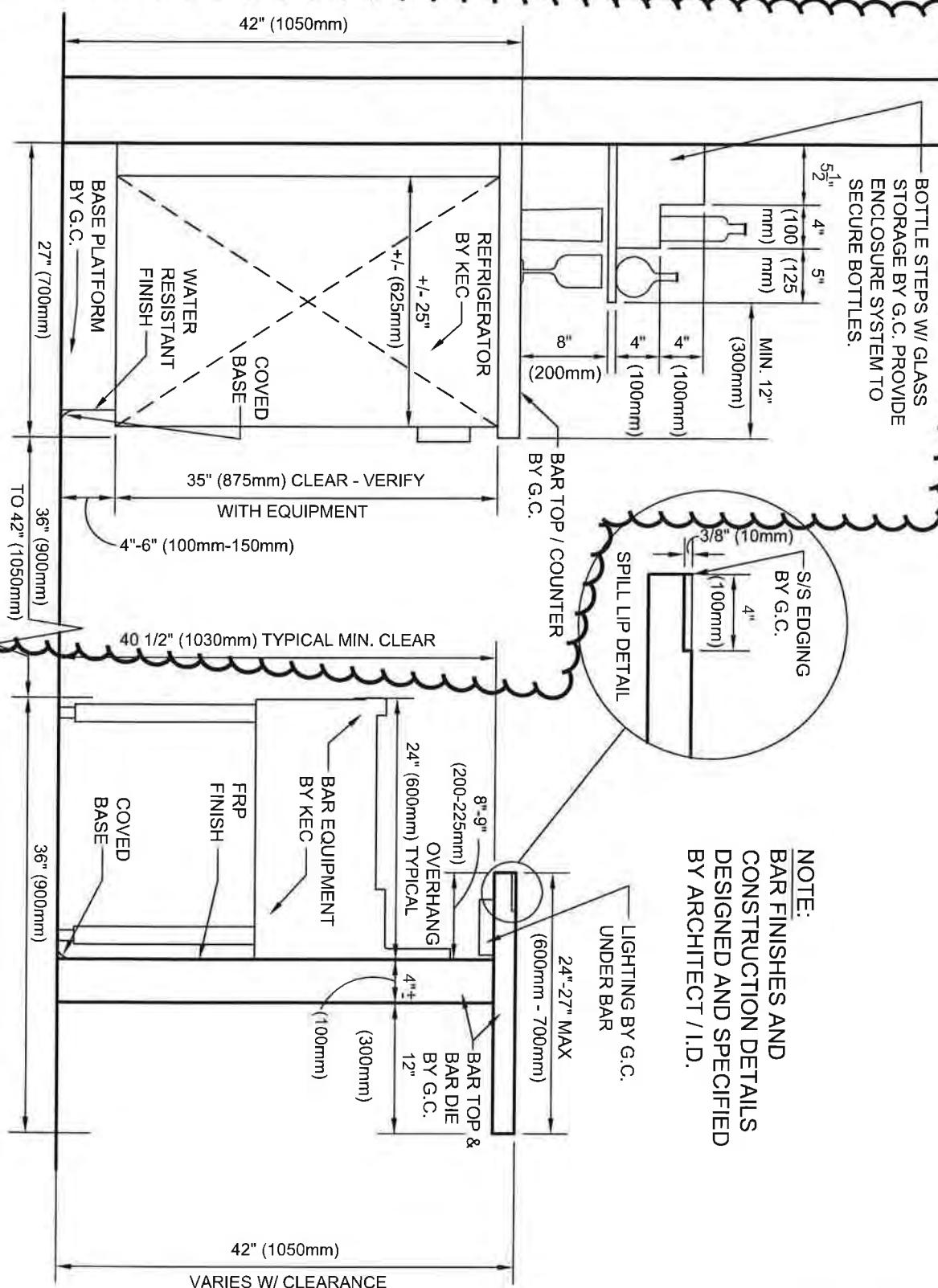
MODEL NOS.	TS24LIC	TSD24LIC	TS24RIC	TSD24RIC
DESCRIPTION	90° Left	90° Left	90° Right	90° Right
SHIP WT. lbs. (kg)	50 (23)	50 (23)	50 (23)	50 (23)
FRONT & SIDES	Stainless steel.			
BACKSPLASH	TS and General: Stainless steel 6" high (4" high optional) with 1" return at top, mechanically fastened and sealed with steel support brackets. TSD Series: Stainless steel rear deck.			
DRAINBOARD	Embossed stainless steel. All horizontal and vertical edges 1/4" radius with balled corners. Underside reinforced with welded brackets. TS Series: 16" deep front to back. TSD Series: 21 ^{7/16} " front to back. Stainless steel drain socket.			
LEGS	1 ^{5/8} " tubular, stainless steel with 1" adjustable thermoplastic foot.			
PLUMBING	Drain connection - 1 ^{1/2} " NPS Male.			



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BAR TOP & DIE

Detail

C8



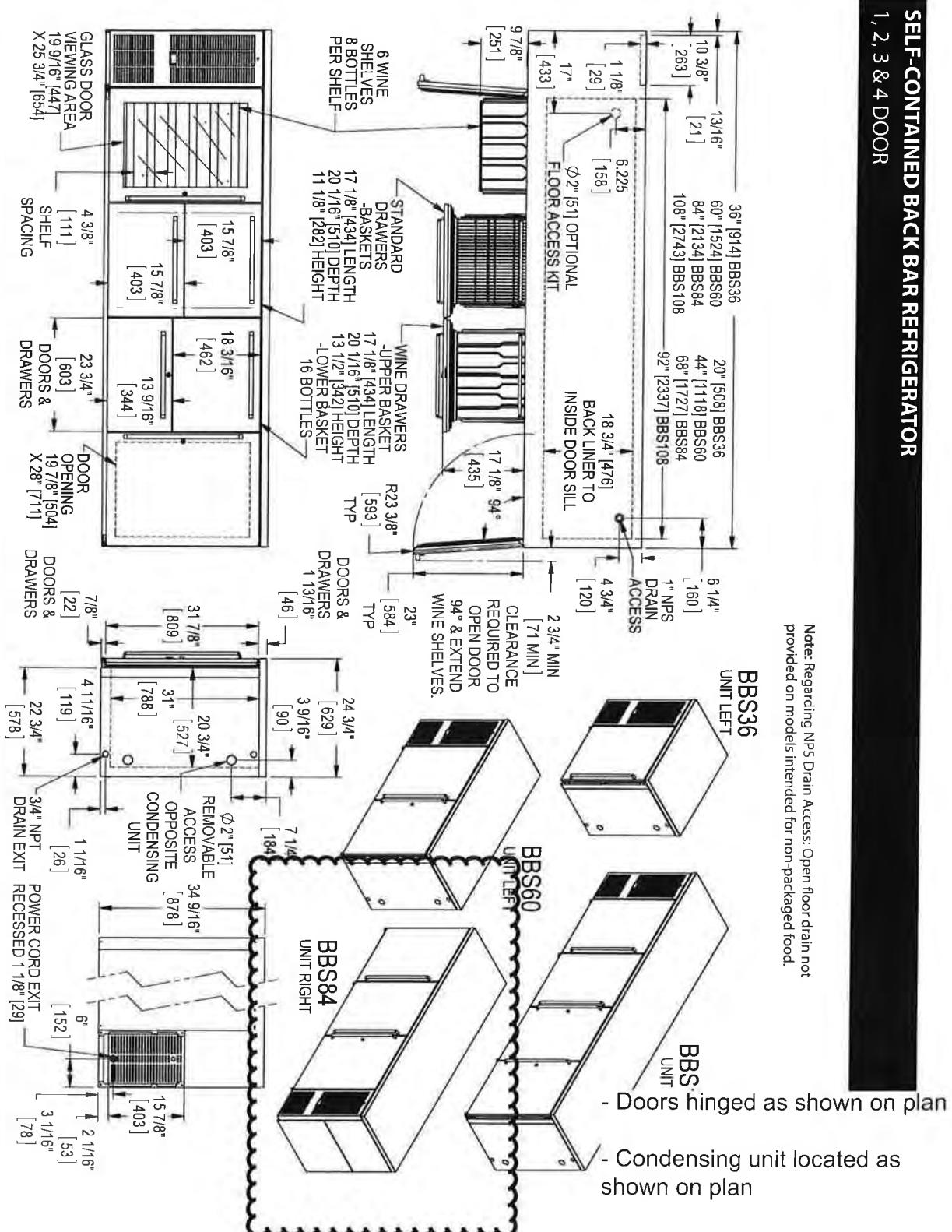
PRODUCT CUTSHEETS ► Refrigerated Cabinets

		SELF-CONTAINED BACK BAR REFRIGERATOR 1, 2, 3 & 4 DOOR												
														
														
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BBS108	4-Door Model													
MODEL NUMBERS			BBS36	BBS60	BBS84	BBS108								
NUMBER OF COMPARTMENTS			1	2	3	4								
EXTERIOR CABINET DIMENSIONS	Length - in. (mm)		36" (914mm)	60" (1524mm)	84" (2134mm)	108" (2743mm)								
	Depth - in. (mm)		24.75" (629mm)	24.75" (629mm)	24.75" (629mm)	24.75" (629mm)								
	Height - in. (mm)		34.565" (878mm)	34.565" (878mm)	34.565" (878mm)	34.565" (878mm)								
INTERIOR CABINET DIMENSIONS	Length - in. (mm)		20" (508mm)	44" (1118mm)	68" (1727mm)	92" (2337mm)								
	Depth - in. (mm)		18.75" (476mm)	18.75" (476mm)	18.75" (476mm)	18.75" (476mm)								
	Height - in. (mm)		28.5" (724mm)	28.5" (724mm)	28.5" (724mm)	28.5" (724mm)								
INTERNAL VOLUME Net. Cu. Ft. (Litres)			7.4' (210lt)	16' (453lt)	24.8' (702lt)	33.5' (949lt)								
SHIPPING WEIGHT Lbs. (kg.)			254# (115kg)	340# (154kg)	490# (222kg)	671# (304kg)								
ELECTRICAL SPECIFICATIONS	Electrical Supply		120 VAC/60 Hz/1 Ph											
	Running Load Amps		3.2	5.5	6.3	6.3								
	Electrical Connection		Cord Connected	Cord Connected	Cord Connected	Cord Connected								
	Cord Plug Type		NEMA 5-15	NEMA 5-15	NEMA 5-15	NEMA 5-15								
	Cord Length		8'	8'	8'	8'								
	Defrost Initiation		Automatic	Automatic	Automatic	Automatic								
	Defrost Type		Off Cycle	Off Cycle	Off Cycle	Off Cycle								
	Thermostat		Digital Control	Digital Control	Digital Control	Digital Control								
REFRIGERATION SPECIFICATIONS	Lighting Type		LED	LED	LED	LED								
	Horsepower		1/5	1/4	1/3	1/3								
	Refrigerant		R134a	R134a	R134a	R134a								
	Refrigerant Charge		6.5	7.0	7.0	7.0								
	Factory Temperature Setting-Refrigerator		38 (3.3)	38 (3.3)	38 (3.3)	38 (3.3)								
	Temperature Range-Refrigerator		33-40 (0.5-4.5)	33-40 (0.5-4.5)	33-40 (0.5-4.5)	33-40 (0.5-4.5)								
	Factory Temperature Setting-White Wine		50-55 (10.0-13.0)	50-55 (10.0-13.0)	50-55 (10.0-13.0)	50-55 (10.0-13.0)								
	Factory Temperature Setting-Red Wine		60-65 (15.5-18.0)	60-65 (15.5-18.0)	60-65 (15.5-18.0)	60-65 (15.5-18.0)								
	Temperature Range-Wine		50-65 (10.0-18.0)	50-65 (10.0-18.0)	50-65 (10.0-18.0)	50-65 (10.0-18.0)								
	Condensing Unit Location		Left Or Right	Left Or Right	Left Or Right	Left Or Right								
	Expansion Device		Capillary Tube	Capillary Tube	Capillary Tube	Capillary Tube								
PLUMBING	Pull Out Condensing Unit		Yes	Yes	Yes	Yes								
	Front Vented		Yes	Yes	Yes	Yes								
			Automatically	Automatically	Automatically	Automatically								

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SELF-CONTAINED BACK BAR REFRIGERATOR
1, 2, 3 & 4 DOOR

Note: Regarding NPS Drain Access: Open floor drain not provided on models intended for non-packaged food.



- Doors hinged as shown on plan

- Condensing unit located as shown on plan

- All doors to be glass with stainless steel frame

- S/S Condensing unit cover

- No legs or casters

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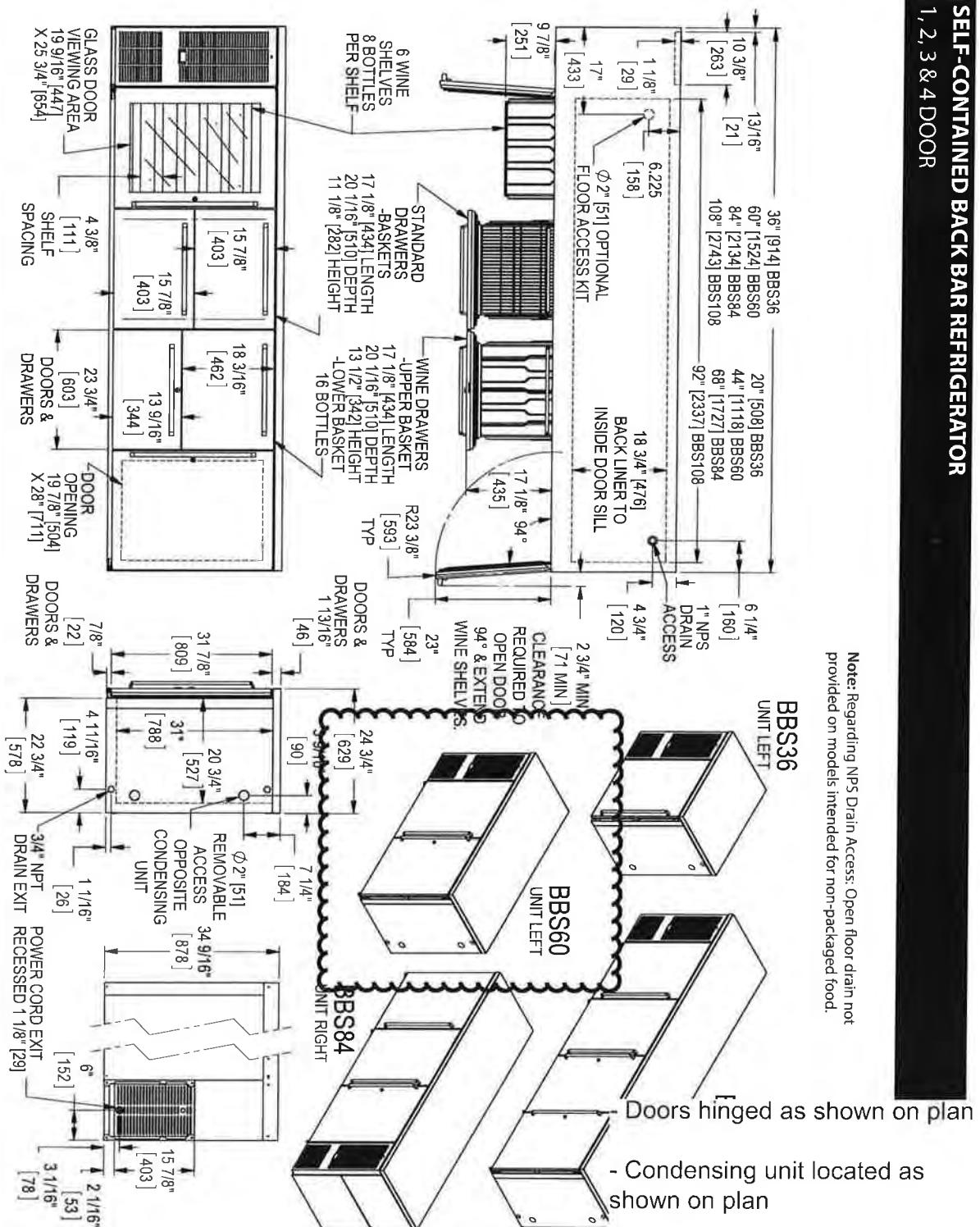
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PERLICK CORPORATION 8300 West Good Hope Road, Milwaukee, WI 53223 • (800) 558-5592 • perlick.com

**SELF-CONTAINED BACK BAR REFRIGERATOR
1, 2, 3 & 4 DOOR**

Note: Regarding NPS Drain Access: Open floor drain not provided on models intended for non-packaged food.



- All doors to be glass with stainless steel frame

- S/S Condensing unit cover

- No legs or casters

8300 West Good Hope Road, Milwaukee, WI 53223
(800) 558-5592 • perlick.com



PRODUCT SPECIFICATION SHEETS ► Tee Towers, Standard and Wide Base



- Pure copper coolant lines and cold block maintain chilled beverage temperature.
- Insulated dispensing head ensures a perfect temperature right up to the faucet.
- Factory-balanced restrictors control beverage flow and assure solid beer from the faucet with every pour.

JOB
AREA
ITEM NO.
MODEL NO.

STANDARD BASE			
4006-2B	4006-3BTF	4006-5BPC	4006-7B
4006-2B2	4006-3BTF2	4006-5BPC2	4006-7B2
4006-2B4	4006-3BTF4	4006-5BPC4	4006-7B4
4006-2BPC	4006-4B	4006-5BTF	4006-7BPC
4006-2BPC2	4006-4B2	4006-5BTF2	4006-7BPC2
4006-2BPC4	4006-4B4	4006-5BTF4	4006-7BPC4
4006-2BTF	4006-4BPC	4006-6B	4006-7BTF
4006-2BTF2	4006-4BPC2	4006-6B2	4006-7BTF2
4006-2BTF4	4006-4BPC4	4006-6B4	4006-7BTF4
4006-3B	4006-4BTF	4006-6BPC	
4006-3B2	4006-4BTF2	4006-6BPC2	
4006-3B4	4006-4BTF4	4006-6BPC4	
4006-3BPC	4006-5B	4006-6BTF	
4006-3BPC2	4006-5B2	4006-6BTF2	
4006-3BPC4	4006-5B4	4006-6BTF4	

STANDARD BASE

NUMBER OF FAUCETS	2	3	4	5	6	7
MODEL NUMBERS	Stainless Steel 4006-2B	4006-3B	4006-4B	4006-5B	4006-6B	4006-7B
	Polished Chrome 4006-2BPC	4006-3BPC	4006-4BPC	4006-5BPC	4006-6BPC	4006-7BPC
	Tarnish-Free Brass 4006-2BTF	4006-3BTF	4006-4BTF	4006-5BTF	4006-6BTF	4006-7BTF
"A", Length (mm)	9-1/8" (232)	9-1/8" (232)	11-7/8" (302)	14-5/8" (372)	17-3/8" (441)	20-1/8" (511)
Faucet Centers (mm)	5-1/2" (140)	2-3/4" (70)	2-3/4" (70)	2-3/4" (70)	2-3/4" (70)	2-3/4" (70)
"B", Standard Height (mm)	12-15/16" (329)	12-15/16" (329)	12-15/16" (329)	12-15/16" (329)	12-15/16" (329)	12-15/16" (329)
Extra high model: To add 2-5/8" to height, add a 2 suffix to model number.	15-9/16" (395)	15-9/16" (395)	15-9/16" (395)	15-9/16" (395)	15-9/16" (395)	15-9/16" (395)
Extra high model: To add 3-3/4" to height, add a 4 suffix to model number.	16-11/16" (424)	16-11/16" (424)	16-11/16" (424)	16-11/16" (424)	16-11/16" (424)	16-11/16" (424)
Shipping Weight, Lbs. (kg)	30 (13)	32 (14)	35 (15)	37 (16)	40 (18)	42 (19)
Optional Drip Pan	Top Mount - 5020 Series	5020*	5020*	5020*	5025*	5025*
	Top Mount - C18000 Series	C18640A*	C18640A*	C18640A*	C18645A*	C18645A*
	Recessed	C21379A*	C21379A*	C21379A*	C32357*/C32257*	C32357*/C32257*

* Add "TF" to Drip Pan model number for Tarnish-Free Brass finish.

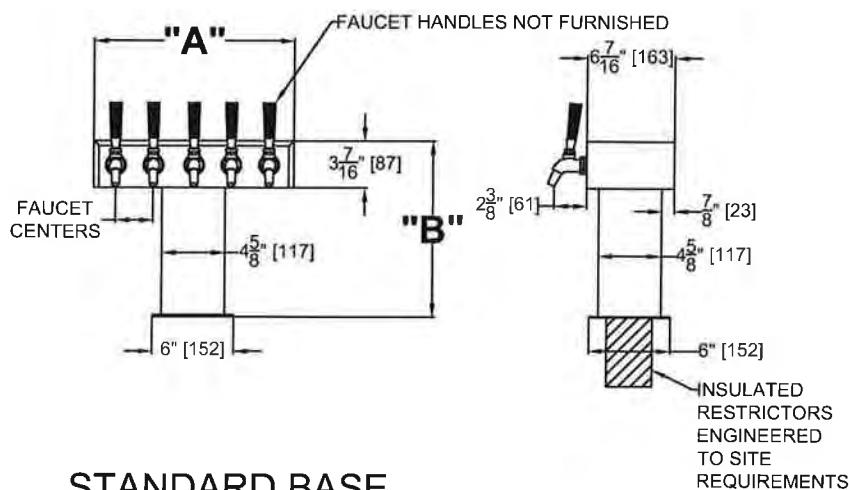
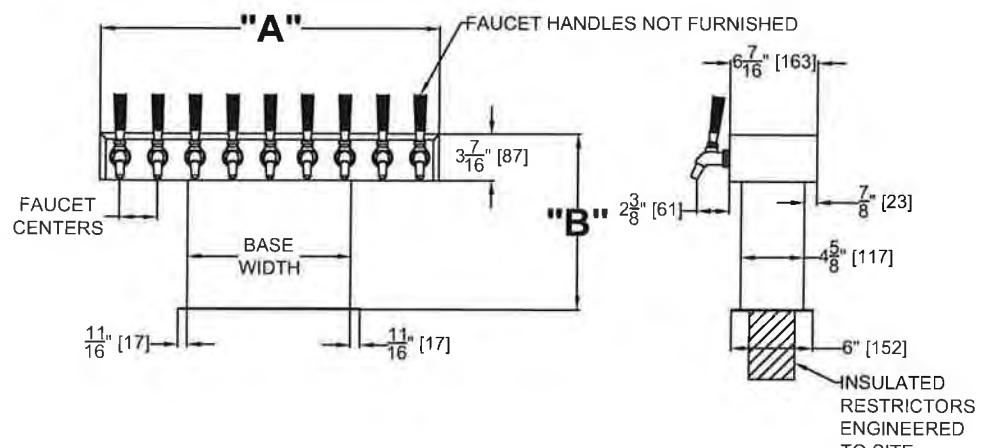
Available options:

- For NSF Approved Tee Towers, add a "N" suffix to model number
- Faucet locks

Form No. 95151
Rev. 06.18.2013

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PRODUCT SPECIFICATION SHEETS ► Tee Towers, Standard and Wide Base

TEE TOWERS
STANDARD AND WIDE BASESTANDARD BASE
TEE TOWERSWIDE BASE
TEE TOWERS

Form No. 95151
Rev. 06.18.2013

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DRIP PANS

Perlick Features

- Variety of sizes, and configurations to fit any installation.
- Available in stainless steel or tarnish-free brass.
- Removable, glass rack.

MODEL NOS.

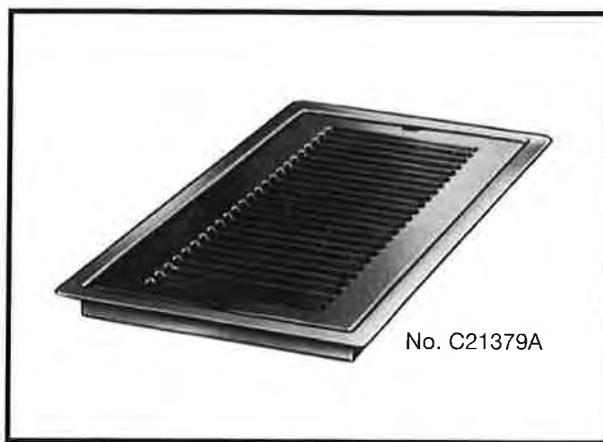
- Top-Mounted
- Angled
- Recessed
- Cutout
- Spacesaver



No. 5020



No. 18635



No. C21379A



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Toll Free 800-558-5592 • E-Mail: Perlick@Perlick.com • www.Perlick.com

Sizes and Specifications — Drip Pans

Recessed, Cutout and Spacesaver

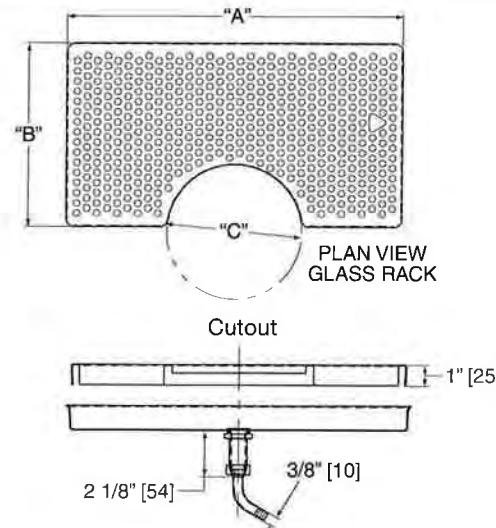
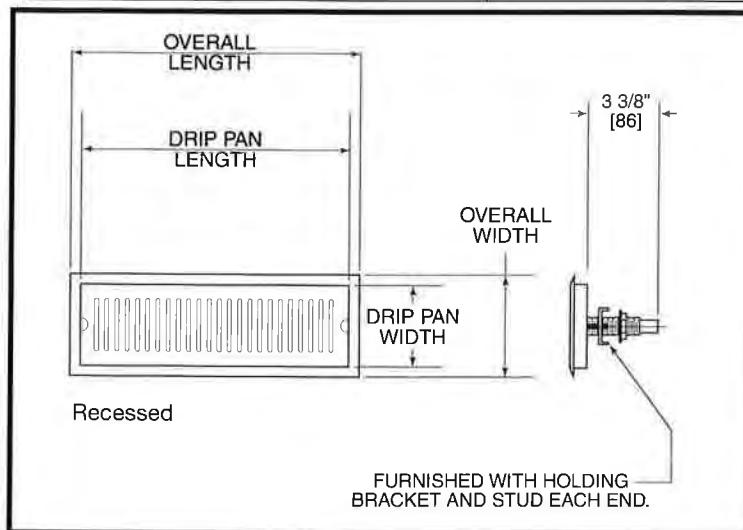
Job _____
 Area _____
 Item No. _____
 Model No. _____

RECESSED

MODEL NOS.	Stainless Steel	C11988A	C21379A	C32357	C32257	58979
	Tarnish-Free Brass	C11988ATF	C21379ATF	C32357TF	C32257TF	58979TF
OVERALL LENGTH (mm)		8 $\frac{5}{8}$ " (219)	14 $\frac{1}{16}$ " (357)	19 $\frac{1}{4}$ " (489)	20 $\frac{5}{8}$ " (524)	37 $\frac{5}{16}$ " (948)
DRIP PAN LENGTH (mm)		7 $\frac{7}{16}$ " (179)	12 $\frac{7}{16}$ " (327)	18 $\frac{3}{16}$ " (462)	19 $\frac{7}{16}$ " (494)	36 $\frac{1}{8}$ " (918)
OVERALL WIDTH (mm)		7 $\frac{5}{8}$ " (194)	7 $\frac{5}{8}$ " (194)	5 $\frac{1}{8}$ " (130)	7 $\frac{5}{8}$ " (194)	5 $\frac{1}{8}$ " (130)
DRIP PAN WIDTH (mm)		6 $\frac{7}{16}$ " (164)	6 $\frac{7}{16}$ " (164)	4" (102)	6 $\frac{7}{16}$ " (164)	3 $\frac{7}{8}$ " (98)
DRIP PAN and GLASS RACK		No. 4 finish, type 302 stainless steel or tarnish-free brass.				
PLUMBING		Equipped with $\frac{9}{16}$ " I.D. waste drain and universal drain tubes. Use with $\frac{1}{2}$ " N.P.T. pipe fittings or 1390D $\frac{1}{2}$ " I.D. flexible drain tube.				

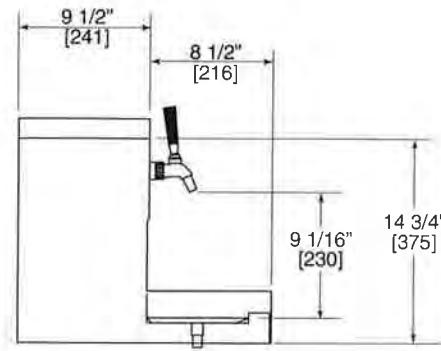
CUTOUT

MODEL NOS.	Stainless Steel	62303SS	62303	62304
	Tarnish-Free Brass	62302	62303	62304
DIMENSIONS "A" (mm)		16" (406)	19 $\frac{11}{16}$ " (500)	19 $\frac{11}{16}$ " (500)
DIMENSIONS "B" (mm)		8 $\frac{7}{8}$ " (225)	9 $\frac{7}{8}$ " (251)	9 $\frac{7}{8}$ " (251)
DIMENSIONS "C" (mm)		5 $\frac{7}{8}$ " (149)	8 $\frac{9}{16}$ " (217)	10 $\frac{1}{4}$ " (260)
DRIP PAN and GLASS RACK		Brass or stainless steel. Stainless steel glass rack.		
PLUMBING		Chrome plated brass drain and $\frac{3}{8}$ " elbow hose coupling.		



SPACESAVER DRIP PANS

MODEL NOS.	Stainless Steel	3713-1	3721-1
LENGTH (mm)	12 $\frac{7}{8}$ " (327)	21 $\frac{1}{8}$ " (537)	
DEPTH (mm)	8 $\frac{7}{8}$ " (225)	8 $\frac{7}{8}$ " (225)	
HEIGHT (mm)	14 $\frac{3}{4}$ " (375)	14 $\frac{3}{4}$ " (375)	
DRIP PAN and GLASS RACK	Stainless steel.		
PLUMBING	Equipped with $\frac{9}{16}$ " I.D.-waste drain and universal drain tubes. Use with $\frac{1}{2}$ " N.P.T. pipe fittings or 1390D $\frac{1}{2}$ " I.D. flexible drain tube.		



Spacesaver



Sizes and Specifications Compatible Heads and Drip Pans

	TOP MOUNTED										RECESSED			CUTOUT	SPACE SAVER						
	5015	5020	5025	5028	5030	C18635A	C18640A	C18645A	C18650A	C18655	C18660	57120	C11988A	C21379A	C32357	58979	62302	62303	62304	3713-1	3721-1
DRAFT ARMS																					
1 FAUCET (4010)	■					■						■									
2 FAUCET (4016)		■■					■						■		■■						
3 FAUCET (4026)		■■					■							■■							
TEE TOWERS																					
2 FAUCET (4006-2B)		■					■							■							
3 FAUCET (4006-3B)		■■					■■														
4 FAUCET (4006-4B)		■■					■■														
5 FAUCET (4006-5B)			■■					■■													
6 FAUCET (4006-6B)			■■					■■													
7 FAUCET (4006-7B)				■■					■■						■■						
8 FAUCET (4006S8B)				■■					■■												
BRIDGE TOWERS																					
8 FAUCET (4006-8B)							■■						■■								
9 FAUCET (4006-9B)							■■						■■								
10 FAUCET (4006-10B)							■■						■■								
11 FAUCET (4006-11B)							■■						■■								
12 FAUCET (4006-12B)							■■						■■								
GAMBRINUS																					
3 FAUCET (4005-3B)		■■					■■						■■		■■						
4 FAUCET (4005-4B)		■■					■■						■■		■■						
5 FAUCET (4005-5B)								■■					■■			■■					
6 FAUCET (4005-6B)																■■					
13" SPACESAVER																					
2 FAUCET (4040A2B)																			■■		
3 FAUCET (4040A3B)																		■■			
4 FAUCET (4040A4B)																		■■			
21" SPACESAVER																				■■	
2 FAUCET (4060A2B)																					■■
3 FAUCET (4060A3B)																					■■
4 FAUCET (4060A4B)																					■■
5 FAUCET (4060A5B)																					■■
6 FAUCET (4060A6B)																					■■
7 FAUCET (4060A7B)																					■■
PIPE TOWERS																					
6 FAUCET (4008-6B)							■■						■■								
8 FAUCET (4008-8B)							■■						■■								
10 FAUCET (4009-10B)								■■					■■								
12 FAUCET (4009-12B)							■■						■■								
NAPOLI																					
2 FAUCET (4053)							■■						■■								
FIRENZA																					
1 FAUCET (4051WH1B)	■■						■■						■■			■■					
2 FAUCET (4051WH2B)		■■					■■						■■			■■					
ROMA																					
3 FAUCET (4056-3B)													■■								■■
4 FAUCET (4056-4B)													■■								■■
5 FAUCET (4056-5B)													■■								■■
TORINO - COLLAR STYLE																					
1 FAUCET (4054-1B)													■■								■■
2 FAUCET (4054-2B)													■■								■■
3 FAUCET (4054-3B)													■■								■■
TORINO - BEAM STYLE																					
3 FAUCET (4055-3B)		■■					■■						■■								■■
4 FAUCET (4055-4B)		■■					■■						■■								■■
5 FAUCET (4055-5B)			■■				■■						■■								■■
6 FAUCET (4055-6B)			■■				■■						■■			■■					■■
7 FAUCET (4055-7B)				■■				■■								■■					■■

8300 West Good Hope Road • Milwaukee, WI 53223 • Phone 414-353-7060 • Fax 414-353-7069
 Toll Free 800-558-5592 • E-Mail: Perlick@Perlick.com • www.Perlick.com

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 Rev. 10.24.08

DESCRIPTION: OPEN NO.

OPEN NUMBER

CUSTOM FABRICATED BY KEC

- Stainless Steel**
- Millwork**

EXISTING EQUIPMENT

- Relocated by KEC**
- Remain In Place**

NOT IN KITCHEN EQUIPMENT CONTRACT (NIKEC)

- Equipment By Owner/Operator**
- Equipment By Vendor**
- Millwork By Architect/Interior Designer**
- Equipment by Others** _____.

REMARKS: _____

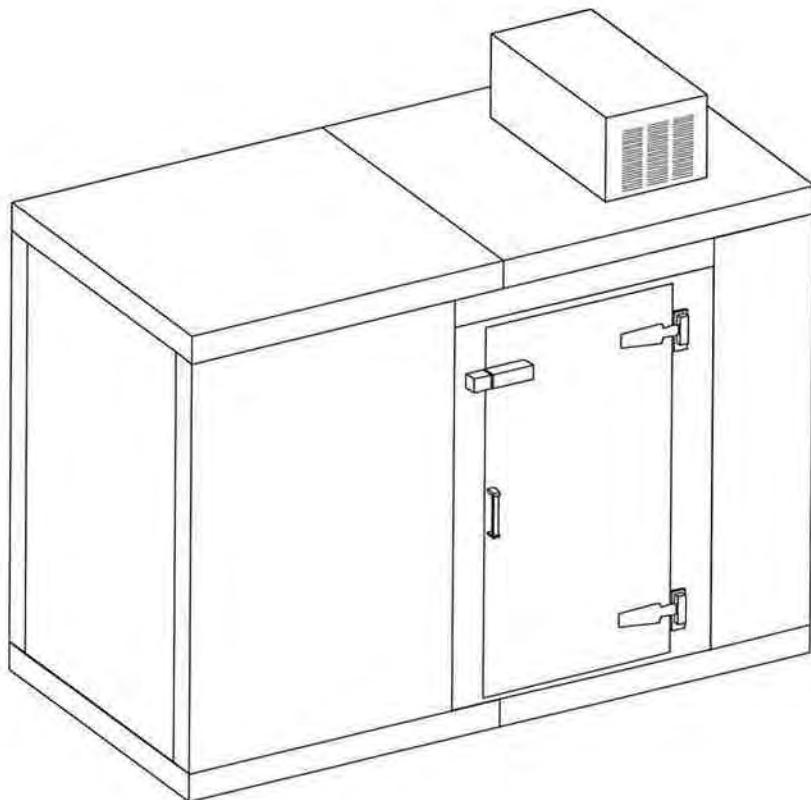
UTILITY COOLERS

Perlick Features

- Four keg and ten keg capacities; self-contained refrigeration.
- Compact size requires minimum space.
- Designed especially for draft beer keg storage.
- Efficient "cam-lock" construction for easy installation.
- Stucco-pattern galvanized steel exterior; galvanized G90 steel interior floor.
- Light "on" indicator in door.
- Flush-mounted, self-closing door with cam-lift hinges.

MODEL NOS.

US4KP
 US10KP

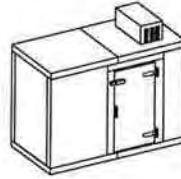
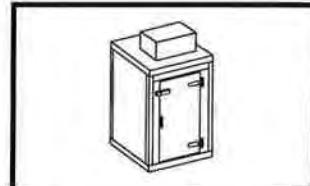


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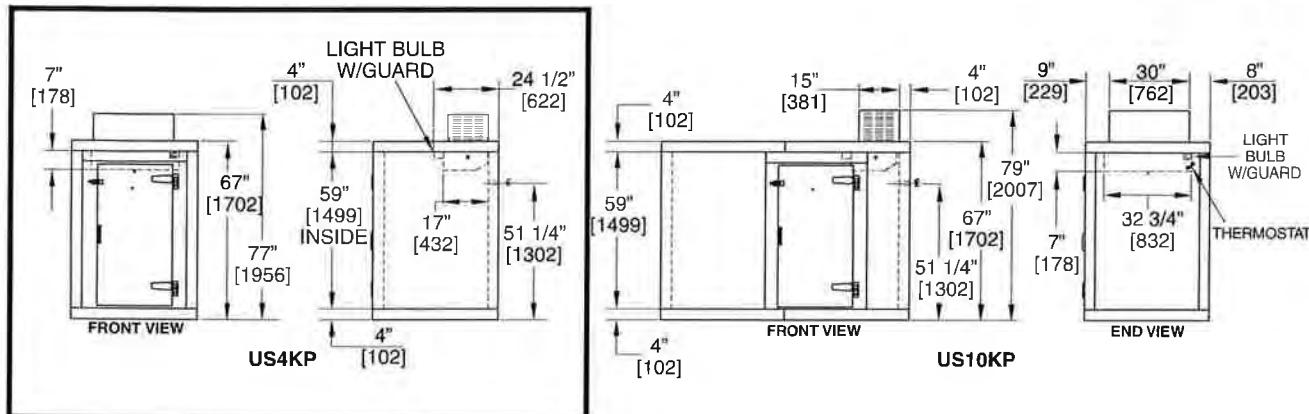
Form No. 101596
Rev. 06.03.10

Sizes and Specifications Utility Coolers

Job _____
 Area _____
 Item No. _____
 Model No. _____



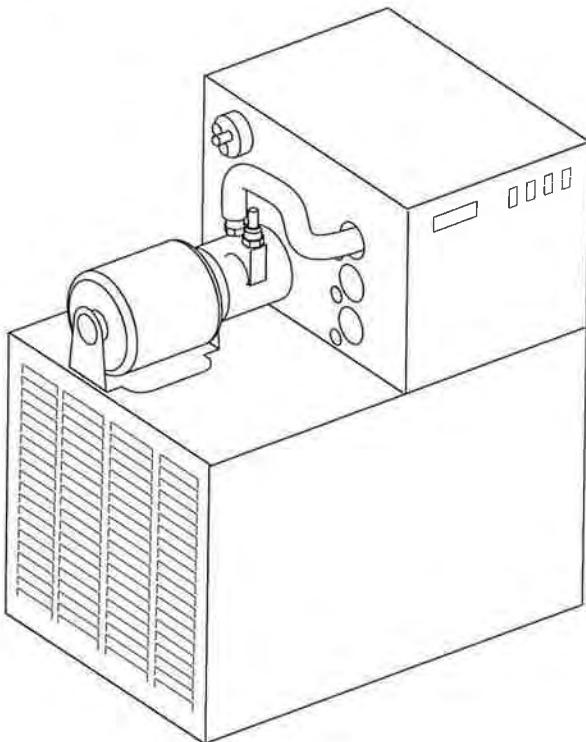
MODEL NOS.	US4KP	US10KP
CABINET DIMENSIONS	Length - Inches (mm) 47" (1194) Depth - Inches (mm) 47" (1194) Height - Inches (mm) 77" (1956)	93" (2362) 47" (1194) 79" (2007)
KEG CAPACITY	4	10
CONDENSER UNIT H.P.	1/3	1/2
FULL LOAD AMPS	8.5	10.2
MAX. FUSE	15	15
SHIP WT Lbs. (kg)	700 (318)	1150 (552)
EXTERIOR	Floor: Stucco galvanized steel. Roof, Walls & Door: Stucco galvanized steel painted grey.	
INTERIOR	Floor: Galvanized G90 steel with plywood reinforcement. Roof, Walls & Door: Painted Model: Stucco pattern galvanized steel.	
ELECTRICAL	115 Volt, 60 Hz., 1 Phase AC. Junction box provided.	
PLUMBING	Evaporator condensate drains through access hole in wall. 20" x 1/2" I.D. drain line provided.	
REFRIGERATION	R-134a refrigerant.	
INSULATION	4" UL Class 1 urethane foam. Flame Spread Rating: 25 or less. Smoke Develop Rating: 450 or less.	
DOORS	Flush-mounted with cam-lift chrome hinges, automatic door closer, magnetic gasket, chrome pull handle. Door size: 30" wide x 55" high. Right-hand hinge standard.	
FEATURES	Light "on" indicator in door. Light switch and fixture installed on evaporator. Thermometer furnished loose.	
OPTIONAL ACCESSORIES	<ul style="list-style-type: none"> • Floor Rack • Keg Shelf 	



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 Rev. 06.03.10

CENTURY SYSTEM POWER PAKS (WATER-COOLED)



MODELS

- 4404W Series
- 4410W Series
- 4414W Series
- 4420W Series

Perlick Features

- 1/3 and 1/2 and 3/4 HP 115V, and 1^{1/2} HP 230 volt models.
- 134a, constant pressure expansion valve, and condensing unit with service valves
- Adjustable electronic temperature control with digital readout.
- High efficiency, compact heat exchanger provides more efficiency for longer beer runs.
- Top mounted, close-coupled pump and 1/3 HP ball bearing motor assembly for easy service
- Factory pre-mixed glycol guarantees performance
- Optional leg kit for free standing, off the floor installation
- Optional factory-installed multiple pump kits

Form No. 121601
Rev. 04.19.2013



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Size and Specifications - Century System

Power Paks – Water-Cooled

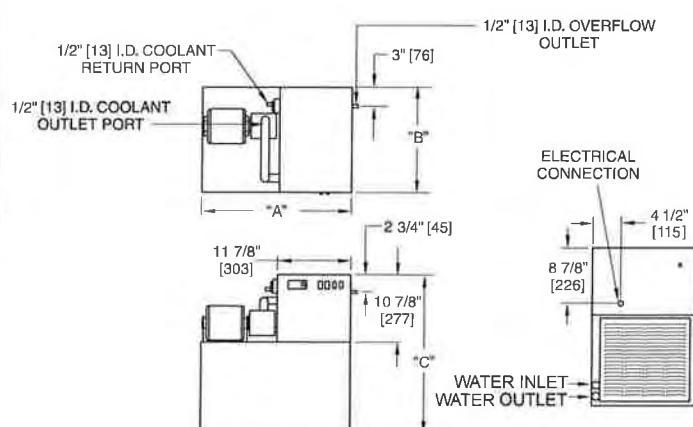
Job _____
 Area _____
 Item No. _____
 Model No. _____

MODEL NOS.	4404W	4410W	4414W	4420W
DIMENSIONS: EXTERIOR (mm)	Length "A" Width "B" Height "C"	24 ^{1/4} " (616) 17 ^{1/4} " (438) 25 ^{1/2} " (648)	24 ^{1/4} " (616) 17 ^{1/4} " (438) 25 ^{1/2} " (648)	26 ^{3/4} " (679) 20 ^{1/4} " (519) 31" (782)
	A minimum of six inches of clearance should be allowed around the entire unit for proper performance. Additional clearance should be considered for above the unit and in front of the unit for serviceability.			
	Voltage Frequency Phase	120 V 60 Hz 1 Ø	120 V 60 Hz 1 Ø	208/230 V*** 60 Hz 1 Ø
SINGLE PUMP	RLA MCA	9.7 17.8	12.7 19.9	13.4 20.4
DUAL PUMPS (add -2 to model #)	RLA MCA	N/A N/A	15.5 22.7	16.2 23.2
TRIPLE PUMPS (add -3 to model #)	RLA MCA	N/A N/A	N/A N/A	N/A 28.4
COMPRESSOR	1/3 HP			
EVAPORATOR RATING @ 20°F (BTUH)	3420			
HEAT REJECTION (MAX)	2050			
REFRIGERANT	R-134a			
SHIPPING WEIGHT LBS (kg)	141 (64)			
CABINET	Stainless Steel			
CIRCULATING PUMP	100 GPH/130 PSIG			
RESERVOIR CAPACITY	1.75 gal			
REFRIGERATION	Constant Pressure Expansion Valve, Condensing Unit with Service Valves			
REFRIGERANT CHARGE (grams)	14.5 oz / 410 g			
GLYCOL CONCENTRATION	33%			
PLUMBING REQUIREMENTS				
INLET & OUTLET	All employ 1/2" O.D. Quick Connect Fittings			
FLOW RATE (gpm) @ 75°F	0.5			
PRESSURE DROP (psig)	0.1			
MAX SUPPLY PRESSURE	All Models: Incoming Water Pressure not to exceed 150 psig			

OPTIONAL ACCESSORIES	4430 115V pump kit for 4410 Power Pak (field installed) 4431 115V pump kit for 4414 Power Pak (field installed) 4435 BLM Receptacle 4408SS Wall Bracket for 4404 & 4410 only 57782 Set of four adjustable legs 54838 Water hammer arrestor (add if incoming water is under 65°F) 61790 Dual tier rack 61791+1 Triple tier rack 61792+2 Quad tier rack C22296A-20 Cord Kit for 120V single pump Power Paks only (Field Installed) C21499BSS Stainless Steel Table Stand
-----------------------------	--

*Note: Allow a minimum of six inches of clearance on the louvered ends of the cabinet for proper air flow. Allow accessibility room on top and front of cabinet for serviceability. Above specifications are subject to change without prior approval.

***Requires four (4) wires (2 hot, 1 neutral, 1 ground)



Form No. 121601
Rev. 04/19/2013

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DESCRIPTION: Soda System

OPEN NUMBER

CUSTOM FABRICATED BY KEC

- Stainless Steel**
- Millwork**

EXISTING EQUIPMENT

- Relocated by KEC**
- Remain In Place**

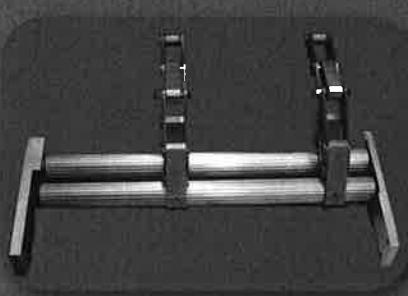
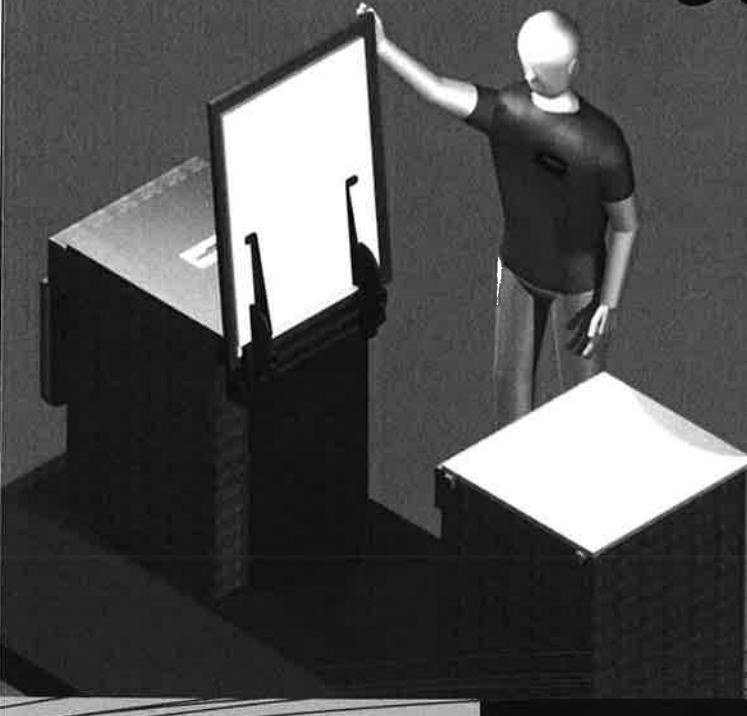
NOT IN KITCHEN EQUIPMENT CONTRACT (NIKEC)

- Equipment By Owner/Operator**
- Equipment By Vendor**
- Millwork By Architect/Interior Designer**
- Equipment by Others**

REMARKS: ELEC. DR, 120V/1PH, 20.0AMP
MECH. 1/2" CW

Counter-A-SYST

Ideal for hotels and motels, restaurants, resorts, casinos, bars and lounges, hospitals, private residences and educational institutions.



FEATURES

- **EFFORTLESS OPENING**
Neutralizes the weight of the countertop
- **SMOOTH MOTION & STOPPING**
Holds securely in open, closed and in-between positions
- **SOFTER, QUIETER CLOSING**
Weightless, providing a softer close
- **MAINTENANCE FREE**
- Manufactured without compressed gases, oils and service schedules

ALL DAY, EVERY DAY IN USE WORLDWIDE

CounterBalance now offers a unique solution for controlling the upward and downward motion of lift gate countertops. The new *Counter-A-SYST* is a torsion spring specifically engineered to neutralize the force of gravity and the weight of the lift gate. Whether the counter is open, closed or somewhere in-between the *Counter-A-SYST* allows the counter to safely balance from full open to full close.

CounterBalances are used in fast food grills, cookers, ovens, refrigerator lids and similar devices. Now this innovative product can also be used to lift countertops. Easy installation instructions assure minimum effort to install *Counter-A-SYST* in most granite, wood and synthetic conventional lift gate countertops.

1025 Louis Drive Warminster, PA 18974
1070 Endeavor Ct. N. Venice, FL 34275

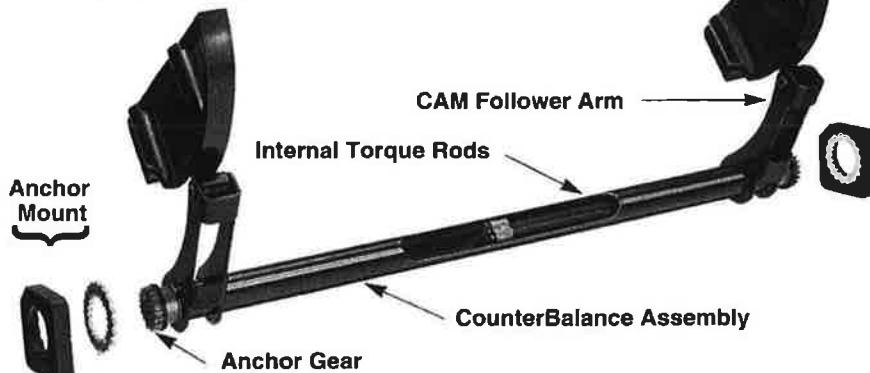
Tel 215.957.9260 Fax 215.957.9263 WWW.CBAL.COM

CounterBalance

Safe. Silent. Reliable.

CounterBalance

The CounterBalance is a modular torsion-spring system designed to take all the effort out of lifting and supporting lids, covers and electro-mechanical equipment. By carefully controlling the release of spring energy to precisely counteract the downward force of gravity, the system does more than just hold the lid open. It exactly balances the load in every intermediate position as well. Silently. Safely. Reliably.



As shown above, the CounterBalance consists of three basic elements. The CounterBalance torque tube assembly incorporating torque rods and cam followers, the anchor mount hardware to retain the assembly . . . and the cam assemblies.

While the CounterBalance provides support and control for all kinds of hinged loads, it does not function as the hinge. In fact, the central axis of the CounterBalance must be displaced from the main pivot axis of the lid in order to set up the conditions for relative motion that make the cam effective.



CB160 provides unobstructed access.

The cam shape is defined by the requirements of each application.

The torsion rods are allowed to untwist at a very specific (and continuously varying) rate as the lid opens. Where perfect balance is desired, the force delivered to the cams correctly neutralizes the effect of gravity, in every position.

The CB160 is compact, light-weight and ideal for light covers and lifting.

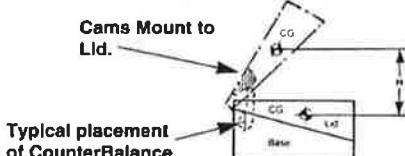
The CB222 is designed for medium-sized applications and is suitable for aircraft or business machines, etc.

The CB318 is for large lids or complex electro-mechanical and hydraulic equipment.

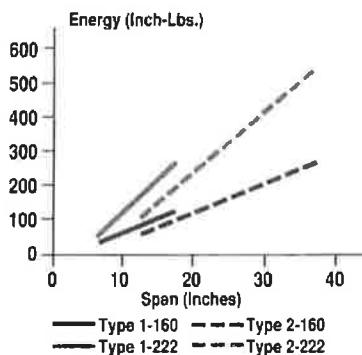
Furthermore, CounterBalance Corporation can provide unique design, construction and operational solutions for the most demanding applications.

To identify the CounterBalance series most likely to meet your requirements, simply multiply the weight of the load you desire to support by the vertical distance through which your CG travels.

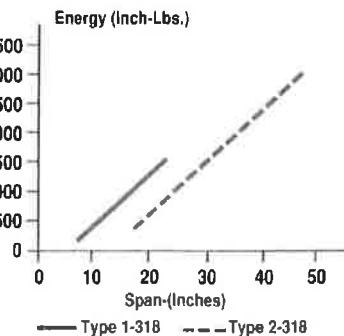
$$\text{Load Rating} = \text{Weight} * \text{Height}$$



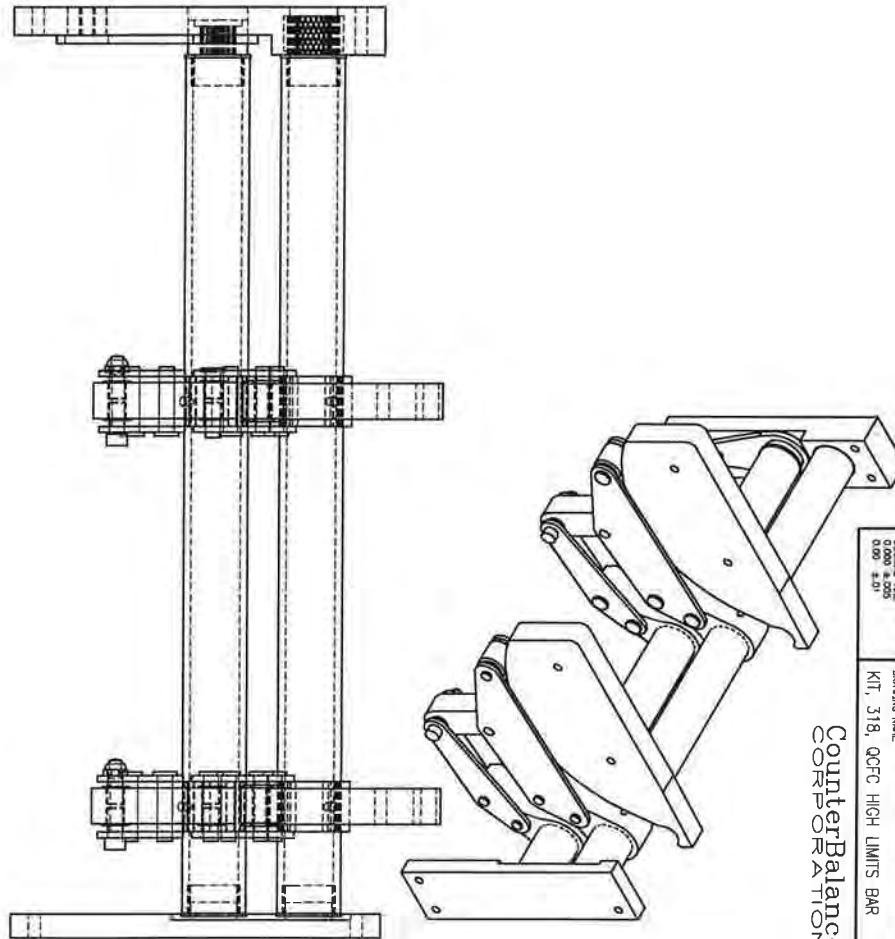
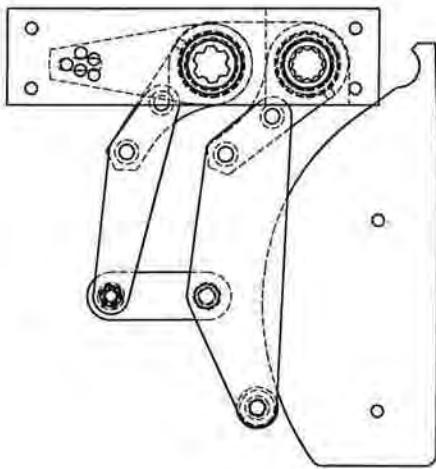
Load Rating CB160/CB222



Load Rating CB318



K2588	Component	Description
BR4217	BRACKET,318,ALU,ANCHOR, QFC	Qty Req
BR4218	BRACKET,318,ALU,PIVOT, QFC	1.0000000
C2588	CAM,318,ALU,QUALITY CABINET	EA
CB2588	CB,318,2,ARM,1,BDL,19,125,ALU	1.0000000
CB2589	CB,318,2,ARM,1,BDL,18,540,ALU	EA
F1115	SHOULDER BOLT,5/16 X 1.25	1.0000000
F1116	ACORN NUT,HEX,1/4-20	EA
F1120	JAM NUT,STEEL,CZ,1/4-20	2.0000000
F1223	SHCS,1/4-20 X 1/2,LOW HEAD	EA
F1240	CABLE TIE,NATURAL,11 INCH	1.0000000
P130F	CARTON,160,275,D/W,PRINTED	2.0000000
		0.2500000



MATERIAL	INITIALS	DRAWING NUMBER	REVISION
SFE BOM	GSF	K2588	=A
DESIgnal TOL:	DRAWING NAME:		FIRST DATE:
0.000 ± .005	KIT, 318, QFC HIGH LIMITS BAR		23-DEC-08
0.000 ± .010		LAST DATE:	
		K RELEASED	
			23-DEC-08

CounterBalance
CORPORATION

CounterBalance Series CB 318

CB 318 is a modular design Counter-Balance which can be configured to handle a wide range of load support situations. Each CB 318 consists of three module elements:

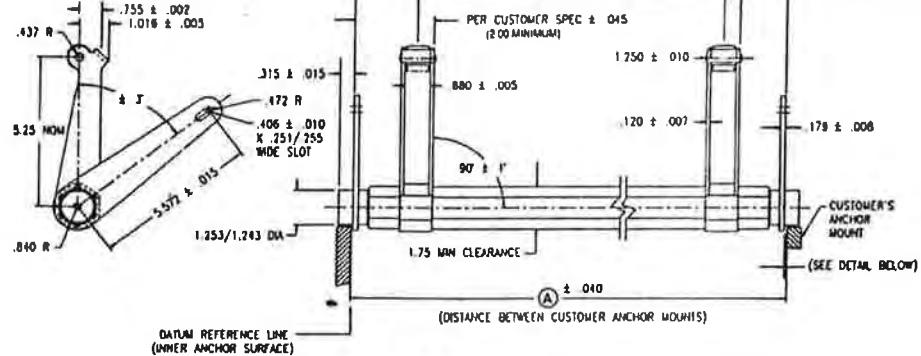
1. CounterBalance Assembly - the support assembly complete with cam followers, torque tube, and anchor gears.

2. Cams - cams are fabricated to specific requirements of each application.

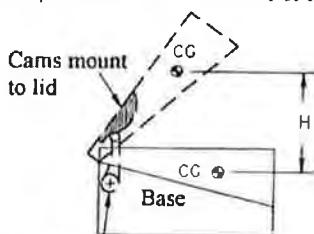
3. Anchor Plates - paired left and right anchor plates retain CounterBalance assembly and assure precise indexing. Anchor plates are affixed to structure ensuring sufficiently rigid installation.

To identify the CounterBalance series most likely to meet your requirements, simply multiply the weight of load you desire to support by the vertical distance through which your CG travels, as shown at right.

We recommend that initial considerations avoid the upper limit capabilities hereby permitting some variation of weights and cg location.



The Series 318 is offered in customized lengths ranging from 8 to 48 inches. The longer the unit, the greater the load it can support. Keep in mind that the unit must be placed parallel to the hinge axis of your enclosure, within about two inches of that axis.

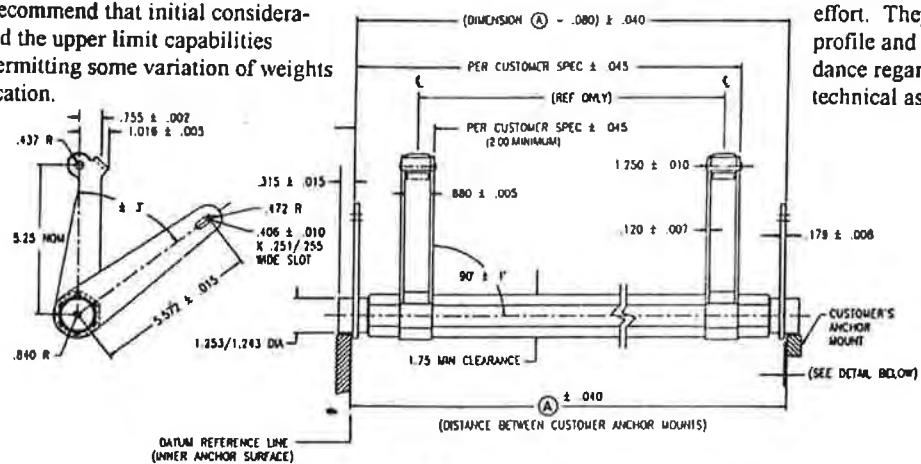


$$\text{Load Rating} = \text{Weight} \times \text{Height}$$

After the CounterBalance is selected and physical installation assured, the exact motion profile should be designated. Neutral balance may be chosen for the entire range of motion, or varying degrees of upward or downward bias may be specified for segments with the arc of motion. Detents may be designed into the cam to hold the lid firmly at selected positions. "Pop-open" or "snap-shut" are additional possibilities.

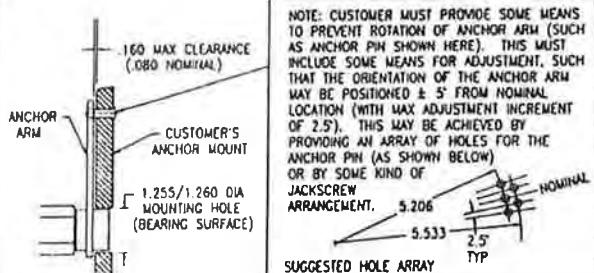
Cam elements, which usually mount to the lid, determine motion profile. Two arms and two cams are generally used, with the arms normally located near the ends of the unit (note minimum distances). It is not necessary to space the cam follower arms symmetrically.

Please consult our application engineers for assistance and clarification, especially during the preliminary state of your design effort. They will determine the correct cam profile and provide you with valuable guidance regarding mounting techniques. For technical assistance, phone (215) 957-9260.



MOUNTING DETAIL

NOTE: CUSTOMER IS RESPONSIBLE FOR DESIGN AND MANUFACTURE OF ANCHOR MOUNTS. THE COUNTERBALANCE IS DIMENSIONED SUCH THAT NOMINAL CLEARANCE BETWEEN ANCHOR ARMS AND CUSTOMER'S ANCHOR MOUNTS IS .080 (TO ACCOMMODATE MANUFACTURING TOLERANCES) IF CUSTOMER CANNOT MAINTAIN ± .040 BETWEEN ANCHOR MOUNT SURFACES (SEE DIMENSION "A" ABOVE), SOME KIND OF SHIMMING ARRANGEMENT SHOULD BE CONSIDERED TO PREVENT EXCESSIVE CLEARANCE IN WORST-CASE INSTALLATIONS. EXCESSIVE CLEARANCE CAN LEAD TO FAILURE AT MOUNTS DUE TO HIGH LOCAL LOADING RESULTING FROM INSUFFICIENT BEARING SURFACE CONTACT.



How to specify your requirements

To determine whether a CounterBalance can be configured to meet your specific requirements, our engineering staff will need the following information. Please do not hesitate to call if you have any questions regarding completion of this form:

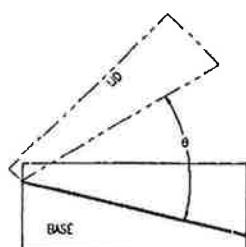


Figure 1 Side View

- 1.** First, we'll need the total lid opening (in degrees) of your hinged element which is designated as "θ". This angular movement is measured from the fully closed position (not from horizontal unless your load lies exactly horizontal in the fully closed position).

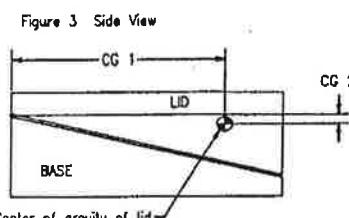
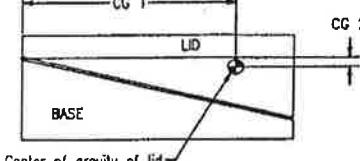


Figure 3 Side View



- 3.** We'll need the horizontal and vertical distances which separate your hinge axis from the center of gravity of the hinged load, designated CG₁ and CG₂, respectively. It is important to try to determine the actual position of the CG as accurately as possible. (When

the CG lies below the hinge axis, as shown, CG₂ will be negative.)

- 2.** We'll need the total usable span available within your enclosure (designated "S") for installation of our unit. The available span must lie within about two inches of your hinge axis. The longer the span, the better the chances that a CounterBalance can be configured to meet your needs.

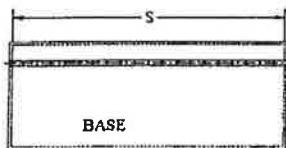


Figure 2 Rear View

- 4.** We'll need the total weight of your hinged element (designated "W"), including any components which mount to that element. This is the total load that our CounterBalance will be supporting. To determine this weight, remove your lid entirely from your enclosure, and suspend it from a scale or force guage as shown.



Figure 4

THE SPECIFIC INFORMATION WE'LL NEED TO GET YOU STARTED:

_____ Lid opening (deg.)

_____ Expected usage (cycles/yr.)

_____ Available span (in.)

_____ Expected volume (units/yr.)

_____ CG₁-horizontal (in.)

_____ CG₂-vertical (in.)

(may be negative)

MOTION CONTROL CHOICES:

- Neutrally balanced
- Detent at full-open position
- Intermediate detent (s)

- "Pop-open"
- "Snap-shut"

_____ Weight (lbs.)
(hanging free, including attached components)

Phone (215) 957-9260

CounterBalance Corporation
1025 Louis Drive
Warminster, PA 18974

Fax (215) 957-9263


INDIGO[®]

Indigo™ Series 322 Ice Cube Machine

Model: ID-0322A IY-0324A ID-0323W IY-0325W



Filtered water
from item V3,
water filter

Indigo Series i-322
Ice Machine on B-320 Bin

Designed for operators who know that ice is critical to their business, the Indigo™ Series ice machine's preventative diagnostics continually monitor itself for reliable ice production. Improvements in cleanability and programmability make your ice machine easy to own and less expensive to operate.

- **Space-Saving Design** – Up to 350 lbs. (159 kgs.) daily ice production and only 22" (55.88 cm) wide.
- **Intelligent Diagnostics** – provide 24 hour preventative maintenance and diagnostic feedback for trouble free operation.
- **Acoustical Ice Sensing Probe** – for reliable operation in challenging water conditions.
- **EasyRead Display** – communicates operating status, cleaning reminders, and asset information through a blue illuminated display.
- **Programmable Ice Production** – by On/Off Time, Ice Volume or Bin Level (with accessory bin level control) further improves energy efficiency and savings.
- **Easy to Clean Foodzone** – Hinged front door swings out for easy access. Removable water-trough, distribution tube, curtain, and sensing probes for fast and efficient cleaning. Select components made with AlphaSan® antimicrobial.
- **DuraTech™ Exterior** – provides superior corrosion resistance. Stainless finish with innovative clear-coat resists fingerprints and dirt.
- Available **Luminice™ Growth Inhibitor** controls the growth of bacteria and yeast within the foodzone.

Ice Machine Electric

115/60/1 standard.
(208-230/60/1 and 230/50/1 also available)

Minimum circuit ampacity:
Air-cooled: 11.5 1ph
Water-cooled: 10.7 1ph

Maximum fuse size:
Air-cooled: 15 amps
Water-cooled: 15 amps

Specifications

BTU Per Hour:
3,300 (average) 4,500 (peak)

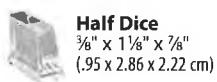
Refrigerant:
R-404A CFC-free

Operating Limits:

- Ambient Temperature Range:
35° to 110°F (1.7° to 43.3°C)
- Water Temperature Range:
35° to 90°F (1.7° to 32.2°C)
- Water Pressure Ice Maker
Water In:
Min. 20 psi (137.9 kPa)
Max. 80 psi (551.1 kPa)

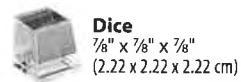


Ice Shape



Half Dice

¾" x 1 ½" x ¾"
(.95 x 2.86 x 2.22 cm)



Dice

¾" x ¾" x ¾"
(2.22 x 2.22 x 2.22 cm)



AMERI RECOGNIZED



2110 South 26th Street
PO Box 1720
Manitowoc, WI 54221-1720 USA

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Indigo™ Series 322 Ice Cube Machine

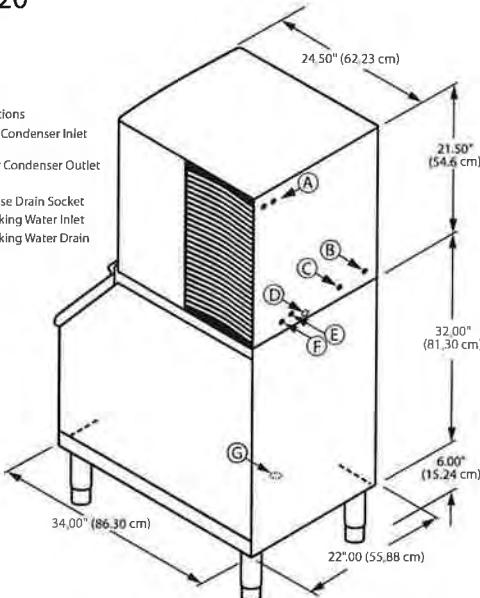


Indigo™ Series 322 Ice Cube Machine

i-322 on B-320 Storage Bin

- (A) Electrical Entrance (2) Options
- (B) 3/8" (0.95 cm) F.P.T. Water Condenser Inlet (water-cooled units)
- (C) 1/2" (1.27 cm) F.P.T. Water Condenser Outlet (water-cooled units)
- (D) 1/2" (1.27 cm) Auxiliary Base Drain Socket
- (E) 3/8" (0.95 cm) F.P.T. Ice Making Water Inlet
- (F) 1/2" (1.27 cm) F.P.T. Ice Making Water Drain
- (G) 3/4" (1.91 cm) Bin Drain

Installation Note
Minimum installation clearance:
Top/side: 12" (30.50 cm)
Back is 5" (12.7 cm)



Space-Saving Designs



	i-322 B-320	i-322 B-420
Height	59.50" 151.13 cm	71.50" 181.61 cm
Width	22.00" 55.88 cm	22.00" 55.88 cm
Depth	34.00" 86.30 cm	34.00" 86.30 cm
Bin Storage	210 lbs. 95 kgs.	310 lbs. 141 kgs.

Height includes adjustable bin legs 6.00" to 8.00", (15.24 to 20.32 cm) set at 6.00" (15.24 cm).

Specifications

	Model	Ice Shape	Ice Production 24 Hours		Power Usage kWh/100 lbs. @90°F Air/70°F	Water Usage/100 lbs. 45.4 kgs. of Ice	ENERGY STAR®
			70°F Air/ 50°F Water	90°F Air/ 70°F Water			
AIR-COOLED	ID-0322A	dice	335 lbs. 152 kgs.	225 lbs. 102 kgs.	7.49	23.9 Gal. 90.5 L	
	IY-0324A	half-dice	350 lbs. 150 kgs.	230 lbs. 104 kgs.		23.9 Gal. 90.5 L	
WATER-COOLED	ID-0323W	dice	330 lbs. 150 kgs.	270 lbs. 122 kgs.	6.19	23.9 Gal. 90.5 L	NA
	IY-0325W	half-dice	350 lbs. 159 kgs.	290 lbs. 132 kgs.		23.9 Gal. 90.5 L	

* Water-cooled Condenser Water Usage / 100 lbs. / 45.4 kgs. Of Ice: 193 gal/731 L.

* Water-cooled models are excluded from ENERGY STAR qualification.

Order ice storage bin separately.

.442 GPM of
CTW required

Accessories

LuminIce™ Growth Inhibitor
reduces yeast and
bacteria growth for a
cleaner ice machine.



Bin Level Control
Allows ice bin level
to be automatically
set. Built-in LED light
illuminates bin.



Arctic Pure® Water Filters
Reduces
sediment and
chlorine odors for
better tasting ice.



AuCS®
schedules and
performs routine ice
machine cleaning
automatically.





SPA-160 • SFA-191 Ice Dispensers

Model

SPA-160 SFA-191

ONLY 22" WIDE



SPA Model

Designed for ice bucket filling in hotels, motels, and resorts

Ice only dispense, with coin-op and room card dispensing control options

Indigo Series 522 Ice Machine
SPA-160 Ice Dispenser



SFA Model

Designed for "large" container ice filling. Accepts up to 10.5" (26.67 cm) high container

Built-in water valve



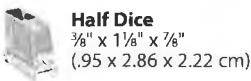
Standard Features

- 120 lbs. (54.4 kgs.) ice storage capacity. Accepts 22" (55.88 cm) wide Manitowoc ice machine.
- Only 22" (55.88 cm) wide, 31" (78.7 cm) deep, and 75.5" high (191.77 cm).
- Patented rocking chute dispense mechanism reduces in-flight ice and ice spillage with quick on/off activation.
- Efficient built-in agitator assures 100% dispensing. Oversized drain pan collects larger quantity of ice overflow.
- DuraTech™ exterior provides superior corrosion resistance. Stainless finish with innovative clear-coat resists fingerprints and dirt.

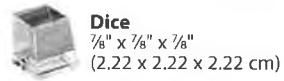
Warranty

- 5-year parts and 5-year labor coverage on ice machine evaporator.
- 5-year parts and 3-year labor coverage on ice machine compressor.
- 3-year parts-and-labor coverage on all other ice machine and dispenser components.

Ice Shape



Half Dice
3/8" x 1 1/8" x 7/8"
(.95 x 2.86 x 2.22 cm)



Dice
7/8" x 7/8" x 7/8"
(2.22 x 2.22 x 2.22 cm)



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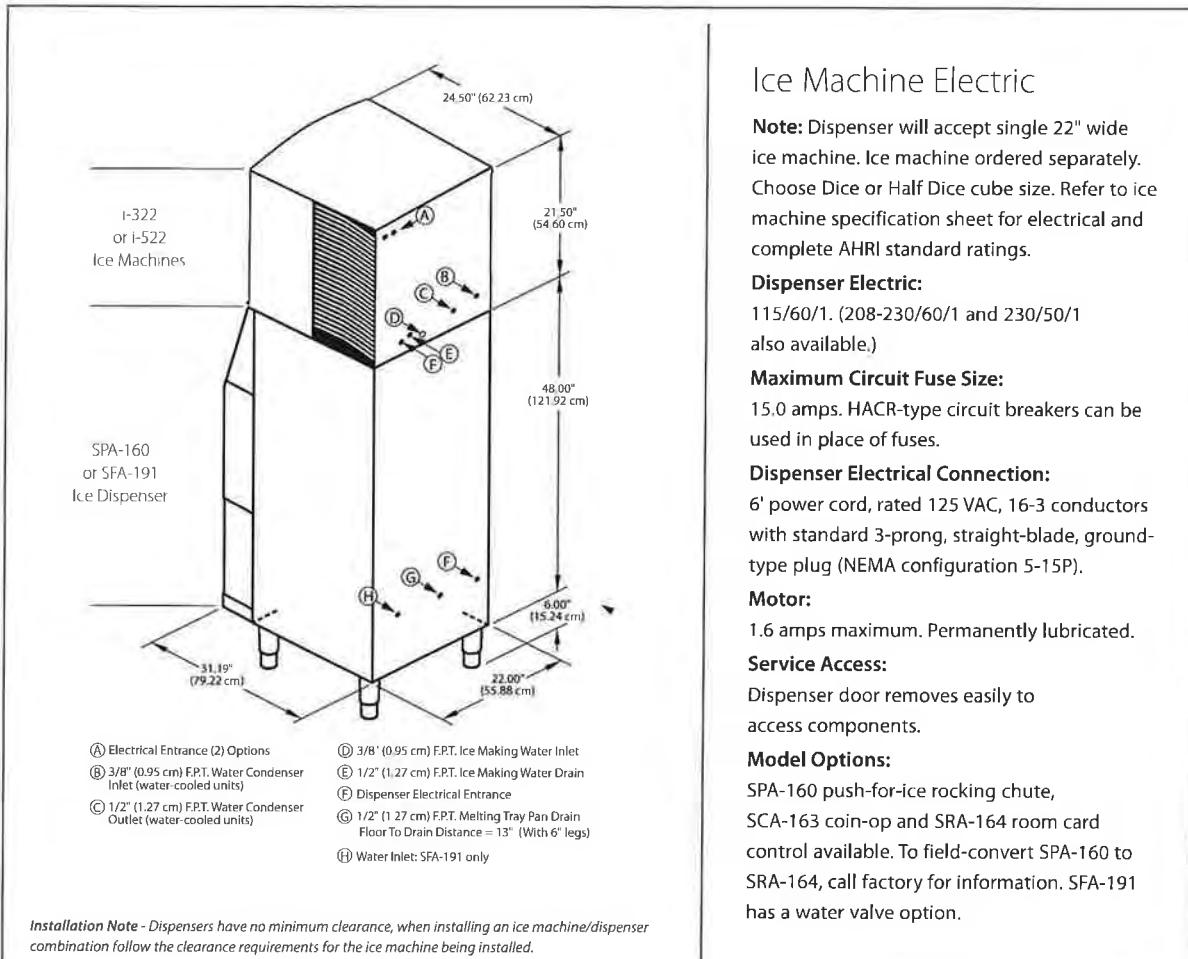
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SPA-160 • SFA-191 Ice Dispensers



SPA-160 • SFA-191 Ice Dispenser



Ice Machine Electric

Note: Dispenser will accept single 22" wide ice machine. Ice machine ordered separately. Choose Dice or Half Dice cube size. Refer to ice machine specification sheet for electrical and complete AHRI standard ratings.

Dispenser Electric:

115/60/1. (208-230/60/1 and 230/50/1 also available.)

Maximum Circuit Fuse Size:

15.0 amps. HACR-type circuit breakers can be used in place of fuses.

Dispenser Electrical Connection:

6' power cord, rated 125 VAC, 16-3 conductors with standard 3-prong, straight-blade, ground-type plug (NEMA configuration 5-15P).

Motor:

1.6 amps maximum. Permanently lubricated.

Service Access:

Dispenser door removes easily to access components.

Model Options:

SPA-160 push-for-ice rocking chute, SCA-163 coin-op and SRA-164 room card control available. To field-convert SPA-160 to SRA-164, call factory for information. SFA-191 has a water valve option.

Series 322 (115 volt)

Model	Ice Shape	Ice Production 24 Hours			
		70°Air/50°F Water	90°Air/70°F Water	lbs.	kgs.
ID-0322A	dice	335	152	225	102
ID-0323W	dice	330	150	270	122
IY-0324A	half-dice	350	159	230	104
IY-0325W	half-dice	350	159	290	132

Series 522 (115 volt)

Model	Ice Shape	Ice Production 24 Hours			
		70°Air/50°F Water	90°Air/70°F Water	lbs.	kgs.
ID-0522A	dice	475	215	325	147
ID-0523W	dice	460	209	375	170
IY-0524A	half-dice	485	220	340	154
IY-0525W	half-dice	480	218	395	179

LuminIce™ Growth Inhibitor reduces yeast and bacteria growth for a cleaner ice machine.



Options for SPA-160:



Room Card
SRA-164



Coin-Op
SCA-163
25-cent coin
standard.

	<p style="text-align: center;">EV9324-01 Insurice Single-i2000² System</p>	
<p>Delivers premium quality water for ice applications</p>	<p>CW to item V1, ice maker</p>	
 <p>Insurice Single-i2000² System: EV9324-01 i2000² Replacement Cartridge: EV9612-22</p>	<p>BENEFITS</p> <p>Reduces water-related ice machine problems caused by scale build-up from dirt and dissolved minerals</p> <p>New and improved Micro-Pure II media inhibits the growth of bacteria</p> <p>Reduces chlorine taste and odor and other offensive contaminants</p> <p>Self-contained scale inhibitor feed keeps ice machines functioning at full capacity</p> <p>Reduces maintenance and service costs by reducing scale and clogging of distribution lines, evaporator plate and pump</p> <p>Precat submicron technology reduces dirt and particles as small as 1/2 micron in size and reduces possible health contaminants such as cysts</p> <p>Sanitary cartridge replacement is simple, quick and clean. Internal filter parts are never exposed to handling or contamination</p> <p>NSF Certified under NSF/ANSI Standards 42 and 53</p>	
<p>INSTALLATION TIPS</p> <p>Choose a mounting location suitable to support the full weight of the system when operating</p> <p>Never use saddle valve for connection</p> <p>Use 3/8" water line</p> <p>Do not connect system to water-cooled condenser</p> <p>Install vertically with cartridges hanging down and allow 2-1/2" clearance below the cartridge for easy cartridge replacement</p> <p>Flush cartridges by running water through system for five minutes at full flow</p>	<p>OPERATION TIPS</p> <p>Change cartridges on a regular 6 month preventative maintenance program</p> <p>Change cartridges when capacity is reached or when pressure falls below 10 psi</p> <p>Service flow rate must not exceed 1.67 gpm</p> <p>Always flush the filter cartridge at time of installation and cartridge change</p>	<p>APPLICATION/SIZING</p> <p>For ice machine applications</p> <p>Most cubers up to 750 lbs./day</p> <p>Most flakers up to 1,500 lbs./day</p> <p>Rated Capacity: 9,000 gallons</p>

Insurice Single-i2000² System

SPECIFICATIONS

Overall Dimensions:

27.38" H x 6" W x 4" D

Inlet connection: 3/8"

Outlet connection: 3/8"

Service Flow Rate:

Maximum 1.67 gpm (6.3 Lpm)

Rated Capacity: 9,000 gallons

Pressure Requirements:

10 - 125 psi (0.7 - 8.6 bar), non-shock

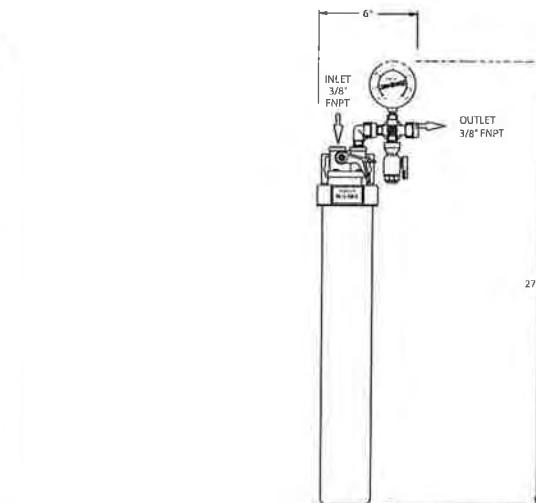
Temperature: 35 - 100°F (2 - 38°C)

No electrical connection required

Shipping Weight: 6 lbs.

Operating Weight: 9 lbs.

The contaminants or other substances removed or reduced by this drinking water system are not necessarily in your water. Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system. Systems certified for cyst reduction may be used with disinfected water that may contain filterable cysts.



WARRANTY

Everpure water treatment systems (excluding replaceable elements) are covered by a limited warranty against defects in material and workmanship for a period of five years after date of purchase. Everpure replaceable elements (filter cartridges and water treatment cartridges) are covered by a limited warranty against defects in material and workmanship for a period of one year after date of purchase. See printed warranty for details. Everpure will provide a copy of the warranty upon request.



System Tested and Certified by NSF International against NSF/ANSI Standard 42 and 53 for the reduction of:

Standard No. 42: Aesthetic Effects

Chemical Unit

Taste and Odor Reduction

Chlorine Reduction

Mechanical Filtration Unit

Particulate Reduction, Class I:

99.9+% reduction of particles

one-half micron and larger in size

Standard No. 53: Health Effects

Mechanical Filtration Unit

Turbidity Reduction

Cyst Reduction

Asbestos Reduction

EVERPURE

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1040 Muirfield Drive
Hanover Park, IL 60133
Ph: 630-307-3000 Fax: 630-307-3030

SECTION 123661 - SIMULATED STONE COUNTERTOPS AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Quartz agglomerate countertops, backsplashes, and accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials and accessories.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples for Initial Selection: For each type of material exposed to view.
- D. Samples for Verification: For all products.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOPS

- A. Configuration: Provide countertops with the following front and backsplash style:
 - 1. Front: Straight, slightly eased at top.
 - 2. Backsplash: Straight, slightly eased at corner.
 - 3. Endsplash: Matching backsplash.
- B. Countertops: 3/4-inch- (19-mm-) thick, quartz agglomerate with front edge built up with same material.
- C. Backsplashes: 1/2-inch- (12.7-mm-) thick, quartz agglomerate.
- D. Thresholds: As indicated on Drawings, polished finish.
- E. Soap Shelves: As indicated in Finish Schedule.

F. Fabrication: Fabricate tops in one piece with shop-applied edges[**and backsplashes**] unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

2.2 COUNTERTOP MATERIALS

- A. Composite Wood and Agrifiber Products: Provide products that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
- C. Adhesives: Adhesives shall not contain urea formaldehyde.
- D. Adhesives: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with the "Physical Characteristics of Materials" Article of ANSI SS1.
 1. Colors and Patterns: As indicated by manufacturer's designations on Finish Schedule, and if not indicated, to be selected by Architect from manufacturer's full range..

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m).
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 1. Install backsplashes and endsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 2. Seal edges of cutouts in particleboard subtops by saturating with varnish.

END OF SECTION 123661

SECTION 132233 – ABOVE GRADE SWIMMING POOLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Swimming Pool Construction.

- B. Related Sections:

- 1. Division 1 Sections.
 - 2. Division 26 – Electrical.

1.3 SUBMITTALS

- A. Product Data: Submit Manufacturer's data on material composition, tested characteristics, and installation requirements specific to Project.

- B. Shop Drawings: Prior to the commencement of installation, submit shop drawings which shall include the following:

- 1. Pipe penetration drawings.
 - 2. Mechanical and piping installation including pipe runs and support.
 - 3. Construction details for work not shown in the Construction documents or which have been changed or adjusted from the Construction documents based on manufacturer's recommendations or approved substitution material requirements.

- C. Samples:

- 1. Tile samples.
 - 2. Coping samples.

- D. Manuals: Provide (3) copies of an Operations and Maintenance Manual identifying all items of Water Features equipment furnished and installed as a part of the work, and include a cut sheet or photograph of each item. Provide operating and maintenance instructions for each item of such equipment.

- E. Three sets of plans showing the work specified in this Section in "as-built" conditions.

1.4 QUALITY ASSURANCE

- A. Qualifications of Contractor: The Contractor, as a condition to being entitled to bid the water feature portion of the work specified shall have a valid State of Hawaii C-49 swimming pool contractor's license and the following:
 - 1. At least five (5) years of experiences in the construction of commercial swimming pools in the State of Hawaii and must list at least five (5) installations of above grade pools of similar size and scope of which, upon investigation, have been found to be completed in a satisfactory manner.
- B. Subcontractor: Whenever any portion of the work is performed by a Subcontractor and that portion of the total contract exceeds 20% of the work, that portion of work must be performed by a licensed contractor normally doing the work.
- C. Standards:
 - 1. The work specified in this Section shall comply with the Building Code of the City and County of Honolulu, with the regulations of the Department of Health of the State of Hawaii, and with all other governmental and quasi-governmental authorities applicable to the work.
 - 2. The work specified in this Section shall comply with the standards stated in the current edition of the National Swimming Pool Institute (NSPI) recommendations for the construction of Swimming Pools, to the extent that same are applicable to the work.
 - 3. The work specified in this Section shall comply with the standards stated in the current edition of the Association of Pool and Spa Professionals (APSP) recommendations for "the American National Standard for Suction Entrapment Avoidance in Swimming Pools, Wading Pools, Spas, Hot Tubs, and Catch Basins".
 - 4. Installation of reinforcing steel for all water features shall comply with all applicable codes and regulations, as specified elsewhere in these specifications and shall comply with all applicable recommendations contained in the following: "Manual of Standard Practice for Detailing Reinforced Concrete Structures," publication ACI 316-65 of the American Concrete Institute, current edition; "Building Code Requirements for Reinforced Concrete," publication ACI 318-83 of the American Concrete Institute.
 - 5. The work specified in this Section shall comply with all applicable requirements of the National Electrical Code, current edition.
 - 6. Where provisions of applicable codes and pertinent standards conflict with these Specifications or the Drawings, the more stringent provisions shall govern; provided, that no provision of these Specifications or of the Drawings shall require construction or installation in violation of any applicable governmental code.
 - 7. In addition to all other expressly required and provided guarantees and warranties, all products of the work specified in this Section shall have a warranty period of one year and upon such terms, if any, as are described in the appropriate section of the architect's specifications relating to the work specified by this Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Water Feature Mechanical Equipment: The data pertaining to the materials to be used in the performance of the work specified in this Section shall be as stated in the Drawings of the work, to which reference is made.
- B. Construction Materials: All construction materials used in the performance of the work specified in this Section shall be of proper and adequate quality and new.

2.2 REINFORCING STEEL

- A. Bars: All steel bars used for reinforcement as specified in this Section shall conform to "Specifications for Deformed Billet-Steel Bars for Concrete Reinforcement", ASTM A-615, grade 40.
- B. Wire: All wire used for reinforcement as specified in this Section shall conform to "Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement".

2.3 SHOTCRETE

- A. Cement: All cement for shotcrete shall conform to the standard criteria of ASTM C-150. Type 1.
- B. Sand: All sand for shotcrete shall consist of clean, hard particles, with a moisture content of not more than 5%, with the sand well graded in size within the following limits:

<u>Particle Size</u>	<u>Percentage Passed by Weight</u>
Passing through 3/8" screen	100%
Passing through number 4 mesh sieve	95%-100%
Passing through number 8 mesh sieve	70%-95%
Passing through number 16 mesh sieve	60%-85%
Passing through number 30 mesh sieve	45%-65%
Passing through number 50 mesh sieve	15%-35%
Passing through number 100 mesh sieve	0% - 15%

- C. Water: All water for shotcrete shall be clean and free from such amounts of acid, alkali and foreign substances as would significantly impair the strength and durability of the installed shotcrete.
- D. Strength: All shotcrete shall attain a maximum strength of 3,500 psi at 28 days curing after placement of same.
- E. Mix Proportions::

1. Shotcrete: The mix design of the shotcrete shall be provided by supplier, which shall be approximately 75% sand, 25% coarse aggregate, 3/8" maximum size, 6 to 7-1/2 sacks cement.
2. Gunite: The mix of gunite shall be one part cement to 3.5-4.5 parts of sand, by volume.

F. Mixing:

1. Mixing Method: Mixing shall be accomplished in a power batch mixer approved by Contractor and equipped to measure accurately the quantity of aggregate and the time of mixing.
2. Mixing Period: The mixing period shall be at least 1-1/2 minutes at a mixer peripheral speed of approximately 200 feet per minute. Materials mixed more than 45 minutes shall not be used in the work and shall be discarded.

G. Other Materials:

1. All other materials not specifically described but required for the complete and proper shotcrete installation specified in this Section shall be as selected by the Contractor subject to the approval of the Construction Project Manager.

2.4 TILE

- A. The Pool shall have a ceramic tile finish at the waterline of the raised deck interface and as the contrasting tile bands and steps and benches.
- B. All tiles shall be glazed tile with absorption not greater than 3%, such as manufactured by Fujiwa, or OAE, and shall be 1 inch x 1 inch in size, except where noted below. Specialty pieces shall be as follows:
 1. All necessary trim pieces as noted or required by the Drawings or as specified in this Section.
 2. All contrasting tile bands to be solid, non-skid 1" X 1" TILE.
 3. Depth Marker tiles at the waterline and deck to be 6 inch x 6 inch with 4 inch high numerals and letters on a contrasting background field. All depth marker tiles on horizontal surfaces to be non-skid.
 4. Depth marker notation to include imperial and metric depth notations.
 5. Colors: Colors shall as selected and approved by the Architect, or as noted on Applicable Drawings. Contractor to provide six (6) samples of color notated tile for approval by Architect.
- C. Application: Contractor shall use a Laticrete System for thin set method of adhering tile.
 1. Mortar: Laticrete 226 Thick Bed Mortar with Laticrete 3701 Mortar Admix.
 2. Waterproofing: Miracote MiraFlex Membrane C.
 3. Thin Set: Laticrete 254 Platinum.
 4. Grout: All grout shall be Laticrete 1500 sanded grout, unless otherwise specified by the tile manufacturer for a non-epoxy grout material. Color to be selected by Architect.

2.5 PLASTER

- A. The Pool shall have a plaster finish on all underwater interior surfaces. All plaster shall be Marble Plaster manufactured by Lewis-Osbourne Company or Kaiser Industries, or an approved equal, mixed with white Portland cement. Color shall be Pearl Gray or as selected by the Architect. A 3" x 3" sample shall be submitted for approval prior to installation.
- B. Standards: The work specified in this Section shall meet the requirements and recommendations of the applicable provisions of the current editions of the Standards listed below:

ANSI American Society for Testing Materials

- C. Water: All plaster shall be prepared using potable water, and shall be clean and free from deleterious amounts of acid, alkali, and foreign substances.

2.6 STONE COPING

- A. Swimming Pool: Pool coping to be a quartzite stone material. Material to be selected by Architect.
- B. All exposed coping edges to have an eased corner.

2.7 MECHANICAL EQUIPMENT AND PIPING

- A. General: All materials and equipment required by the work specified in this Section shall be new, of proper and adequate quality for the purpose intended, and shall be clearly marked or stamped with the manufacturer's name and nameplate data or stamp and rating.
- B. Equipment and Accessories: Hayward, Pentair, or Speck equipment may be substituted for the items specified in this Article upon approval. All equipment and accessories must be tested and approved by the NSF (National Sanitation Foundation).
- C. The pumps shall be Pentair WhisperFlo and Pentair EQ Series, as described in the Drawings.
- D. Variable Frequency Drive: A Variable Frequency Drive shall be supplied for the Recirculation Pump. Danfoss VLT AQUA Drive. Size per NEMA standards for current and power ratings. Local Control Panel, up to 6 digital inputs, two 0-10 analog inputs, AC main disconnect, DC-link reactors, and Electronic Thermal Relay.
- E. Filter: The filter system shall be Pentair Triton II, as described in the Drawings.
- F. Main Drain: The main drains for the swimming pool shall be equipped with a fastenable grate that meets all requirements for VGB and ANSI/ASME A112-19-8-2009 compliance. AquaStar or equivalent.
- G. Inlet Fittings: Inlet fittings shall be 1-1/2" eyeball. Pentair or equivalent.

- H. Chemical Feed Units: ChlorKing Salt Chlorinator.
- I. Flow Sensor: Georg Fischer Signet 2537 Rotor-X flow sensor with PVC 80 installation fitting. Flow sensors to be installed on all pipe runs between the pump and filter as well as on all return lines.
- J. Pressure Gauge: 3-1/2" diameter face, range 0 – 60 psi. Ashcroft or equivalent. To be installed on discharge side of each pump.
- K. Vacuum Gauge: 3-1/2" diameter face, range 0 – 30 in.hg. Ashcroft or equivalent. To be installed on suction side of each pump.
- L. True-union Ball Valves: PVC body construction with viton seals. Asahi, Duo-Bloc, True Blue or equivalent.
- M. Butterfly Valves: PVC body with polypropylene disk, wafer style, lever or gear operated with locking device. Asahi/America, R & G Sloan, or equivalent.
- N. Check Valve: Wafer style check valve with PVC. FPM (Viton) o-rings, flanged connections, 100 psi rating minimum. Chemline Plastics Limited PW Series. Check valves to be installed at the discharge side of every pump.
- O. Pipe: Pipe to be used in the work specified in this Section shall conform to the standard applicable to the specific pipe of the following standards:
 - 1. PVC, Schedule 80: Type 1, normal impact, ASTM 1785 and CS-207-60,nsf, for socket welding application. Color shall be gray. Pipe conforming to this standard shall be used in the mechanical room and any other exposed areas.
 - 2. PVC, Flexible: Minimum working pressure for 2 inch diameter, at 80 degrees F., is 75 psi.
 - 3. CPVC, Schedule 40: Type 1, normal impact, ASTM 1785 and CS-207-60, nsf, for socket welding application. Pipe conforming to this standard shall be used at influent and effluent piping locations within 5' of heat exchangers and heaters unless otherwise prevented by code or manufacturer's recommendation.
- P. Pipe Hangers and Supports:
 - 1. Piping near floor shall be supported with steel stanchions welded to end plates secured to pipe and floor.
 - 2. Plastic pipe shall be supported in stainless steel support brackets with an insulation material.
 - 3. Hangers to be combination spring and double deflection neoprene type. Mason Industries model 30N or equivalent.
 - 4. Hangers shall be of the proper size to fit around pipes and hanger rods, screws, bolts, nuts, etc. shall be sized in accordance with the recommendations of manufacturer's sizing charts.
 - 5. Hangers for horizontal pipes shall be spaced at a maximum of 4 feet for 1" pipe and under, 5 feet for 1" to 2" pipe, 6 feet for 2" to 4" pipe, and 8 feet for 6" to 12" pipe.
 - 6. All belts and other fasteners installed in submerged, buried, or mechanical room locations shall be stainless. All hangers and rods shall be galvanized

Q. Valves:

1. All valves over 2 inches may be flanged PVC body butterfly valves or true union ball valves. Flanged butterfly valves shall be PVC body w/polypropylene disc, wafer style, and lever or gear operated with locking device as manufactured by Asahi America, R & G Sloane or equivalent. Ball valves shall be true union type and of PVC construction w/viton seals as manufactured by Duo Bloc, True Blue, or equivalent.
2. All valves 2 inches and under shall be true union PVC ball valves as manufactured by True Blue, Duo Bloc, or equivalent.

R. Motor Control Center:

1. Motor Control Center shall contain a main protection switch, buswork, circuit breakers, single phase protectors, magnetic motor starters, auxiliary relays, control fuses, on/off push buttons, manual/auto selector switches, duty/standby selector switches, power 'on' and 'off' lights, pump running and overload lights, 24-hour timers, terminal blocks, wiring and accessories for the full operation and control of the associated pumps.
2. Motor Control Center enclosures to be NEMA 3R or higher. All exterior door fittings shall be chrome plated.
3. Provide shop drawings and product data:
 - a. Shop drawings to show front and side views of motor control center enclosures with overall dimensions and include conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase; neutral, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components.
 - b. Provide product data on motor starters, relays, pilot devices, and switching and over current protective devices.

PART 3 - EXECUTION

3.1 GENERAL

- A. Familiarization: Contractor shall, prior to commencement of the work specified in this Section, become familiar with the site, the site conditions and all portions of the Work falling within the specifications of this section.

3.2 INSPECTION

- A. Prior to the commencement of performance of any of the work specified in any Section of these Specifications, Contractor shall inspect the existing conditions and installed work of other trades and shall verify that all such work is complete and that no discrepancy exists in such conditions, or such work which would impair or prevent commencement of the work specified in the Section.
- B. In the event that Contractor shall, upon inspection, discover a discrepancy, Contractor shall promptly notify the Architect and General Contractor of such discrepancy, and shall not proceed

with installation of the work in question until all such discrepancies shall have been remedied or resolved.

- C. Coordinate this work with the work of other contractors for the Project as required in order that such other contractors shall incorporate tie-in and other items required to be present therein for the proper performance of the Work specified in this Section, and shall timely provide to such other contractors all tie-in work and other items so required for incorporation in such other work as same progresses.

3.3 DELIVERY OF EQUIPMENT

- A. Familiarization: Contractor shall, prior to commencement of the work specified in this Section, become familiar with the site, the site conditions and all portions of the Work falling within the specifications of this section.
- B. Be responsible for delivering the material and equipment into the assigned locations for storage.

3.4 PACKING, STORAGE, AND PROTECTION

- A. All materials, equipment, components, and accessories shall be delivered to the Work new and in the manufacturer's original containers with all labels intact and legible and shall be properly packed and protected against damage or contamination, breakage, or structural weakening due to handling, adverse weather, or other circumstances and, as far as practical. They shall be kept in the protected packing cases or under approved protective coverings until required for use.
- B. Any items suffering from damage during manufacture, or in transit, or on site while in storage or during erection will be rejected and replaced without extra cost to the Owner.
- C. The Contractor shall apply an approved protective coating or fix some other protective material to the materials, equipment, components, and accessories so as to protect them after installation. In the event that the Contractor fails to do so, the Contractor shall repair to the satisfaction of the Owner or supply at no added charge any replacement required to substitute for any part of the materials, equipment, components, and accessories which may have been damaged in whole or in part as a result of such failure and shall without prejudice to such other liabilities under this Contract, pay for all expenses incurred in respect of the removal and disposal of the damaged parts and the installation of the substitute parts.

3.5 INSTALLATION – GENERAL:

- A. All materials shall be installed in compliance with manufacturer's published instructions and/or recommendations for the installation of same.
- B. All work shall be performed in a manner equal to or exceeding accepted trade industry standards as outlined by the specific trade council for the trade(s) involved in the performance of such work.

3.6 REINFORCING STEEL

A. General:

1. Contractor shall, prior to commencement of the work specified in this Section, inspect the installed work of other trades and verify that all such Work is complete to the point where the performance of the work specified in this Section may properly commence.
2. Contractor shall verify that the reinforcement specified in this Section, when placed as specified herein, will permit placement of concrete in accord with the design indicated on the applicable Drawings.
3. Contractor shall verify that all waterproofing and liner materials are adequately protected from damage such as might be caused by the installation of the reinforcement specified in this Section.

B. Discrepancies:

1. In the event that Contractor shall discover a discrepancy in the conditions or work inspected as provided in the preceding paragraph, Contractor shall promptly notify the Architect and CPM of such discrepancy, and Contractor shall not proceed with the installation of reinforcement specified in this Section in any area where such discrepancy(s) exist until all such discrepancies have been remedied or resolved.

C. Bending:

1. All reinforcing steel bars shall be bent cold.
2. All bends for stirrups and ties shall be made around a pin having a diameter not less than two times the minimum thickness of the bar being so bent.
3. All bends for stirrups and ties shall be made around a pin having a diameter not less than two times the minimum thickness of the bar being so bent.

D. Placing Reinforcement:

1. Contractor shall, before commencing placement of concrete, accurately place all concrete reinforcement, positively securing and supporting same with concrete blocks, metal chairs or spacers, or with metal hangers. In all Water Features with vulnerable waterproofing membrane liner materials, Contractor shall not allow steel reinforcement to touch the membrane liner directly; Contractor shall protect the surface of such membrane liner with compressible filler, fiberboard, or Geotextile.

E. Clearance:

1. A clear space shall be preserved between bars of not less than 1-1/2 times the nominal diameter of round bars.
2. In no case shall the clear distance of reinforcement be less than 1-1/2 inches nor less than 1-1/3 times the maximum size of the aggregate of the concrete to be reinforced.
3. The following minimum covering of reinforcement shall be provided:
 - a. Conduct demolition in an orderly and careful manner as required to accommodate new work, including that required for connection to the existing building. Protect existing supporting structural members.

- b. Cease operations and notify Architect immediately if safety of adjacent structure appears to be endangered. Do not resume operations until safety is restored.
- c. Concrete below ground deposited against forms: 2 inches.
- d. Concrete deposited against earth: 2-1/2 inches.

F. Splicing of Reinforcement:

1. Horizontal Bars:
 - a. Conduct demolition in an orderly and careful manner as required to accommodate new work, including that required for connection to the existing building. Protect existing supporting structural members.
 - b. A clear space shall be preserved between bars of not less than 1-1/2 times the nominal diameter of round bars.
 - c. Bars in horizontal members shall be placed with a minimum lap at splices sufficient to develop the strength of the bars.
 - d. Bars may be wired together with laps, except at points of support of the member, at which points it is required to preserve clear space as described above.
 - e. Whenever possible, stagger the splices of adjacent bars.
 - f. Splices shall overlap 40 bar diameters minimum.

G. Dowels: All required steel dowels shall be placed and securely anchored into position before concrete is placed.

3.7 SHOTCRETE

- A. Conditions: Contractor shall verify that the shotcrete installation specified in this Section may be completed in accordance with the specifications of this Section and in accordance with all applicable codes and regulations and with the original design of the work specified in the Drawings and in these Specifications.
- B. Coordination: Coordinate with all other applicable trades in order to accomplish proper and adequate provision in the shotcrete for such items as are required to be furnished and installed in, on, or upon the shotcrete under other sections of these Specifications.-
- C. Protection: All means reasonably required to protect shotcrete material before, during and after installation and to protect the installed work and materials of other trades shall be utilized.
- D. Placing of Shotcrete: Shotcrete shall only be placed by qualified personnel as defined in this Section using such equipment and facilities as are reasonably required for the proper placement of shotcrete in swimming pools and similar structures required for this Work.
- E. Back-Up Surfaces:
 1. The shotcrete shall be applied against material which will not significantly yield or displace during the application of the shotcrete.
 2. Shotcrete shall be applied to the floor area adjacent to vertical areas before application of shotcrete to the vertical areas in order to prevent rebound accumulation during application.

3. All surfaces on which shotcrete is to be applied shall be dampened sufficiently to prevent excessive absorption of water content from the shotcrete mix prior to curing.
4. Sufficient ground wires shall be furnished and installed to permit establishment of correct thickness and surface planes of the shotcrete; both horizontal and vertical ground wires shall be installed at corners and offsets not clearly established by the formwork, where needed to establish correct thickness and planes.

F. Nozzle Technique:

1. Shotcrete shall, where possible, be applied with the application nozzle held at right angles to the surfaces to be shotcreted and at a distance of 2-1/2 to 3 feet, except when enclosing reinforcing steel.
2. Shotcrete shall, when applied to enclose reinforcing steel, be applied with the application nozzle held so as to direct the shotcrete behind the reinforcing steel bars, and shall be directed at each side of such bars separately.
3. Shotcrete shall be placed into, around, or over rebound materials.

G. Tolerances: All shotcrete shall be placed to the lines and dimensions indicated on the Drawings and as required to allow for finish material to achieve true planes and uniform surfaces

1. Rebound:
 - a. All deposits of loose sand and rebound shall be removed from all surfaces before application of shotcrete to such surfaces.
 - b. Shotcrete shall not be applied to deposits of loose sand and rebound shall be removed from all surfaces before application of shotcrete to such surfaces.

H. Joints:

1. All joints shall be tapered at a slope of 1:12 (thickness to width).
2. If a joint is 24 hours old, or less, Contractor shall prepare the joint edges appropriately before application of concrete mix to same.
3. For joints more than 24 hours old, a coat of Sikadur Hi Mod Epoxy of appropriate viscosity shall be applied to the tapered edge before application of concrete mix to same.

I. Defective Work:

1. All rebound pockets, sags, sloughs and other defects shall be removed and replaced with shotcrete meeting the specifications of this Section.
 2. Shotcrete dragged or torn by use of trowels, straight edges or from any other source, shall be considered defective and shall be removed and replaced as described in the preceding paragraph hereof.
- J. Pressure: The cement applications gun shall be provided with air pressure not less than 45 pounds, or more than 70 pounds, during the application process.
- K. Cleaning Up:
1. All build up in and on the nozzle, hoses, pumps, mixer and other equipment shall be removed daily during the application process.

2. The site of the application shall be kept in a neat and orderly condition during the application process to the extent same is consistent with the requirements of performance of the work specified in this Section at all times during the application process.
3. Upon completion of the work specified in this Section, all debris and equipment created or required by the performance of the work specified in this section shall be removed from the jobsite.

3.8 TILE FINISHES

A. Surface Conditions:

1. Inspections:
 - a. Contractor shall, prior to commencement of the work specified in this Section, inspect the installed Work of other trades and shall verify that all such Work is complete to the extent that the work specified in this Section may properly commence, and shall verify that the tile installation specified in this Section may be completed in accordance with the requirements of this Section.
 - b. Contractor shall verify that the tile and specialty items specified in this Section are installed in accordance with the original design of the Drawings and in conformity with the standards specified in this Section.
 - c. Discrepancies: Contractor shall not proceed with the work specified in this Section in any area of discrepancy until all such discrepancies have been remedied or resolved.

B. Installation: The tile and stone veneer installation specified in this Section shall be accomplished as follows:

1. All tiles and stone veneer shall be installed in accordance with the installation method for swimming pools stated in the "2014 Handbook for Ceramic, Glass, and Stone Tile Installation".
 2. All specialty items and embedments shall be installed in accordance with the recommendations of the respective manufacturers of such items and embedments, and in compliance with all pertinent codes and regulations and the standards specified in this Section.
- C. Interface: Contractor shall establish and follow the required horizontal and vertical elevations shown on the Drawings to ensure proper and adequate space for the work and materials of other trades.
1. Upon completion, the exposed tile and specialty items shall be properly cleaned and polished and all equipment and debris which was a product of this work shall be removed and the site of the work left in a clean and presentable condition.

3.9 PLASTER

- A. Conditions: Contractor shall, prior to commencing the work specified in this Section, inspect the installed work of other trades and verify that all such work is complete to the extent required for the installation specified in this Section to properly commence.

- B. Protection: Contractor shall utilize such means as are reasonably necessary to protect water feature plaster before, during and after installation of same and to protect the installed work and materials of other trades.
- C. Replacement: In the event of damage to the work specified in this Section through fault of the Contractor, all repairs and replacements reasonably required to return the work to its condition prior to such damage shall be made at no additional cost to the Owner.
- D. Pre-Plaster Inspection: Contractor shall notify the Architect and Construction Project Manager at least 72 hours in advance of commencement of application of plaster for the purpose of conducting the pre-plaster inspection of the Work, and shall not commence application of plaster until such inspection has been concluded and the Work and the application of plaster thereon has been approved.
- E. Environmental Conditions:
 - 1. Unsuitable Weather: No plastering shall be done under unsuitable conditions of weather or temperature.
 - 2. Rain: Plaster shall not be installed during rain and, if rain commences after plastering has begun, the plaster then installed shall be promptly protected from rain by all necessary means until after the plaster has set.
 - 3. Wind: Plaster shall not be installed during wind and, if wind commences after plastering has begun, the plaster then installed shall be promptly protected from wind by all necessary means and any debris shall be promptly removed from the freshly plastered surface.
- F. Plastering:
 - 1. Plastering shall not commence until the concrete to be plastered has cured for a period not less than 14 days.
 - 2. Plastering shall not commence until all concrete deck areas and other construction adjacent to the pool are complete and all construction equipment used for those portions of the Work has been removed from the area in which plastering is to be applied.
 - 3. Plaster shall not be applied in environmental conditions which may leave doubt as to quality of the finish, allowing for time to properly fill, chemically balance and cure the new plaster.
- G. Conditions of Surfaces:
 - 1. Concrete surfaces shall be clean and free of all dust and loose particles and other foreign matter prior to application of plaster to same. Any foam, grease and/or oil on such surfaces shall be removed by application of a dilute solution of Trisodium Phosphate followed by application of a 10% solution of Muriatic Acid mixed with clean water, followed by a thorough water rinse.
 - 2. Contractor to confirm that concrete surfaces shall be sufficiently textured to provide a strong mechanical bond and that all bond-breaking mortar has been removed.
 - 3. Prior to plastering, wet concrete surfaces with a fine fog water spray to produce a uniformly moist condition.
 - 4. Provide fabric type shade protection to cover pool during plastering operations.

5. Scrub bond coat into the prepared concrete surfaces immediately prior to plastering. Use stiff bristle brush to ensure total coverage and penetration of the bond coat slurry.

H. Installation of Plaster:

1. A finish coat of the specified marble plaster shall be applied by trowel to a thickness of between 3/8 inch minimum and 3/4 inch maximum onto the rough gunite surface or the brown coat of the rough concrete. If a leveling coat of plaster is required, regular sand plaster or for spot leveling master Flow 713 by Master Builders may be trowelled on.
2. Apply plaster in two coats by "double-back" method with the second coat applied as soon the first coat is tamped and initially floated. Apply plaster with sufficient pressure to provide good bond on bases. Work plaster to screeds at intervals of from 5 feet to 8 feet on straight surfaces. The plaster shall be floated to a uniform plane and towed to a smooth, dense, impervious surface, using extreme care to avoid waves, cracks, trowel marks, ridges, pits, crazing, discoloration, projections, stains, or other imperfections.
3. The plaster shall be accurately interfaced with the finish planes of items installed by other trades.

I. Curing of Plaster:

1. Preparation: Contractor shall anticipate the need for the equipment required for curing of the plaster and shall have all such equipment immediately available at the site of the work for use following completion of the plastering.
2. A fine fog water spray is to be applied to the finish coat as frequently as required to keep the plaster moist to prevent dry-out prior to the filling of the pool. A fine fog water spray is to be applied to the finish coat as frequently as required to keep the plaster moist to prevent dry-out prior to the filling of the pool.

J. Pool Filling:

1. Upon completion of the plaster application, the plaster shall be cured by gradually filling the subject Water Feature with water, preventing all damage to finished plaster surfaces during this process.
2. The filling water shall be flowed continuously until the subject Water Feature is filled.
3. When the water volume filling the pool is slow, the plastered pool walls shall be kept continually damp with a fine fog water spray.
4. Contractor shall coordinate as required to fill the pool with clean and properly balanced water, such that the water shall have no deleterious effects on the plaster.

K. Clean-Up: Upon completion of the plastering, remove all excess plaster from adjacent surfaces, remove all equipment and debris, which was a product of such work, and leave the site in a clean and presentable condition.

L. Contractor shall request a review of the completed work specified in these Specifications. The Architect and CPM shall make the observation and review of the completed work and shall note any items of the work not in conformity with the Drawings or these Specifications. If 10 percent or more of the pools plaster finish is found to be defective, the plaster shall be removed from all surfaces and replaced complete. Final acceptance shall be made by Owner following correction of the items specified.

M. Warranty:

1. Plastering Contractor shall warrant that the materials furnished are in accordance with the specifications, and that the installation shall be free from defects not inherent in the quality required or permitted, and that the Work conforms with the requirements of the Contract Documents.
 - a. Warranty shall be for a period of two (2) years from the date of acceptance. Pro-rated warranties are not acceptable. The warranty shall include repair or replacement of the plaster finish in whole or in part due to cracks, blisters, spalling, delamination, and excess fading. The warranty excludes remedy for damage or defect caused by abuse, improper or insufficient maintenance, improper operation, or modifications not executed by the Contractor.
 - b. Under the warranty, the Contractor shall repair or replace any defective work at no cost to the Owner during the warranty period.

3.10 MECHANICAL EQUIPMENT AND PIPING:

A. The work specified in this Section includes the following:

1. All material, labor, equipment and services necessary to install the swimming pool fittings, equipment and accessories shall be provided.
2. All material, labor, equipment and services necessary to furnish and install the water feature's mechanical systems, fittings and accessories shall be provided.
3. All system piping, equipment and accessories, including but not limited to, all trim and miscellaneous face piping for proper operation of equipment, whether or not specifically described on the Drawings, shall be provided.
4. All equipment bases, isolators, anchor belts, and no leak wall flanges shall be furnished and installed.
5. Supervision and inspection of all work to insure pipes are installed true to line and grade, equipment is connected without strain, spools are set accurately and are not dislodged during concrete pour and that no damage is done to Mechanical Equipment subsequent to its installation shall be provided.
6. Miscellaneous carpentry, masonry and metal work required for proper performance of the work specified in this section shall be provided, except where specifically called for under other sections of these Specifications.
7. Cutting and patching of holes required for the work specified in this section shall be provided.

B. Product Handling:

1. Delivery: All materials shall be delivered to the job site in new condition and in manufacturers' original containers with all labels intact and legible.
2. Storage: All materials which are sensitive to exposure to the elements shall be stored under cover in a manner sufficient to reasonably protect same against damage and/or contamination. Only the specified materials shall be stored at the job site.

C. Protection Against Damage:

1. Contractor shall comply with all minimum temperature recommendations of the manufacturer relating to the storage and installation of glue and grouting material.
2. Contractor shall utilize such means as are reasonably necessary to protect plastic pipe and specialty items from damage before, during and after installation and to protect from damage the installed work and materials of other trades.
3. During construction, Contractor shall provide reasonably adequate protection of all work specified in this Section from damage by accident, weather or otherwise. All work damaged as a consequence of failure of Contractor to provide such reasonably adequate protection shall be removed and replaced at the expense of the Contractor.
4. Contractor shall be responsible for damage to the work and equipment specified in this Section caused by Contractor and/or by failure to provide reasonably adequate protection of such work and equipment; and Contractor shall repair or replace with new materials damage resulting from work due to construction and/or tests performed by Contractor of or on the work specified in this Section.
5. Until formal turnover of the water features specified in these Specifications to owner, Contractor shall be responsible for the repair of any damage caused by leaks in any of the piping systems or fittings, or by overflow of water features, and shall be responsible for the repair of damage to any part of the building caused by leaks in the work specified in this Section.

D. Piping:

1. Contractor shall, prior to performance of the work specified in this Section, inspect the installed Work of other trades in order to verify that all such Work is complete to such extent that the work specified in this Section may properly commence, and shall verify that the mechanical system may be properly completed in accordance with this Section of these Specifications.
2. Contractor shall provide unions at connections to equipment for the purpose of facilitating maintenance of the equipment and piping involved.
3. Contractor shall size any pipe for which size is not indicated and/or any intermediate section erroneously shown undersized the same size as the largest pipe connecting to it. Sizes as listed in the Drawings relating to the work specified in this Section are nominal.
4. Valves shall be installed so as to permit reasonable access to such valves.
5. All above grade PVC piping shall be installed using socket welded fittings and approved cement. Each fitting and pipe end shall be prepared with solvent primer and the fitting joined individually with enough time allowed between assemblies of adjacent parts to allow solid sealing. Pipe ends shall be chamfered and fittings roughened. All procedures, methods and techniques shall be performed in accordance with the manufacturer's recommendations.
6. All connections between the domestic water systems and equipment or face piping shall be made with approved backflow protection devices.
7. In mechanical rooms, all piping shall be appropriately labeled, and such labels shall include indication of flow direction.
8. All above grade piping that is exposed (not within building structure) shall be painted.

E. Equipment:

1. Equipment shall be positioned consistent with good appearance, access to all components for maintenance and adequate space for repairs. Piping, and ducts shall be installed so as to not interfere with necessary access to equipment.

2. All floor anchors shall be stainless steel.
3. All equipment shall be installed level, secure and out of direct exposure to external moisture.
4. Pumps shall be installed on 4" concrete housekeeping pads.

F. Valves:

1. Contractor shall identify each valve with an engraved, numbered, metal or plastic tag chained to the handle of such valve. Contractor shall provide one (1) typed valve identification chart laminated in plastic and mounted in the mechanical room.
2. Valve handles shall be located within 6 feet of the floor and in the horizontal or vertical plane of the pipe to which such valve is attached. Valve handles should be located so as to be accessible with adequate clearance for ease of operation.

G. Tests:

1. Contractor shall perform tests in the presence of the Architect and/or Owner's Representative for the duration designated in this Section without loss of pressure or observable leaks.
2. Equipment which could be damaged by the high pressure shall not be included in pressure tests.
3. A low pressure (not, however, less than 20 psi) shall be maintained in all piping lines with water during all phases of water feature construction.
4. Perform tests as follows:
 - a. Test for Water Loss: Automatic make-up water systems shall be tested and operative at the time of final observation.
 - b. Static water tests shall be made by the Contractor for a period of twenty-four hours (24) to verify that the water features are water tight. These tests shall be verified by the Architect, Owner's Representative, and/or the General Contractor.

3.11 START-UP AND TRAINING

- A. Contractor shall be responsible for start-up of the Swimming Pool and responsible for maintaining the above water features in a clean and chemically-balanced condition for thirty (30) days following the date of Substantial Completion.
- B. When directed by the Owner or Construction Project Manager, instruct the Owner's Maintenance Personnel in the proper operation and maintenance of all water features and installed equipment; and in the use of the Manual as a maintenance and replacement guide.

END OF SECTION 132233

SECTION 142400 - HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hydraulic passenger elevators.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
2. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
3. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
4. Section 051200 "Structural Steel Framing" for the following:
 - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
 - b. Hoist beams.
5. Section 055000 "Metal Fabrications" for the following:
 - a. Attachment plates and angle brackets for supporting guide-rail brackets.
 - b. Structural-steel shapes for subsills.
 - c. Pit ladders.
6. Section 221429 "Sump Pumps" for sump pumps, sumps, and sump covers in elevator pits.
7. Section 271500 "Communications Horizontal Cabling" for telephone service for elevators.
8. Section 283111 "Digital, Addressable Fire-Alarm System" for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.

1.3 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

1.4 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.
- B. Shop Drawings:
 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
 2. Include large-scale layout of car-control station.
 3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- C. Samples for Initial Selection: For finishes involving color selection.
- D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; **3-inch- (75-mm-)** square Samples of sheet materials; and **4-inch (100-mm)** lengths of running trim members.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard two-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.9 COORDINATION

- A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.10 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 - 2. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Basis-of-Design Product:** Subject to compliance with requirements, provide ThyssenKrupp Elevator; AMEE Plan II, or comparable product by one of the following:
1. [KONE Inc.](#)
 2. [Otis Elevator Co.](#)
 3. [Schindler Elevator Corp.](#)
 4. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.
1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
 2. Affected peak velocity acceleration (Av) for Project's location is as indicated on structural drawings.
 3. Provide earthquake equipment required by ASME A17.1/CSA B44.
 4. Provide seismic switch required by ASCE/SEI 7.
 5. Design earthquake spectral response acceleration short period (Sds) for Project is as indicated on structural drawings.
 6. Project's Seismic Design Category: As indicated on structural drawings.
 7. Elevator Component Importance Factor 1.0.

2.3 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
1. Type: Holeless, beside-the-car, single-acting, dual cylinder.
 2. Rated Load: **4000 lb (1816 kg).**
 3. Rated Speed: **125 fpm (0.64 m/s).**

4. Operation System: Selective-collective automatic.
5. Auxiliary Operations:
 - a. Battery-powered lowering.
 - b. Automatic dispatching of loaded car.
 - c. Nuisance call cancel.
6. Car Enclosures:
 - a. Inside Width: **92 inches (2337 mm)** from side wall to side wall.
 - b. Inside Depth: **65 inches (1651 mm)** from back wall to front wall (return panels).
 - c. Inside Height: **94 inches (2388 mm)** to underside of ceiling.
 - d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish with integral car door frames.
 - e. Car Fixtures: Satin stainless steel, No. 4 finish.
 - f. Side and Rear Wall Panels: Textured stainless steel.
 - g. Reveals: Satin stainless steel, No. 4 finish.
 - h. Door Faces (Interior): Satin stainless steel, No. 4 finish.
 - i. Door Sills: Aluminum, mill finish].
 - j. Ceiling: Satin stainless steel, No. 4 finish.
 - k. Handrails: **1/2 by 2 inches (13 by 50 mm)** rectangular satin stainless steel, No. 4 finish, at sides and rear of car.
 - l. Floor recessed and prepared to ceramic tile (specified in Section 093013 "Ceramic Tiling").
7. Hoistway Entrances:
 - a. Width: **48 inches (1219 mm)**.
 - b. Height: **84 inches (2134 mm)**.
 - c. Type: Single-speed center opening.
 - d. Frames: Satin stainless steel, No. 4 finish.
 - e. Doors: Satin stainless steel, No. 4 finish.
 - f. Sills: Aluminum, mill finish.
8. Hall Fixtures: Satin stainless steel, No. 4 finish.
9. Additional Requirements:
 - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.

2.4 SYSTEMS AND COMPONENTS

- A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.
 1. Pump shall be submersible type with submersible squirrel-cage induction motor, and shall be suspended inside oil tank from vibration isolation mounts.
 2. Motor shall have wye-delta] or solid-state starting.

- B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.
- C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.
- D. Hydraulic Fluid: Elevator manufacturer's standard fire-resistant fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.
- E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- F. Car Frame and Platform: Welded or bolted steel units.
- G. Guides: Roller guides; polymer-coated, nonlubricated sliding guides; or sliding guides with guide-rail lubricators. Provide guides at top and bottom of car and counterweight frames.

2.5 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.
- B. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
 1. Single-Car Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
 2. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors start closing.
 3. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.

2.6 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.

2.7 CAR ENCLOSURES

- A. General: Provide enameled-steel car enclosures to receive removable wall panels, with car roof, access doors, power door operators, and ventilation.
 1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

B. Materials and Finishes: Manufacturer's standards, but not less than the following:

1. Subfloor: Exterior, C-C Plugged grade plywood, not less than **7/8-inch (22.2-mm)** nominal thickness.
2. Floor Finish: Specified in Section 093000 Ceramic Tile.
3. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
4. Fabricate car with recesses and cutouts for signal equipment.
5. Fabricate car door frame integrally with front wall of car.
6. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
7. Sight Guards: Provide sight guards on car doors.
8. Sills: Extruded metal, with grooved surface, **1/4 inch (6.4 mm)** thick.
9. Metal Ceiling: Flush panels, with four low-voltage downlights in each panel. Align ceiling panel joints with joints between wall panels.
10. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

2.8 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
- B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.
1. Fire-Protection Rating: As indicated on drawings, with 30-minute temperature rise of **450 deg F (250 deg C)**.
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
1. Stainless-Steel Frames: Formed from stainless-steel sheet.
 2. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
 3. Sight Guards: Provide sight guards on doors matching door edges.
 4. Sills: Extruded metal, with grooved surface, **1/4 inch (6.4 mm)** thick.
 5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.9 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with LEDs.
- B. Car-Control Stations: Provide manufacturer's standard semirecessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.

1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Section 283111 "Digital, Addressable Fire-Alarm System".
- E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- F. Hall Push-Button Stations: Provide one hall push-button station at each landing.
 1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
 2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.
 3. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Section 283111 "Digital, Addressable Fire-Alarm System".
- G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide one of the following:
 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
 2. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
 3. Units mounted in both jambs of entrance frame.
 4. Units mounted in both car door jambs.
- H. Hall Announcer: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
 1. At manufacturer's option, audible signals may be placed on cars.
- I. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above hoistway entrance at ground floor. Provide units with flat faceplate for mounting and with body of unit recessed in wall.
 1. Integrate ground-floor hall lanterns with hall position indicators.
- J. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.

- K. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.
- L. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.10 FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
 - B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
 - C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
 - D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
 - E. Textured Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 with embossed texture rolled into exposed surface.
 - 1. Product: Subject to compliance with requirements, provide "<Insert product name>" by <Insert manufacturer's name>.
 - 2. Metal surface is [satin polished] [satin relieved] [titanium nitride colored] [oxide colored] [satin polished and titanium nitride colored] [satin relieved and titanium nitride colored] [satin polished and oxide colored] [satin relieved and oxide colored] [color coated and satin relieved] [color coated and bright relieved] after texturing.
- F. Stainless-Steel Bars: ASTM A 276, Type 304.
- G. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- H. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**, Alloy 6063.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.

- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- D. Install piping above the floor, where possible. Install underground piping in casing.
- E. Lubricate operating parts of systems as recommended by manufacturers.
- F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- G. Leveling Tolerance: **1/4 inch (6 mm)**, up or down, regardless of load and travel direction.
- H. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- I. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
 1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
 2. Place hall lanterns either above or beside each hoistway entrance.
 3. Mount hall lanterns at a minimum of **72 inches (1829 mm)** above finished floor.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

- A. Temporary Use: Comply with the following requirements for elevator used for construction purposes:
1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
 2. Provide strippable protective film on entrance and car doors and frames.
 3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
 4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 5. Do not load elevators beyond their rated weight capacity.
 6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).
- B. Check operation of elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
1. Perform maintenance during non-normal working hours as directed by Owner.
 2. Perform emergency callback service during normal working hours with response time of two hours or less.

END OF SECTION 142400

SECTION 143100 - ESCALATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes standard exterior escalators.

- B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
2. Section 051200 "Structural Steel Framing" for attachment plates, angle brackets, and other preparation of structural steel to support escalator trusses.
3. Section 083113 "Access Doors and Frames" for wall and ceiling access panels and access doors in escalator enclosures.
4. Section 101400 "Signage" for "Caution" signs required by ASME A17.1/CSA B44.
5. Section 283111 "Digital, Addressable Fire-Alarm System" for smoke detectors that activate escalator alarm and, after at least 15 seconds, cause the interruption of power to the escalator motor and brake and for connection to escalator controllers.

1.3 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, safety features, finishes, and similar information.

- B. Shop Drawings:

1. Include plans, elevations, sections, and details indicating coordination with building structure and relationships with other construction.
2. Indicate maximum loads imposed on building structure at points of support, and power requirements.
3. Indicate access and ventilation for escalator machine space.

- C. Delegated-Design Submittal: For escalators.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Seismic Qualification Certificates: For escalator equipment, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Manufacturer Certificates: Signed by manufacturer certifying that escalator layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for escalator system being provided.
- D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For escalators to include in emergency, operation, and maintenance manuals.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted escalator use.
- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard two-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Escalator manufacturer or an authorized representative who is trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.8 COORDINATION

- A. Coordinate installation of sleeves, block outs, escalator equipment with integral anchors, and other items that are embedded in concrete or masonry for escalator equipment. Furnish templates, sleeves, escalator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

- B. Coordinate locations and dimensions of other work relating to escalators including sumps and floor drains in pits; electrical service; and electrical outlets, lights, and switches in pits.

1.9 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace escalator work that fails in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 2. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide ThyssenKrupp Elevator; "Velino" Model, Type FT823X 5EK 30D 800 HOR, or comparable product by one of the following:
1. KONE Inc.
 2. Otis Elevator Co.
 3. Schindler Elevator Corp.
- B. Source Limitations: Obtain escalator from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Braking Performance: Provide brakes that stop escalator in up-running mode at a rate no greater than 3 ft./s² (0.91 m/s²).
- C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design escalators.
- D. Seismic Performance: Escalators shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Design earthquake spectral response acceleration short period (Sds) for Project is indicated on the structural drawings.
 2. Project's Seismic Design Category: As indicated on the structural drawings.
 3. Escalator Component Importance Factor: 1.0.

- E. Structural Performance of Balustrades, Deck Barricades, and Handrails: Provide components and assemblies capable of withstanding the effects of loads indicated in ASCE/SEI 7 for handrail assemblies and guardrail systems.

2.3 ESCALATORS

- A. Escalators, General: Manufacturer's standard escalators complying with requirements. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard escalator systems and as required for complete system.
- B. Design and equip escalators to run in either direction.
- C. Provide escalators with two flat steps at top and bottom landings.
- D. Rated Speed **100 fpm (0.5 m/s)**.
- E. Nominal Width of Treads: 40 inches (1000 mm).

2.4 COMPONENTS

- A. Fabricate exposed metalwork, including deck covers, balustrade panels, and trim to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use; increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as necessary. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
- B. Transparent Balustrades: Manufacturer's standard profile or arrangement of moving handrails on guide rail that is supported by tempered glass panels, with deck covers, skirts, trim, and accessories.
- C. Direction Indicator Lights: Provide red and green indicator lights at least **2 inches (50 mm)** in diameter in both balustrade newels at both upper and lower landings. Green light indicates entrance end, and red light indicates exit end. When escalator is stopped, red lights are illuminated at both ends.
- D. Guards at Ceiling Intersection: Clear plastic.
- E. Handrails: Smooth, jointless, reinforced neoprene.
 - 1. Color: Black.
- F. Deck Covers and Trim: Satin stainless steel.
- G. Stationary skirt panels adjacent to the steps shall be rigid and permanently coated with a friction-reducing compound. Skirting shall be finished in AISI 316 brushed no. 4 stainless steel. Skirt panels shall be designed and constructed to meet ASME A17.1-2000-2002 or the latest code requirements regarding loaded gap/skirt deflection performance.

- H. Skirt panels shall be designed to provide a flush transition between the skirt and inner decking above with no protruding edges. The skirt height along the entire length of the escalator shall be at least 7-1/4" at right angles to the step running line.
- I. Skirt Deflector Devices: Factory-installed skirt brushes shall be provided per ASME A17.1-2000-2002 or the latest code requirements.
- J. Steps: One-piece, die-cast aluminum with demarcation grooves at front and rear of tread surface.
 - 1. Finish: Powder-coated, silver color.
 - 2. Step Demarcation: **1-1/2- to 2-inch- (38- to 50-mm-)** wide yellow stripe at sides and backs of step treads.
 - 3. Nosing Demarcation: **2-inch- (50-mm-)** wide yellow stripe at nosings of step treads.
 - 4. Step guide rails on the passenger side shall be formed using U-shaped profiles from lacquered sheet steel to protect the chain from external influences. All other track shall be formed using galvanized sheet steel.
- K. Combs: Cast aluminum.
 - 1. Comb Color: Yellow.
- L. Combplate Lights: Provide recessed light fixtures with flush lenses mounted in skirt panels at each side of combplates, designed to illuminate combplate steps.
- M. Floor Plates: Removal aluminum or stainless steel lightweight plates of rigid construction with grooved or patterned surface.
- N. The operating noise level of the escalator shall not exceed 55 decibels when measured at a height of three feet above the combplate assemblies.

2.5 FEATURES

- A. Operational Control: Provide key-operated starter switches and key-operated switches for directional control located on exterior deck above newel base at both upper and lower landings of escalators.
- B. Fault Indicator: Provide escalators with a microprocessor unit that monitors safety devices, motor temperature, and escalator speed and records in nonvolatile memory the date, time, and device identification if a safety device is activated or escalator malfunctions.
 - 1. Provide built-in unit to display recorded information.
- C. Energy-Saving Feature: Provide escalator motors and controls designed for motors running on partial windings (at reduced power) when not under full load.
- D. Brake-Saving Feature: Provide stopping mechanism that allows escalator to coast to a stop before applying brakes, unless stopping is initiated by a safety device.
- E. Equip step drive mechanism with automatic step-chain lubricators.

- F. Oil Drip Pan: Provide metal pan under full width and length of escalator to collect and hold oil and grease drippings from lubricated components. Design and fabricate drip pan to sustain a load of **250 lbf (1.1 kN)** on a **1.0-sq. ft. (0.9-sq. m)** area at any location without permanent deflection.
- G. Overspeed Governor: Provide units with overspeed governor that is activated if speed of steps exceeds rated speed by more than 20 percent.
- H. Upper-Landing, Step Upthrust Device: Activated if a step is displaced against upthrust track at upper curve in passenger-carrying line of track system.
- I. Comb-Step Impact Device: Activated if a horizontal force in direction of travel is applied exceeding **400 lbf (1780 N)** at either side or exceeding **800 lbf (3560 N)** at center of front edge of combplate, or a resultant force in upward direction is applied exceeding **150 lbf (688 N)** at center of front edge of combplate.
- J. Pit Lights: Provide manufacturer's standard pit lights.
- K. Electrical Receptacles: Provide manufacturer's standard 120V GFI receptacles.
- L. Missing Step Indicator: Provide manufacturer's standard missing step indicator.
- M. Auxiliary Brake: Provide manufacturer's standard auxiliary brake.
- N. Under Step Entrance Lighting: Provide manufacturer's standard under step lighting.
- O. Trap Door: Provide manufacturer's standard trap doors for maintenance.

2.6 EXTERIOR ESCALATORS

- A. Fabricate exposed components from stainless steel unless otherwise indicated.
- B. Hot-dip galvanize escalator trusses and other structural components to comply with ASTM A 123/A 123M. Use only stainless-steel or zinc-plated fasteners.
- C. Fabricate oil drip pan from galvanized-steel sheet. Provide drain and oil/water separator in oil drip pan.
- D. Provide drains, weeps, and drips to prevent water accumulation on horizontal surfaces and to direct water away from electrical equipment and moving parts.
- E. Provide enclosures complying with NEMA 250, Type 4 for electrical connections, switches, and equipment.
- F. Provide totally enclosed motors complying with NEMA MG 1, Insulation Class B.
- G. Equip step drive mechanism with automatic step-chain lubricators.

2.7 MATERIALS

- A. Stainless Steel: ASTM A 240/A 240M Type 316.
 - 1. Satin Finish: No. 4 directional satin.
- B. Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- C. Clear Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 1 (clear), Quality q3 (glazing, select), Kind FT (fully tempered), 10.0 mm thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine escalator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine supporting structure, machine spaces, and pits; verify critical dimensions; and examine conditions under which escalators are to be installed.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions.
- B. Set escalators true to line and level, properly supported, and anchored to building structure. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
- C. Adjust installed components for smooth, efficient operation, complying with required tolerances and free of hazardous conditions. Lubricate operating parts, including bearings, tracks, chains, guides, and hardware. Test operating devices, equipment, signals, controls, and safety devices. Install oil drip pans and verify that no oil drips outside of pans.
- D. Repair damaged finishes so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of escalator installation and before permitting escalator use, perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by authorities having jurisdiction.
 - 1. For escalators specified to comply with requirements more stringent than those of ASME A17.1/CSA B44, perform tests for compliance with specified requirements. Test safety devices that are not required by ASME A17.1/CSA B44 as well as those that are.
- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate escalators.
- B. Check operation of escalators with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.5 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of escalator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper escalator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance during non-normal working hours, as directed by Owner.
 - 2. Perform emergency callback service during normal working hours with response time of two hours or less.

END OF SECTION 143100

SECTION 149133 - LAUNDRY AND LINEN CHUTES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes repairs to existing laundry and linen chute. Repairs to be limited to replacement of all intake and discharge doors only.

1.3 DEFINITIONS

- A. Chase: The shaft that encloses a chute.
- B. Intake Door: Door or hatch that penetrates the chase wall and chute, and through which materials are fed into the chute.
- C. Discharge Door: Door or hatch at the bottom of a chute, through which materials exit the chute.
- D. Access Door: Door other than an intake or discharge door that penetrates the chase wall for service access to devices in the chase.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chutes.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For chutes to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing and inspecting agency, for fire-protection ratings indicated.
 - 1. Test Pressure: Test at atmospheric (neutral) pressure according to NFPA 252 or UL 10B.
 - 2. Intake Doors: Labeled, 1-1/2-hour fire-resistance rated with 30-minute temperature rise of 250 deg F (140 deg C).
 - 3. Discharge Doors: Labeled, 1-1/2-hour fire-resistance rated with 30-minute temperature rise of 250 deg F (140 deg C).
 - 4. Access Doors: Labeled, 1-1/2-hour fire-resistance rated with 30-minute temperature rise of 250 deg F (140 deg C).
- B. Standard: Provide replacement doors to bring existing chute in compliance with NFPA 82 unless otherwise indicated.

2.2 DOORS

- A. Intake-Door Assemblies: ASTM A 240/A 240M, Type 304, stainless-steel self-closing units with positive latch and latch handle, with stainless-steel trim; constructed as required for performance requirements indicated; and with frame suitable for the enclosing chase construction.
 - 1. Door Type: Side hinged, 180-degree swing, square.
 - 2. Size: Manufacturer's standard size for door type, chute type, and diameter indicated.
 - 3. Finish: Manufacturer's standard satin or No. 3 directional polish.
 - 4. Latchset: Lever-handle type that unlatches door.
 - 5. Accessible Automatic Door Operating System: Manufacturer's standard system complying with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.
- B. Discharge-Door Assemblies: Aluminum-coated-steel doors; horizontal-discharge, top-hinged, self-closing and latching, hopper-type door; constructed as required for performance requirements indicated; equipped with 165 deg F (74 deg C) fusible links that cause doors to close in the event of fire; with floor-mounted leg brace designed to absorb impact of material dropping against chute; and with minimum NPS 2 (DN 50) drain pipe connection.
 - 1. Locate smoke detector outside discharge door with solenoid to close discharge door.
- C. Access-Door Assemblies: Manufacturer's standard ASTM A 240/A 240M, Type 302/304, stainless-steel doors with trim; constructed as required for performance requirements indicated; with frame suitable for the enclosing chase construction; and in satin or No. 3 directional polish finish; equipped with cylinder locks that release latch with keys that are removable only when cylinder is locked.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Intake and Discharge Doors: Interface door units with throat sections of chutes for safe, snag-resistant, sanitary depositing of materials in chutes.
- B. Test and adjust chute components after installation. Operate doors, locks, and interlock systems to demonstrate that hardware operates properly and smoothly and electrical wiring is connected correctly.

3.2 CLEANING

- A. After completing chase enclosure, clean exposed surfaces of chute system's components. Do not remove labels of testing and inspecting agencies.

END OF SECTION 149133

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Concrete bases.
7. Supports and anchorages.

1.2 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: The contractor shall submit equipment, riser and piping layout plans, drawn to scale, on which all other electrical, mechanical, plumbing or other systems and building construction are shown and coordinated with each other, using input from installers of the items involved.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 QUALITY ASSURANCE

- A. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solvent Cements for Joining CPVC Plastic Piping: ASTM F 493.

2.3 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Plastic or Carbon steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.

- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- F. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
- G. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-suppression materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

END OF SECTION 210500

SECTION 211313 - WET-PIPE FIRE-SUPPRESSION SPRINKLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Sprinklers.
3. Pressure gages.

1.2 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.3 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. The design and installation shall comply with the requirements of NFPA 13, NFPA 14, the local jurisdiction, and the owner's insurance underwriter.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: Greater of 10 percent or 10-psi, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:

- a. Automobile Parking Areas: Ordinary Hazard, Group 1.
- b. Building Service Areas: Ordinary Hazard, Group 1.
- c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
- d. General Storage Areas: Ordinary Hazard, Group 1.
- e. Libraries except Stack Areas: Light Hazard.
- f. Library Stack Areas: Ordinary Hazard, Group 2.
- g. Machine Shops: Ordinary Hazard, Group 2.
- h. Mechanical Equipment Rooms: Ordinary Hazard, Group .
- i. Office and Public Areas: Light Hazard.

- j. Restaurant Service Areas: Ordinary Hazard, Group 1.
 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (4.1 mm/min. over 139-sq. m) area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m) area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. (8.1 mm/min. over 139-sq. m) area.
 4. Maximum Protection Area per Sprinkler: Per UL listing.
 5. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 120 sq. ft. (11.1 sq. m).
 - b. Storage Areas: 130 sq. ft. (12.1 sq. m) .
 - c. Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m) .
 - d. Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m) .
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm (6.3 L/s) for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm (15.75 L/s) for 60 to 90 minutes.
- D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13.

1.4 SUBMITTALS

- A. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: For power, signal, and control wiring.
- B. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional responsible for their preparation.
- C. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Domestic plumbing piping.
 2. HVAC equipment and ductwork in ceiling space
 3. HVAC hydronic piping.
 4. Items penetrating finished ceiling include the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.

- D. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13 and NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations.
- E. Fire-hydrant flow test report.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Standards: All sprinkler system design, materials, equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
 - 2. NFPA 14, "Standard for the Installation of Standpipe and Hose Systems"
 - 3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
 - 4. International Fire Code
 - 5. Local jurisdiction requirements

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M,. Pipe ends may be factory or field formed to match joining method.

- B. Schedule 40, Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 40. Pipe ends may be factory or field formed to match joining method.
- C. Schedule 10 Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
- D. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.
 - 2. Pressure Rating: 175 psig (1200 kPa) minimum.
 - 3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
- E. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig (1200-kPa) pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Victaulic Company.

2.3 STEEL PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.
 - 1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.4 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18 pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22 pressure fittings.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- G. Copper Pressure-Seal Fittings:
 - 1. Standard: UL 213.
 - 2. **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.5 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 - 1. Valves shall be UL listed or FM approved.
 - 2. Minimum Pressure Rating: 175 psig (1200 kPa).
- B. Check Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AFAC Inc.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. Anvil International, Inc.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Crane Co.; Crane Valve Group; Stockham Division.
 - h. Fire-End & Croker Corporation.
 - i. Fire Protection Products, Inc.
 - j. Fivalco Inc.
 - k. Globe Fire Sprinkler Corporation.
 - l. Groeniger & Company.
 - m. Kennedy Valve; a division of McWane, Inc.
 - n. Matco-Norca.

- o. Metraflex, Inc.
 - p. Milwaukee Valve Company.
 - q. Mueller Co.; Water Products Division.
 - r. NIBCO INC.
 - s. Potter Roemer.
 - t. Reliable Automatic Sprinkler Co., Inc.
 - u. Shurjoint Piping Products.
 - v. Tyco Fire & Building Products LP.
 - w. United Brass Works, Inc.
 - x. Venus Fire Protection Ltd.
 - y. Victaulic Company.
 - z. Viking Corporation.
 - aa. Watts Water Technologies, Inc.
- 2. Standard: UL 312.
 - 3. Pressure Rating: 250 psig (1725 kPa) minimum.
 - 4. Type: Swing check.
 - 5. Body Material: Cast iron.
 - 6. End Connections: Flanged or grooved.

C. Bronze OS&Y Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. United Brass Works, Inc.
- 2. Standard: UL 262.
- 3. Pressure Rating: 175 psig (1200 kPa).
- 4. Body Material: Bronze.
- 5. End Connections: Threaded.

D. Iron OS&Y Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Hammond Valve.

- h. Milwaukee Valve Company.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Shurjoint Piping Products.
 - l. Tyco Fire & Building Products LP.
 - m. United Brass Works, Inc.
 - n. Watts Water Technologies, Inc.
- 2. Standard: UL 262.
 - 3. Pressure Rating: 250 psig (1725 kPa) minimum.
 - 4. Body Material: Cast or ductile iron.
 - 5. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Shurjoint Piping Products.
 - h. Tyco Fire & Building Products LP.
 - i. Victaulic Company.
- 2. Standard: UL 1091.
- 3. Pressure Rating: 175 psig (1200 kPa) minimum.
- 4. Valves NPS 2 (DN 50) and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
- 5. Valves NPS 2-1/2 (DN 65) and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.

2.6 TRIM AND DRAIN VALVES

A. General Requirements:

- 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

2. Minimum Pressure Rating: 175 psig (1200 kPa).

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Affiliated Distributors.
 - b. Anvil International, Inc.
 - c. Barnett.
 - d. Conbraco Industries, Inc.; Apollo Valves.
 - e. Fire-End & Croker Corporation.
 - f. Fire Protection Products, Inc.
 - g. Flowserve.
 - h. FNW.
 - i. Jomar International, Ltd.
 - j. Kennedy Valve; a division of McWane, Inc.
 - k. Kitz Corporation.
 - l. Legend Valve.
 - m. Metso Automation USA Inc.
 - n. Milwaukee Valve Company.
 - o. NIBCO INC.
 - p. Potter Roemer.
 - q. Red-White Valve Corporation.
 - r. Southern Manufacturing Group.
 - s. Stewart, M. A. and Sons Ltd.
 - t. Tyco Fire & Building Products LP.
 - u. Victaulic Company.
 - v. Watts Water Technologies, Inc.

2.7 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. AFAC Inc.

- b. Globe Fire Sprinkler Corporation.
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Tyco Fire & Building Products LP.
 - e. Venus Fire Protection Ltd.
 - f. Victaulic Company.
 - g. Viking Corporation.
2. Standard: UL 193.
 3. Design: For horizontal or vertical installation.
 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, and fill-line attachment with strainer.
 5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
 6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4 (DN 20).
6. End Connections: Threaded.

2.8 FIRE-DEPARTMENT CONNECTIONS

- A. Flush-Type, Fire-Department Connection: Provide a fire-department connection of the size and type required by the local authority.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. GMR International Equipment Corporation.
 - d. Guardian Fire Equipment, Inc.
 - e. Potter Roemer.
 2. Standard: UL 405.
 3. Type: Flush, for wall mounting.
 4. Pressure Rating: 175 psig (1200 kPa) minimum.
 5. Body Material: Corrosion-resistant metal.

6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal.
11. Number of Inlets: Two.
12. Escutcheon Plate Marking: Similar to "AUTO SPKR."
13. Finish: Polished chrome plated.
14. Outlet Size: NPS 4 (DN 100).

2.9 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig (1200 kPa) minimum.

4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer.
2. Standard: UL 199.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CECA, LLC.
 - b. Corcoran Piping System Co.

- c. Merit Manufacturing; a division of Anvil International, Inc.
 - 2. Standard: UL 1474.
 - 3. Pressure Rating: 250 psig (1725 kPa) minimum.
 - 4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
 - 5. Size: Same as connected piping.
 - 6. Length: Adjustable.
 - 7. Inlet and Outlet: Threaded.
- F. Flexible, Sprinkler Hose Fittings:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fivalco Inc.
 - b. FlexHead Industries, Inc.
 - c. Gateway Tubing, Inc.
 - 2. Standard: UL 1474.
 - 3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
 - 4. Pressure Rating: 175 psig (1200 kPa) minimum.
 - 5. Size: Same as connected piping, for sprinkler.
- 2.10 SPRINKLERS
- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 1. AFAC Inc.
 - 2. Globe Fire Sprinkler Corporation.
 - 3. Reliable Automatic Sprinkler Co., Inc.
 - 4. Tyco Fire & Building Products LP.
 - 5. Venus Fire Protection Ltd.
 - 6. Victaulic Company.
 - 7. Viking Corporation.
- B. General Requirements:
- 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Pressure Rating for Residential Sprinklers: 175 psig (1200 kPa) maximum.
 - 3. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.
 - 4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig (1725 kPa) minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
- 1. Nonresidential Applications: UL 199.

2. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated – in unoccupied locations (mechanical rooms, storage rooms, etc.)
2. Bronze.
3. Painted – white – in occupied, visible locations.

E. Special Coatings:

1. Wax.
2. Lead.
3. Corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Plastic, white finish, one piece, flat.
2. Sidewall Mounting: Plastic, white finish, one piece, flat.

G. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.11 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Globe Fire Sprinkler Corporation.
 - b. Tyco Fire & Building Products LP.

- c. Victaulic Company.
 - d. Viking Corporation.
- 2. Standard: UL 753.
 - 3. Type: Mechanically operated, with Pelton wheel.
 - 4. Alarm Gong: Cast aluminum with red-enamel factory finish.
 - 5. Size: 10-inch (250-mm) diameter.
 - 6. Components: Shaft length, bearings, and sleeve to suit wall construction.
 - 7. Inlet: NPS 3/4 (DN 20).
 - 8. Outlet: NPS 1 (DN 25) drain connection.

C. Water-Flow Indicators:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ADT Security Services, Inc.
 - b. McDonnell & Miller; ITT Industries.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Viking Corporation.
 - f. Watts Industries (Canada) Inc.
- 2. Standard: UL 346.
- 3. Water-Flow Detector: Electrically supervised.
- 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
- 5. Type: Paddle operated.
- 6. Pressure Rating: 250 psig (1725 kPa).
- 7. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
- 2. Standard: UL 346.
- 3. Type: Electrically supervised.
- 4. Components: Single-pole, double-throw switch with normally closed contacts.
- 5. Design: Signals that controlled valve is in other than fully open position.

2.12 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AMETEK; U.S. Gauge Division.
 - 2. Ashcroft, Inc.
 - 3. Brecco Corporation.
 - 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa) minimum.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include[retard feature and] "AIR" or "AIR/WATER" label on dial face.

2.13 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated finish with set-screws.
- C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw or spring clips.
- E. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with concealed hinge and set-screw.
- F. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed hinge, set-screw or spring clips.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.14 SLEEVES

- A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

- C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.
- G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set-screws.

2.15 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories required at connection to water-service piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. All exposed sprinkler piping shall be run neat and symmetrical with regard to other construction and shall be approved by the architect.
 - 2. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- N. Fill sprinkler system piping with water.

- O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Coordinate with the electrical contractor.

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.4 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.5 SPRINKLER INSTALLATION

- A. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- B. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.6 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.7 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, stamped steel with set-screw.
 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split plate, stamped steel with set-screw
 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish
 5. Bare Piping in Equipment Rooms: One piece, stamped steel with set-screw.
 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.8 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 7 Section "Joint Sealants."
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 7 Section "Joint Sealants."
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE, Molded PVC, or Galvanized-steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe or Stack sleeve fittings.
 - a. Extend sleeves 2 inches (50 mm) above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Comply with requirements for flashing in Division 7 Section "Sheet Metal Flashing and Trim."
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. PVC-pipe sleeves for pipes smaller than NPS 6 (DN 150).
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 (DN 150) and larger.
 - c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6 (DN 150).
 - b. Cast-iron wall-pipe sleeves for pipes NPS 6 (DN 150) and larger.
 - c. Install sleeves that are large enough to provide 1-inch (25-mm) annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - 5. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. PVC-pipe sleeves for pipes smaller than NPS 6 (DN 150).
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 (DN 150) and larger.

- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 7 Section "Through-Penetration Firestop Systems."

3.9 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.10 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Electrical Identification."

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 4. Energize circuits to electrical equipment and devices.
 5. Start and run excess-pressure pumps.
 6. Coordinate with fire-alarm tests. Operate as required.
 7. Coordinate with fire-pump tests. Operate as required.
 8. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.12 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.13 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end-pipe couplings; and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Wet-pipe sprinkler system, NPS 2 and smaller, shall be the following:
 1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Type L (Type B), hard copper tube with plain ends; cast- or wrought-copper, solder-joint fittings; and brazed joints.
 3. Type L (Type B), hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
 - 4.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 3 to NPS 6, shall be the following:
 1. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.14 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Ceilings: Semi-recessed sprinklers.
 3. Wall Mounting: Sidewall sprinklers.
 4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 3. Recessed Sprinklers: Bright chrome, with painted white escutcheon.
 4. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

AQUA WAIKIKI WAVE
BUILDING PACKAGE

34-14102-00
FOR REVIEW - NOT FOR CONSTRUCTION

END OF SECTION 211313

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- D. Solvent Cements for Joining Plastic Piping:
 1. ABS Piping: ASTM D 2235.
 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 3. PVC to ABS Piping Transition: ASTM D 3138.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- D. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.4 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

- B. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Fixtures and Equipment to Be Removed: Disconnect and cap services and remove fixture or equipment.
 - 3. Fixtures or Equipment to Be Removed and Salvaged: Disconnect and cap services and remove fixture or equipment and deliver to Owner.
- B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 INSTALLATION – COMMON REQUIREMENTS

- A. Install all fixtures, material, accessories, etc. according to the manufacturer's instructions.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.

- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through gypsum-board partitions.
- N. Verify final fixture locations for roughing-in.
- O. Refer to fixture specifications in other Sections of these Specifications for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
 5. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- H. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- I. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

END OF SECTION 220500

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Tel-Tru Manufacturing Company.
 - e. Trerice, H. O. Co.
 - f. Weiss Instruments, Inc.
 - g. Winters Instruments - U.S.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 7-inch (178-mm) nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and or red organic liquid.

6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C).
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Trerice, H. O. Co.

- l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
- m. Weiss Instruments, Inc.
- n. WIKA Instrument Corporation - USA.
- o. Winters Instruments - U.S.
2. Standard: ASME B40.100.
3. Case: Sealed type; cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Metal.
11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range or better.

2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with [NPS 1/4 (DN 8)] [NPS 1/4 or NPS 1/2 (DN 8 or DN 15)] [NPS 1/2 (DN 15)], ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
 2. Hot water recirculation piping near the water heater.
 3. Inlets and outlets of each domestic water heat exchanger.
 4. Inlet and outlet of each domestic hot-water storage tank.
- H. Install pressure gages in the following locations:
1. Building water service entrance into building.
 2. Inlet and outlet of each pressure-reducing valve.
 3. Suction and discharge of each domestic water pump.
- I. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- J. Adjust faces of meters and gages to proper angle for best visibility.

3.2 THERMOMETER SCHEDULE

- A. Thermometers shall be:
1. Liquid-filled, bimetallic-actuated type.
- B. Thermometer stems shall be of length to match thermowell insertion length.

3.3 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C).
- B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F (0 to 150 deg C).

3.4 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 100 psi (0 to 600 kPa)

END OF SECTION 220519

SECTION 220523 - GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ball valves.
2. Gate valves
3. Check valves
4. Balancing valves

1.2 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.

1. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
2. Maintenance data for valves to include in the operation and maintenance manual specified in Division 01. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.3 QUALITY ASSURANCE

A. Single-Source Responsibility: Comply with the requirements specified in Division 01. Provide all valves of the same manufacturer where possible.

1. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

B. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.

3. Set globe and gate valves closed to prevent rattling.
 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:

1. Ball Valves and Gate Valves:
 - a. Hammond Valve Corporation (800-348-6544)
 - b. Milwaukee Valve Company, Inc. (262-432-2700)
 - c. NIBCO Inc. (574-295-3000)
2. Balancing Valves:
 - a. Victaulic Company (800-742-5842)
 - b. Hays Fluid Controls, A Romac Industries, Inc. Company (800-354-4297)
3. Check Valves:
 - a. Hammond Valve Corporation (800-348-6544)
 - b. Milwaukee Valve Company, Inc. (262-432-2700)
 - c. NIBCO Inc. (574-295-3000)

2.2 GENERAL

- A. Design: Rising stem or rising outside screw and yoke stems, except as specified below.
1. Nonrising stem valves may be used only where headroom prevents full extension of rising stems.
- B. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.
- C. Sizes: Same size as upstream pipe, unless otherwise indicated.

- D. Operators: Use specified operators and handwheels, except provide the following special operator features:
1. Handwheels: For valves other than quarter turn.
 2. Lever Handles: For quarter-turn valves 6 inches (DN150) and smaller, except for plug valves, which shall have square heads. Furnish Owner with 1 wrench for every 10 plug valves.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.
- G. Threads: ASME B1.20.1.
- H. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.
- I. Solder Joint: ASME B16.18.
1. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.3 BALL VALVES

- A. Ball Valves, 4 Inches (DN100) and Smaller: MSS SP-110, Class 150, 600-psi CWP, ASTM B584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for 1/2-inch (DN15) valves and smaller and conventional port for 3/4-inch (DN20) valves and larger; blowout proof; bronze or brass stem; Teflon seats and seals; threaded or soldered end connections:
1. Operator: Vinyl-covered steel lever handle.
 2. Stem Extension: For valves installed in insulated piping.
 3. Memory Stop: For operator handles (balancing valves).

2.4 GATE VALVES

- A. Gate Valves, 2-1/2 Inches (DN65) and Smaller: MSS SP-80; Class 125, 200-psi cold working pressure (CWP), ASTM B62 cast-bronze body and bonnet, solid-bronze wedge, copper-silicon alloy rising stem, Teflon-impregnated packing with bronze packing nut, threaded or soldered end connections; and with aluminum or malleable-iron handwheel.
- B. Gate Valves, 3 Inches (DN80) and Larger: MSS SP-70, Class 125, 200-psi CWP, ASTM A126 cast-iron body and bonnet, solid cast-iron wedge, brass-alloy stem, outside screw and yoke, Teflon-impregnated packing with 2-piece packing glad assembly, flanged end connections; and with cast-iron handwheel.

2.5 BALANCING VALVES

- A. Calibrated Balancing Valves: Adjustable, with 2 readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.
 - 1. 2-inch NPS (DN50) and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends.
 - 2. 2-inch NPS (DN500 and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.
- B. Memory-Stop Balancing Valves, 2-Inch NPS (DN50) and Smaller: MSS SP-110, ball valve, rated for 400-psig minimum CWP. Include 2-piece, ASTM B62 bronze body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, solder-joint ends, and vinyl-covered steel handle with memory-stop device.
- C. Automatic Flow Control Valves (AFCV): Automatic flow control valves shall be factory set to rated flow, and shall automatically control the flow to within 10% of the rated value, over a 40 to 1 differential pressure, operating range, (2 to 80 PSID). Operational temperature shall be rated from fluid freezing, to 225 degree F.
 - 1. "MESURFLO" by Hays Fluid Controls, or approved substitution by listed manufacturers.
 - a. Automatic Flow Control valve body shall be constructed of hot forged brass UNS C37700 or C36000 per ASTM B283 latest revision, ductile iron per ASTM A395, valve grade cast iron per ASTM B209, or UNS C84400 Cast Semi-Red Brass with inch size pipe thread fittings per ASME B1.20.1, and B31.9. UNS C37700 and UNS C36000 valve bodies are suitable for 600 PSIG Iron, and Cast Brass valve bodies are suitable for 400 PSIG. Working Pressure rating per ASTM A53 threaded joint type. Valve body shall also be available with sweat fittings per ASME B16.22 requirements and are intended for use in Building Services Piping meeting the requirements of ASME B31.9. The Temperature/Pressure Rating of the Solder Joint is dependent upon the type of solder used. ASME Standard B16.22 Pressure Ratings should be reviewed prior to sweating.
 - 2. "Y-BALL MESURFLO" by Hays Fluid Controls, or approved substitution by listed manufacturers:
 - a. Ball Valve, combination Automatic Flow Control Valves, shall be made of hot forged brass UNS C37700 per ASTM B283 Latest Revision, using full flow design balls, blowout proof stems, and shall be rated for 600 PSIG WOG.
 - b. Copper Sweat fittings 1/2, 3/4, 1 & 1 1/4, INCH shall be suitable for 522 PSIG. Working Pressure Rating per ASME B31.9 Building Services Piping.
 - c. Threaded fittings 1/2, through 1 1/2 INCH shall be suitable for 600 PSIG. Working Pressure Rating per ASTM A53B for threaded joint type extra weight, of the pipe size indicated. (For most Building Services applications, ANSI Class 125 rating.) Flow rates from .5 to 24.0 GPM will have a differential pressure operating range of 2 to 80 PSID. Flow rates shall be field changeable without breaking the piping connections.
 - 3. Valve internal control mechanism shall be of a quiet, clog resistant design and consist of one or more, precision sculptured brass or polyphenylsulfone with high temperature elastomeric

- diaphragm. Each automatic balancing valve will automatically control the flow rate within 10% of its rated flow, over a temperature range of 32 to 225 degree F, and a pressure differential range of 2-80 PSID. Flow increments shall be available in 0.125 to 0.5 GPM steps for 0.5 to 8.0 GPM, 1.0 to 2.0 GPM steps for 9.0 to 24 GPM, and 5.0 GPM steps for 25 to 200 GPM.
4. Dual pressure/temperature test ports for verifying the pressure differential and system temperature shall be standard.
 5. Manufacturer shall provide certified independent laboratory tests verifying accuracy of performance.
 6. All valves shall be marked per MMS-SP-25-78 (1983) and shall show as a minimum; controlled flow direction, flow rate, PSID control range, manufacturer and model number.

2.6 CHECK VALVES

- A. Swing Check Valves, 2-1/2 Inches (DN65) and Smaller: MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:
- B. Swing Check Valves, 3 Inches (DN80) and Larger: MSS SP-71, Class 125, 200-CWP, ASTM A126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged or grooved end connections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the center of the pipe and in a position to allow full stem movement.
- F. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.
- G. Sectional Valves: Install sectional gate or ball valves closest to main on each branch and riser serving plumbing fixtures or equipment, and where indicated.
- H. Shutoff Valves: Install gate or ball shutoff valve on each water supply to equipment, on each supply to plumbing fixtures without supply stops, and where indicated.
- I. Drain Valves: Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Install hose-end drain valves with cap and chain at low points in water mains, risers, and branches.
 - 2. Install stop-and-waste drain valves where indicated.
- J. Balancing Valves: Install in each hot-water circulation return branch, discharge side of each pump and circulator, and where indicated.

3.3 SOLDERED CONNECTIONS

- A. Cut tube square and to exact lengths.
- B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
- D. Open gate and globe valves to fully open position.
- E. Remove the cap and disc holder of swing check valves having composition discs.

- F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.
- G. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.4 THREADED CONNECTIONS

- A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
- D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.5 FLANGED CONNECTIONS

- A. Align flange surfaces parallel.
- B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.6 VALVE END SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 1. Copper Tube Size, 2-1/2 Inches (DN65) and Smaller: Solder ends.
 2. Steel Pipe Sizes, 2-1/2 Inches (DN65) and Smaller: Threaded or grooved end.
 3. Steel Pipe Sizes, 3 Inches (DN80) and Larger: Grooved end or flanged.

3.7 APPLICATION SCHEDULE

- A. General Application: Use gate and ball, valves for shutoff duty; globe and ball for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.
- B. Domestic Water Systems: Use the following valve types:

1. Ball Valves: Class 150, 600-psi CWP, with stem extension.
- C. Domestic Hot Water Recirculation Systems: Use the following valve types:
 1. Balancing Valves: Automatic or adjustable Ball valves with readout ports.

3.8 ADJUSTING

- A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Fastener systems.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated.

1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper- or epoxy-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.2 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa), ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.3 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Fastener System Installation:
 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

- D. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- E. Install lateral bracing with pipe hangers and supports to prevent swaying.
- F. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- I. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Saddles exposed to view shall have a paint grip surface.
 - b. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.

- d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
- e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
- 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.3 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper- or epoxy-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
 - 3. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).

5. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Saddles and shields exposed to view shall have a paint grip surface.
 2. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 3. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 4. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Aluminum, 0.032-inch (0.8-mm) or [anodized aluminum, 0.032-inch (0.8-mm)] minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.

8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 25 feet (15 m) along each run. Reduce intervals to 15 feet (7.6 m) in areas of congested piping and equipment.
 7. Natural Gas Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black
 8. Fire Sprinkler Piping:
 - a. Background Color: Red
 - b. Letter Color: White

9. Hot and Cold Domestic Water Piping:

- a. Background Color: Green.
- b. Letter Color: White.

10. Storm Drain, Overflow Drain, and Sanitary Waste Piping:

- a. Background Color: Green
- b. Letter Color: White

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Refer to the schedules on the plans for plumbing piping services requiring insulation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Aeroflex USA, Inc.; Aerozel.
- b. Armacell LLC; AP Armaflex.
- c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

F. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Fibrex Insulations Inc.; Coreplus 1200.
- b. Johns Manville; Micro-Lok.
- c. Knauf Insulation; 1000-Degree Pipe Insulation.
- d. Manson Insulation Inc.; Alley-K.
- e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 Deg F (454 Deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Aeroflex USA, Inc.; Aeroseal.
- b. Armacell LLC; Armaflex 520 Adhesive.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
- d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 2.
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
 - d. Mon-Eco Industries, Inc.; 22-25.
 3. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 4. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - c. <Insert manufacturer's name; product name or designation>.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Permanently flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
 4. Color: White or gray.
 5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for pipe.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 11.5 mils (0.29 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.

- d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.9 SECUREMENTS

- A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wing seal or closed seal.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- C. Wire: 0.080-inch (2.0-mm) nickel-copper alloy.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C & F Wire.

2.10 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Engineered Brass Company.
 - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing.
 - d. Plumberex.
 - e. Truebro; a brand of IPS Corporation.
 - f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Truebro; a brand of IPS Corporation.
 - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.

- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements for firestopping and fire-resistive joint sealers in other sections of the specifications.
- C. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. for firestopping and fire-resistive joint sealers in other sections of the specifications

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 FINISHES

A. Exposed insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

- a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 PIPING INSULATION SCHEDULE: See drawing schedule for allowable materials, thickness, and jacketing requirements.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes domestic water pipes, tubes, and fittings inside buildings.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. All products shall be UL classified in accordance with ANSI / NSF-61 for potable water service, and shall be certified to the low lead requirements of NSF-372.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.3 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Types L water tube, drawn temper.

2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International.

- e. Matco-Norca.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
2. Standard: ASSE 1079.
 3. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Matco-Norca.
 - d. Watts; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
 2. Standard: ASSE 1079.
 3. Factory-fabricated, bolted, companion-flange assembly.
 4. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C)
 5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - c. Matco-Norca.
 - d. Precision Plumbing Products, Inc.
 - e. Victaulic Company.
 2. Standard: IAPMO PS 66.
 3. Electroplated steel nipple complying with ASTM F 1545.
 4. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C)
 5. End Connections: Male threaded or grooved.
 6. Lining: Inert and noncorrosive, propylene.
- E. Dielectric Waterways:
1. $\frac{1}{2}$ " (DN15) through 4" (DN100) sizes, IPS to copper-tubing size dielectric transition fitting. Fittings shall be a copper-silicon casting conforming to UNS C87850, and UL classified in accordance with ANSI / NSF-61 for potable water service. Fittings shall have threaded ends, grooved ends, or a combination. Victaulic Style 647.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install shut off valves at all locations where branch water piping connects to the main piping. Install valves to isolate each restroom or group of fixtures by room.
- C. Install shutoff valve immediately upstream of each dielectric fitting.
- D. Install domestic water piping level with 0.25 percent slope downward toward drain.
- E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- H. Install piping to permit valve servicing.
- I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- M. Install sleeves for piping penetrations of walls, ceilings, and floors.
- N. Install sleeve seals for piping penetrations of concrete walls and slabs.
- O. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
- E. Install supports for vertical steel piping every 15 feet (4.5 m).
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

- C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
1. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.7 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
 - B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
 - C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.8 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.9 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Mechanically formed tee-branch outlets are strictly prohibited.
- D. Underground, Service Entrance Piping: Do not use flanges or valves underground. Use the following:

1. 2-Inch NPS (DN50) and Smaller: Soft copper tube, Type K (Type A); copper, solder-joint pressure fittings; and soldered joints.
 2. 2-1/2- to 4-Inch NPS (DN65 to DN100): Soft copper tube, Type K (Type A); copper, solder-joint pressure fittings; and soldered joints.
- E. Aboveground, Water Distribution Piping: Use the following:
1. 4-Inch NPS (DN100) and Smaller: Hard copper tube, Type L (Type B); copper, solder-joint fittings; and soldered joints.
 2. 5- to 6-Inch NPS (DN125 to DN150): Hard copper tube, Type L (Type B) with grooved ends; copper, grooved-end fittings; and copper, keyed couplings.
- F. Underground, Water Distribution Piping: Do not use flanges or valves underground. Use the following:
1. 2-Inch NPS (DN50) and Smaller: Soft copper tube, Type L (Type B); wrought-copper, solder-joint pressure fittings; and soldered joints.
 2. 2-1/2- to 4-Inch NPS (DN65 to DN100): Hard copper tube, Type L (Type B); wrought-copper, solder-joint pressure fittings; and soldered joints.
- G. Non-Potable-Water Piping: Use the following:
1. 3-1/2-Inch NPS (DN90) and Smaller: Hard copper tube, Type L (Type B); solder-joint pressure fittings; and soldered joints.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Strainers.
4. Outlet boxes.
5. Hose bibbs.
6. Wall hydrants.
7. Drain valves.
8. Water hammer arresters.
9. Air vents.
10. Trap-seal primer valves.
11. Trap-seal protection devices.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on plastic piping components.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa) unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; SPX Valves & Controls.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Woodford Manufacturing Company.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Rough bronze.

C. Pressure Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Toro Company (The); Irrigation Div.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.

5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Wilkins
 - g. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1013.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.
 5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved stainless steel for NPS 2-1/2 (DN 65) and larger.
 6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
 7. Configuration: Designed for horizontal, straight through flow.
 8. Accessories:
 - a. Valves: Provide gate type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller backflow assemblies; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
 - b. Wafer Check valve upstream of backflow preventer.
 - c. Pressure reducing valve with pressure gauges upstream and downstream of valve.
 - d. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
 1. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
 2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 (DN 65) and larger.
 3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
 4. Screen: Stainless steel with round perforations, unless otherwise indicated.
 5. Perforation Size:
 - a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch.
 - b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch.
 - c. Strainers NPS 5 (DN 125) and Larger: 0.125 inch.
 6. Drain: Pipe plug.

2.6 OUTLET BOXES

- A. Clothes Washer Outlet Boxes: See Plumbing Fixture Schedule on plans.
1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Guy Gray Manufacturing Co., Inc.
 - c. IPS Corporation.
 - d. LSP Products Group, Inc.
 - e. Symmons Industries, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Whitehall Manufacturing; a div. of Acorn Engineering Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 2. Mounting: Recessed.

2.7 HOSE BIBBS

- A. Hose Bibbs: See Plumbing Fixture Schedule on plans
1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.18.1 for sediment faucets.
 3. Body Material: Bronze.
 4. Seat: Bronze, replaceable.

2.8 WALL HYDRANTS

- A. Nonfreeze Wall Hydrants: See Plumbing Fixture Schedule on plans
1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.

2.9 WATER HAMMER ARRESTERS

- A. Water Hammer Arresters:
1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASSE 1010 or PDI-WH 201.
 3. Type: Metal bellows.
 4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.10 AIR VENTS

- A. Bolted-Construction Automatic Air Vents :
1. Body: Bronze.
 2. Pressure Rating: 125-psig (860-kPa) minimum pressure rating at 140 deg F (60 deg C).
 3. Float: Replaceable, corrosion-resistant metal.
 4. Mechanism and Seat: Stainless steel.
 5. Size: NPS 1/2 (DN 15) minimum inlet.
 6. Inlet and Vent Outlet End Connections: Threaded.
- B. Welded-Construction Automatic Air Vents :
1. Body: Stainless steel.
 2. Pressure Rating: 150-psig (1035-kPa) minimum pressure rating.
 3. Float: Replaceable, corrosion-resistant metal.
 4. Mechanism and Seat: Stainless steel.
 5. Size: NPS 3/8 (DN 10) minimum inlet.
 6. Inlet and Vent Outlet End Connections: Threaded.

2.11 TRAP-SEAL PRIMER VALVES

- A. Supply-Type, Trap-Seal Primer Valves :
1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 2. Standard: ASSE 1018.
 3. Pressure Rating: 125 psig (860 kPa) minimum.

4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.12 TRAP SEAL PROTECTION DEVICES

- A. Barrier Type Trap Seal Protection Devices :
1. Basis-of-Design Product: Subject to acceptance by the local jurisdiction, provide SureSeal Manufacturing; Inline Floor Drain Trap Sealer, or a comparable product with IAPMO approval from another manufacturer.
 2. Standard: ASSE 1072-2007.
 3. Body: ASB Plastic
 4. Diaphragm & Sealing Gasket: Neoprene Rubber
 5. Size: 2 inch (50 mm), 3 inch (75 mm), 3-1/2 inch (89 mm), or 4 inch (100 mm).
 6. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- C. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve.
- D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
- a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.

- b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
- c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
- 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
- 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- 5. Install trap-seal protection devices in all floor drains during trim out stage of project.
- E. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs.
- F. Install nonfreeze, nondraining-type post hydrants set in concrete or pavement.
- G. Install water hammer arresters in water piping according to PDI-WH 201.
- H. Install air chambers at each plumbing fixture supply line.
- I. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding."
- C. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
 - B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
 - C. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221125 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig (690 kPa) minimum unless otherwise indicated.
2. Service Regulators: 100 psig (690 kPa) minimum unless otherwise indicated.

B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig (3.45 kPa) but not more than 2 psig (13.8 kPa), and is reduced to secondary pressure of 0.5 psig (3.45 kPa) or less.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of piping specialty, valve, or regulator. Submittals not required on pipe or tubing.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control and test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. OmegaFlex, Inc.
 - b. Parker Hannifin Corporation; Parflex Division.
 - c. Titeflex.
 - d. Tru-Flex Metal Hose Corp.
 - 2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
 - 3. Coating: PE with flame retardant.
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 or less.
 - 4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
 - 5. Striker Plates: Steel, designed to protect tubing from penetrations.
 - 6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
 - 7. Operating-Pressure Rating: 5 psig (34.5 kPa).

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches (1830 mm.)

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (862 kPa).

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig (862 kPa).
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig (4140 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.

4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig (4140 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Eclipse Combustion, Inc.
 - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - e. Invensys.
 - f. Maxitrol Company.
 - g. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 2 psig (13.8 kPa).

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canadian Meter Company Inc.
 - b. Eaton Corporation; Controls Div.
 - c. Harper Wyman Co.
 - d. Maxitrol Company.
 - e. SCP, Inc.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig (13.8 kPa)

2.6 DIELECTRIC UNIONS

A. Dielectric Unions:

1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International Ltd.
 - e. Matco-Norca, Inc.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

- B. Steel Piping with Protective Coating:
 - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 - 3. Replace pipe having damaged PE coating with new pipe.
- C. Install fittings for changes in direction and branch connections.
- D. Install pressure gage downstream from each service regulator.

3.2 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches (38 mm) of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
 3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
5. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

- V. Install pressure gage downstream from each line regulator.
- W. Install sleeves for piping penetrations of walls, ceilings, and floors.
- X. Install sleeve seals for piping penetrations of concrete walls and slabs.
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 PAINTING

- A. Comply with requirements in other sections of the specifications for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (flat).
 - d. Color: To match adjacent surfaces. Piping run on roof surface to be painted yellow.
- C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (flat).
 - d. Color: To match adjacent surfaces. Piping run in mechanical rooms to be painted yellow.
 - 2. Alkyd System: MPI INT 5.1E.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd (flat).
 - d. Color: To match adjacent surfaces.
- D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.4 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

3.5 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 2. Cut threads full and clean using sharp dies.
 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 2. Bevel plain ends of steel pipe.
 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in other sections of these specifications.
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).

2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
- C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
1. NPS 3/8 (DN 10): Maximum span, 48 inches (1220 mm); minimum rod size, 3/8 inch (10 mm).
 2. NPS 1/2 (DN 15): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
 3. NPS 3/4 (DN 20) and Larger: Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).

3.7 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.8 LABELING AND IDENTIFYING

- A. Comply with requirements in other sections of these specifications.
- B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.9 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 OUTDOOR PIPING SCHEDULE

- A. Aboveground natural-gas piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
- B. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.11 INDOOR PIPING SCHEDULE

- A. Aboveground, concealed, branch piping 0.5 psig (3.45 kPa) or less, NPS 2 and smaller shall be one of the following:
 - 1. Where approved by the jurisdiction having authority, corrugated stainless-steel tubing (CCST) with mechanical fittings having socket or threaded ends to match adjacent piping.
 - a. Corrugated stainless steel tubing gas piping systems shall be bonded to the electrical service grounding electrode system. The bonding jumper shall connect to a metallic pipe or fitting between the point of delivery and the first downstream CSST fitting. The bonding jumper shall be not smaller than 6 AWG copper wire or equivalent. Gas piping systems that contain one or more segments of CSST shall be bonded in accordance with the above. It shall be the responsibility of the contractor providing and installing CSST to provide and install the required bonding jumpers.
 - 2. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, exposed, branch piping 0.5 psig (3.45 kPa) or less, NPS 2 and smaller shall be:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- C. Aboveground, distribution piping 0.5 psig (3.45 kPa) or less, NPS 2 and smaller shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
- D. Aboveground, distribution piping 0.5 psig (3.45 kPa) or less, larger than NPS 2 shall be :
 - 1. Steel pipe with wrought-steel fittings and welded joints.
- E. Aboveground, distribution piping above 0.5 psig (3.45 kPa) shall be :
 - 1. Steel pipe with wrought-steel fittings and welded joints.
- F. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

- G. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 (DN 50) and smaller at service meter shall be the following:
1. One-piece, bronze ball valve with bronze trim.
- B. Valves for pipe sizes NPS 2-1/2 (DN 65) and larger at service meter shall be one of the following:
1. Two-piece, full-port, bronze ball valves with bronze trim.
- C. Distribution piping valves for pipe sizes NPS 2 (DN 50) and smaller shall be the following:
1. Two-piece, full-port, bronze ball valves with bronze trim.
- D. Distribution piping valves for pipe sizes NPS 2-1/2 (DN 65) and larger shall be one of the following:
1. Two-piece, full-port, bronze ball valves with bronze trim.
- E. Valves in branch piping for single appliance shall be one of the following:
1. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 221123

SECTION 221223 - INDOOR POTABLE-WATER STORAGE TANKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Insulated, steel, potable-water storage tanks.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water storage tanks.
 - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

- B. Seismic Qualification Certificates: For steel water storage tanks, accessories, and components, from manufacturer.

- 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- C. Product Certificates: For each type of potable-water storage tank, from manufacturer.

- D. Source quality-control reports.

- E. Purging and disinfecting reports.

1.4 QUALITY ASSURANCE

- A. ASME Compliance for Steel Tanks: Fabricate and label steel, ASME-code, potable-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

- B. Comply with NSF 61, "Drinking Water System Components - Health Effects," for potable-water storage tanks. Include appropriate NSF marking.

1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 INSULATED, STEEL, POTABLE-WATER STORAGE TANKS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Laars Heating Systems Company.
 2. Lochinvar Corporation.
 3. PVI Industries, LLC.
 4. Rheem Manufacturing Company.
 5. A. O. Smith Water Products Co.
 6. State Industries, Inc.
- B. Description: Steel, vertical, pressure-rated tank with cylindrical sidewalls.
- C. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
- D. Construction: ASME code, steel, constructed with nontoxic welded joints, for 150-psig (1035-kPa) working pressure.
- E. Manhole: Watertight, for tank more than 36 inches (915 mm) in diameter; same pressure rating as tank.
- F. Tappings: Factory-fabricated steel, welded to tank before testing and labeling.
1. NPS 2 (DN 50) and Smaller: ASME B1.20.1, with female thread.
 2. NPS 2-1/2 (DN 65) and Larger: ASME B16.5, flanged.
- G. Specialties and Accessories: Include tappings in tank and the following:
1. Pressure relief valve.
 2. Pressure gage.
 3. Thermometer.
 4. Gage glass, brass fittings, compression stops, and gage-glass guard.
- H. Tank Interior Finish: Materials and thicknesses complying with NSF 61 barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
1. Coating: Glass.

- I. Insulation: Factory-installed fiberglass or polyurethane foam; surrounding entire tank except connections and other openings; suitable for tank operating temperature; and complying with ASHRAE/IESNA 90.1.
- J. Jacket: Steel, with manufacturer's standard finish unless otherwise indicated.
- K. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.

2.2 SOURCE QUALITY CONTROL

- A. Test and inspect potable-water storage tanks according to the following tests and inspections and prepare test reports:
 - 1. Pressure Testing for ASME-Code, Potable-Water Storage Tanks: Hydrostatically test to ensure structural integrity and freedom from leaks. Fill tanks with water, vent air, pressurize to 1-1/2 times tank pressure rating, disconnect test equipment, hold pressure for 30 minutes with no drop in pressure, and check for leaks.
- B. Repair or replace tanks that fail test with new tanks, and repeat until test is satisfactory.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install water storage tanks on concrete bases, level and plumb, firmly anchored. Arrange so devices needing servicing are accessible.
- B. Install thermometers and pressure gages on water storage tanks and piping if indicated. Thermometers and pressure gages are specified in Division 22 Section "Meters and Gages for Plumbing Piping."
- C. Install the following devices on tanks where indicated:
 - 1. Pressure relief valves.
 - 2. Temperature and pressure relief valves.
 - 3. Vacuum relief valves.
 - 4. Connections to accessories.
- D. After installing tanks with factory finish, inspect finishes and repair damages to finishes.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to potable-water storage tanks to allow service and maintenance.

- C. Connect water piping to water storage tanks with unions or flanges and with shutoff valves. Connect tank drains with shutoff valves and discharge over closest floor drains.
1. General-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
 - a. Valves NPS 2 (DN 50) and Smaller: Ball.
 - b. Valves NPS 2-1/2 (DN 65) and Larger: Butterfly.
 - c. Drain Valves: NPS 3/4 (DN 20) gate or ball valve. Include outlet with, or nipple in outlet with, ASME B1.20.7, 3/4-11.5NH thread for garden-hose service, threaded cap, and chain.
 2. Water Piping Connections: Make connections to dissimilar metals with dielectric fittings. Dielectric fittings are specified in Division 22 Section "Domestic Water Piping."

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following final checks before filling:
1. Test operation of tank accessories and devices.
 2. Verify that pressure relief valves have correct setting.
 - a. Manually operate pressure relief valves.
 - b. Adjust pressure settings.
 3. Verify that vacuum relief valves are correct size.
 - a. Manually operate vacuum relief valves.
 - b. Adjust vacuum settings.
- B. Filling Procedures: Follow manufacturer's written procedures. Fill tanks with water to operating level.

3.5 CLEANING

- A. Clean and disinfect potable-water storage tanks.
- B. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, use procedure described in AWWA C652 or as described below:
1. Purge water storage tanks with potable water.
 2. Disinfect tanks by one of the following methods:

- a. Fill tanks with water-chlorine solution containing at least 50 ppm (50 mg/L) of chlorine. Isolate tanks and allow to stand for 24 hours.
 - b. Fill tanks with water-chlorine solution containing at least 200 ppm (200 mg/L) of chlorine. Isolate tanks and allow to stand for three hours.
 3. Flush tanks, after required standing time, with clean, potable water until chlorine is not present in water coming from tank.
 4. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination made by authorities having jurisdiction shows evidence of contamination.
- C. Prepare written reports for purging and disinfecting activities.

END OF SECTION 221223

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe Materials.
 - 2. Fittings.
 - 3. Joining Materials.

1.2 DEFINITIONS

- A. Sewerage Piping: Building sewer piping outside building that conveys sanitary sewage from building (by Site Contractor).
- B. Drainage Piping: Building sewer piping outside building that conveys storm drainage from building (by Plumbing Contractor, beginning at 5'-0" outside of building.)
- C. Service Entrance Piping: Drainage piping at entry into building between outside building sewer piping and inside drainage piping (by Site Contractor).
- D. Drainage and Vent Piping: Piping inside building that conveys waste water and vapors from fixtures and equipment throughout the building.
- E. Force-Main Piping: Drainage piping, under pressure (where required due to local conditions).
- F. The following are industry abbreviations for plastic and other piping materials:
 - 1. PVC: Polyvinyl chloride.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Soil and Waste Systems: 200-foot head of water.
 - 2. Vent Systems: 20-foot head of water

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

- B. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.
1. Product Data:
 2. Test Results and Reports: Specified in "Field Quality Control" Article.

1.5 QUALITY ASSURANCE

- A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
- B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

- A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.
- B. Hub-and-Spigot, Cast-Iron Soil Pipe: ASTM A74, Service weight ASTM C564 rubber gasket.
- C. Hubless, Cast-Iron Soil Pipe: ASTM A888 or CISPI 301.
- D. PVC Plastic Pipe: ASTM D2665, Schedule 40.
- E. Steel Pipe: ASTM A53.
- F. Ductile Iron Pipe: AWWA C151.
- G. Copper Tubing: ASTM B306.
- H. PVC Piping
 1. PVC Pipe: ASTM D2665, solid-wall drain, waste, and vent.
 - a. PVC Socket Fittings: ASTM D2665, made to ASTM D3311, drain, waste, and vent patterns.

2.2 JOINING MATERIALS

- A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.

- B. Refer to Section 22 95 00 - "Common Work Results for Plumbing" for commonly used joining materials.
- C. Hubless, Cast-Iron, Soil-Piping Couplings: ASTM C1277 assembly of metal housing, corrosion-resistant fasteners, and ASTM C564 rubber sleeve or gasket with integral, center pipe stop. Include the following:
 - 1. Heavy-Duty, Stainless-Steel couplings: ASTM A666, Type 304, stainless-steel housing or shield; and stainless-steel clamps. Include gasket.
 - a. Clamp Width: 3 inches wide with 4 clamps, for piping 1-1/2- to 4-inch NPS.
 - b. Clamp Width: 4 inches wide with 6 clamps, for piping 5- to 10-inch NPS.
- D. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.
- E. Flexible, Transition Couplings for Underground, Nonpressure Piping: ASTM C1173 with elastomeric sleeve. Include ends same sizes as piping to be joined and include corrosion-resistant metal band on each end.
 - 1. Sleeve Type for Plain-End Piping: Rubber or elastomeric sleeve and stainless-steel band assembly, fabricated to match outside diameters of piping to be joined. Include the following:
 - a. Sleeves for Cast-Iron Soil Piping: ASTM C564 rubber.
 - b. Sleeves for Plastic Piping: ASTM F477 elastomeric seal.
 - c. Sleeves for Dissimilar Piping: Compatible with piping materials to be joined.
 - d. Bands: Stainless steel, one at each pipe insert.
 - 2. Gasket Type for Dissimilar-End Piping: Rubber or elastomeric compression gasket, made to match inside diameter of pipe or hub, and outside diameter of adjoining pipe. Include the following:
 - a. Gaskets for Cast-Iron Soil Piping: ASTM C564 rubber.
 - b. Gaskets for Plastic Piping: ASTM F477 elastomeric seal.
 - c. Gaskets for Dissimilar Piping: Compatible with piping materials to be joined.

2.3 PIPE AND TUBE FITTINGS

- A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
- B. Hub-and-Spigot, Cast-Iron, Soil-Pipe Fittings: ASTM A74, Service weight hub and spigot. Include ASTM C564 rubber gasket for each hub.
- C. Hubless, Cast-Iron, Soil-Pipe Fittings: CISPI 301.

- D. Ferrous Expansion Joints: Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe section, and flanged ends.
- E. Ferrous, Double Expansion Joints: Compound, galvanized steel fitting with telescoping body and 2 slip-pipe sections. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.
- F. PVC Socket Fittings: ASTM D2665, made to ASTM D3311 drain, waste, and vent pipe patterns.
- G. Steel Pipe Fittings:
 - 1. Cast-Iron, Threaded, Drainage Fittings: ASME B16.12.
 - 2. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
 - 3. Cast-Iron Flanges: ASME B16.1, Class 125.
 - 4. Cast-Iron, Flanged Fittings: ASME B 16.1, Class 125.
- H. Ductile Iron Pipe Fittings:
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile or gray-iron glands, rubber gaskets, and steel bolts.
- I. Copper Tube Fittings:
 - 1. ASME B16.23, cast copper or ASME B16.29 wrought copper, solder-joint fittings.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Section 31 20 00 - "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Aboveground, Soil, Waste, and Vent Piping: Use the following:
 - 1. 1-1/2-Inch NPS: Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and one of the following hubless, cast-iron, soil-piping couplings:

- a. Couplings: Heavy-duty, Type 304, stainless steel.
 2. 2- to 4-Inch NPS: Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and one of the following hubless, cast-iron, soil-piping couplings:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 3. 5- and 6-Inch NPS (DN125 and DN150): Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and one of the following hubless, cast-iron, soil-piping couplings:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
- D. Underground, Soil, Waste, and Vent Piping: Use the following:
1. 1-1/2-Inch NPS: Not permitted.
 2. 2- to 4-Inch NPS: Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
 3. 2- to 4-Inch NPS: Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and one of the following hubless, cast-iron, soil-piping couplings:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 4. 2- to 4-Inch NPS (DN50 to DN100): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
 5. 5- and 6-Inch NPS (DN125 and DN150): Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and one of the following hubless, cast-iron, soil-piping couplings:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 6. 5- and 6-Inch NPS (DN125 and DN150): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
 7. 8-Inch NPS (DN200): Hub-and-spigot, cast-iron soil pipe, Extra Heavy class; hub-and-spigot, cast-iron, soil-pipe fittings, Extra Heavy class; and compression joints.
 8. 8-Inch NPS (DN200): Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and one of the following hubless, cast-iron, soil-piping couplings:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 9. 8-Inch NPS (DN200): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

3.3 PIPING INSTALLATION, GENERAL

- A. Refer to Section 22 05 00 - "Common Work Results for Plumbing" for basic piping installation.

3.4 SERVICE ENTRANCE PIPING INSTALLATION

- A. Extend building sanitary drain piping and connect to sanitary sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections of building sanitary drains with building sanitary sewers.
- B. Extend building storm drain piping and connect to storm sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections of building storm drains and building storm sewers.
- C. Install wall penetration system at each service entrance pipe penetration through foundation wall. Make installation watertight. Refer to Section 22 95 00 - "Common Work Results for Plumbing" for wall penetration systems.

3.5 DRAINAGE AND VENT PIPING INSTALLATION

- A. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- B. Make changes in direction for drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not make change in direction of flow greater than 90 degrees. Use proper size of standard increasers and reducers if different sizes of piping are connected. Reducing size of drainage piping in direction of flow is prohibited.
- C. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- D. Install drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 1. Sanitary Building Drain: 2 percent downward in direction of flow for piping 3-inch NPS (DN80) and smaller; 1 percent downward in direction of flow for piping 4-inch NPS (DN100) and larger.
 2. Horizontal, Sanitary Drainage Piping: 2 percent downward in direction of flow.
 3. Storm Building Drain: 1 percent downward in direction of flow.
 4. Horizontal, Storm Drainage Piping: 2 percent downward in direction of flow.
 5. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- E. Install force mains at elevations indicated if required due to local conditions.
- F. Install engineered, controlled-flow, storm drainage systems in locations indicated. Comply with standards of authorities having jurisdiction.
- G. Sleeves are not required for cast-iron soil piping passing through concrete slab on grade if slab is without membrane waterproofing.

- H. Install PVC plastic drainage piping according to ASTM D2665.
- I. Install underground, PVC plastic drainage piping according to ASTM D2321.

3.6 JOINT CONSTRUCTION

- A. Refer to Section 22 95 00 - "Common Work Results for Plumbing" for basic piping joint construction.
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Compression Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. PVC Piping Joints: Join drainage piping according to ASTM D2665.
- D. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F402 for safe handling during joining of plastic pipe and fittings.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Refer to Section 22 05 29 - "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
 - 1. Riser clamps, MSS Type 8 or Type 42, for vertical runs.
 - 2. Adjustable steel clevis hangers, MSS Type 1, for individual, straight, horizontal runs 100 feet and less.
 - 3. Adjustable roller hangers, MSS Type 43, for individual, straight, horizontal runs longer than 100 feet.
 - 4. Spring cushion rolls, MSS Type 49, if indicated, for individual, straight, horizontal runs longer than 100 feet.
 - 5. Pipe rolls, MSS Type 44, for multiple, straight, horizontal runs 100 feet or longer. Support pipe rolls on trapeze.
 - 6. Spring hangers, MSS Type 52, for supporting base of vertical runs.
- B. Install supports according to 22 05 29 - "Hangers and Supports for Plumbing Piping and Equipment"
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum spacing and minimum rod diameters:
 - 1. 1-1/2- and 2-Inch NPS (DN40 and DN50): Maximum horizontal spacing, 60 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.

2. 3-Inch NPS (DN80): Maximum horizontal spacing, 60 inches with 1/2-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 3. 4- and 5-Inch NPS (DN100 and DN125): Maximum horizontal spacing, 60 inches with 5/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 4. 6-Inch NPS (DN150): Maximum horizontal spacing, 60 inches with 3/4-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 5. 8- through 12-Inch NPS (DN200 through DN300): Maximum horizontal spacing, 60 inches with 7/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 6. Spacing for horizontal pipe in 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

- A. Connect service entrance piping to exterior sewerage and drainage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage piping to service entrance piping, and extend to and connect to the following:
 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Section 22 40 00 "Plumbing Fixtures."
 2. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Section 22 10 13 - "Plumbing Specialties."
 3. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections 2-1/2-inch NPS (DN65) and larger.
- C. Connect force-main piping to service entrance piping, and extend to and connect to the following:
 1. Sump Pumps: Connect force-main piping to sump-pump discharge.

3.9 FIELD QUALITY CONTROL

- A. Inspect drainage and vent piping as follows:
 1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 3. Roughing-In Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10 feet of head. Water level must not drop from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of water-based latex paint.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Roof flashing assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.

1.2 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES (if required)

A. Horizontal, Cast-Iron Backwater Valves :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Body: Cast iron.
5. Cover: Cast iron with threaded access check valve.
6. End Connections: Hubless.
7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.

8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.
- B. Drain-Outlet Backwater Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Size: Same as floor drain outlet.
 3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
 4. Check Valve: Removable ball float.
 5. Inlet: Threaded.
 6. Outlet: Threaded or spigot.

2.2 CLEANOUTS

- A. Exposed Cast-Iron Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Drainage Products.
 - f. Zurn Plumbing Products Group.
 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 3. Size: Same as connected drainage piping
 4. Body Material: Hubless, cast-iron soil pipe test tee] as required to match connected piping.
 5. Closure: Countersunk cast-iron plug.
 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

- e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.36.2M for adjustable housing cleanout.
 - 3. Size: Same as connected branch.
 - 4. Type: Cast-iron soil pipe with cast-iron ferrule.
 - 5. Body or Ferrule: Cast iron.
 - 6. Outlet Connection: Threaded.
 - 7. Closure: Brass plug with tapered threads.
 - 8. Adjustable Housing Material: Cast iron with threads.
 - 9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 - 10. Frame and Cover Shape: Round.

C. Cast-Iron Wall Cleanouts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.36.2M. Include wall access.
- 3. Size: Same as connected drainage piping.
- 4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
- 5. Closure: Countersunk brass plug.
- 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- 7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Commercial Enameling Co.
 - b. Josam Company; Josam Div.
 - c. MIFAB, Inc.
 - d. Prier Products, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.

- h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Pattern: Floor drain.
 - 3. Outlet: Bottom.
 - 4. Top or Strainer Material: Nickel bronze.
 - 5. Trap Features: Trap-seal primer valve drain connection.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
- 2. Description: Manufactured assembly made of 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch-(1.6-mm-) thick, lead flashing collar and skirt extending at least 6 inches (150 mm) from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Open-Top Vent Cap: Without cap.
 - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

- 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
- 2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.

B. Air-Gap Fittings:

- 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
- 2. Body: Bronze or cast iron.
- 3. Inlet: Opening in top of body.
- 4. Outlet: Larger than inlet.
- 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:

- 1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top

- of fitting that will extend 2 inches (51 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.
- D. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 2. Size: Same as connected stack vent or vent stack.
- E. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 2. Size: Same as connected stack vent or vent stack.

2.6 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backwater valves in sanitary waste gravity-flow piping where the flood level rims of the plumbing fixtures are below the elevation of the manhole cover of the next upstream manhole in the public sewer.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.

3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
- I. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- K. Install vent caps on each vent pipe passing through roof.
- L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221413 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following storm drainage piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
 1. Storm Drainage Piping: 200-foot head of water.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.

- B. Cast-Iron, Hubless-Piping Couplings:
1. Standard: ASTM C 1277.
 2. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 ABS PIPE AND FITTINGS

- A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.
- B. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
- C. Solvent Cement: ASTM D 2235.
 1. ABS solvent cement shall have a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Solvent Cement: ASTM D 2564.
 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in other sections of these specifications.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- J. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
 1. Building Storm Drain: 1 percent downward in direction of flow unless noted otherwise on the plans.
 2. Horizontal Storm-Drainage Piping: 1 percent downward in direction of flow unless noted otherwise on the plans.

- K. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- L. Install aboveground ABS piping according to ASTM D 2661.
- M. Install aboveground PVC piping according to ASTM D 2665.
- N. Plumbing Specialties:
 - 1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
 - 2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."
- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors.
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs.
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

- A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Shielded, nonpressure transition couplings.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 4. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 - 5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
 - 4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 - 5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
 - 6. Spacing for 10-foot (3-m) pipe lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- G. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.

3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- H. Install supports for vertical ABS and PVC piping every 48 inches (1200 mm).
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.7 IDENTIFICATION

- A. Identify storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 5. Prepare reports for tests and required corrective action.

3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping NPS 6 (DN 150) and smaller shall be the following:
 1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
- C. Aboveground, storm drainage piping NPS 8 (DN 200) and larger shall be the following:
 1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.

AQUA WAIKIKI WAVE
BUILDING PACKAGE

34-14102-00
FOR REVIEW - NOT FOR CONSTRUCTION

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Flashing materials.

1.2 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron General-Purpose Roof Drains:

1. Standard: ASME A112.6.4, for general-purpose roof drains.
2. Body Material: Cast iron.
3. Dimension of Body: Nominal 14-inch diameter.
4. Outlet: Bottom.
5. Underdeck Clamp: Required.
6. Sump Receiver Plate: Required.
7. Dome Material: Cast iron.
8. Water Dam: 2 inches high (on overflow drains only).

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Adaptors:

1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
2. Size: Inlet size to match parapet drain outlet.

B. Downspout Boots:

1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 (DN 100) outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout and NPS 4 (DN 100) outlet.

C. Downspout Nozzles:

1. Description: Bronze body with bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

2.3 CLEANOUTS

A. Floor Cleanouts:

1. Standard: ASME A112.36.2M, for threaded, adjustable housing cleanouts.
2. Size: Same as connected branch.
3. Type: Threaded, adjustable housing.
4. Body or Ferrule Material: Cast iron
5. Outlet Connection: Threaded.
6. Closure: Brass plug with tapered threads.
7. Adjustable Housing Material: Cast iron.
8. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
9. Frame and Cover Shape: Round.

B. Test Tees:

1. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure Plug: Countersunk.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:

1. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
2. Size: Same as connected drainage piping.
3. Body Material: Hubless, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure: Countersunk plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.
7. Wall Access: Round wall-installation frame and cover.

2.4 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).

- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
 - 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Install expansion joints, if indicated, in roof drain outlets.
 - 3. Position roof drains for easy access and maintenance.
- B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.
- C. Install downspout boots at grade with top 6 inches (152 mm) above grade. Secure to building wall.
- D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- E. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
 - 1. Use cleanouts the same size as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
 - 3. Locate cleanouts at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 - 4. Locate cleanouts at base of each vertical stack.
- F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

- H. Install test tees in vertical conductors and near floor.
- I. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- J. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.
- K. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. (30-kg/sq. m) lead sheets, 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of 4.0-lb/sq. ft. (20-kg/sq. m) lead sheets, 0.0625-inch (1.6-mm) thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches (250 mm) and with skirt or flange extending at least 8 inches (200 mm) around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

END OF SECTION 221423

SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Submersible sump pumps.
2. Sump-pump basins and basin covers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.
 - 2. Warranty shall include a 1 year labor warranty.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

- A. Submersible, Fixed-Position, Single-Seal Sump Pumps:
 - 1. Manufacturers: Subject to compliance with requirements, provide the basis of design products shown on the plans or an equal product by one of the following:
 - a. Bell & Gossett Domestic Pump; ITT Corporation.
 - b. Ebara
 - c. Goulds Pumps; ITT Corporation.
 - d. Grundfos Pumps Corp.
 - e. Weil Pump Company, Inc.
 - f. Zoeller Company.
 - 2. Description: Factory-assembled and -tested sump-pump unit.
 - 3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump.
 - 4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
 - 5. Impeller: Statically and dynamically balanced, design for clear wastewater handling, and keyed and secured to shaft.
 - 6. Pump and Motor Shaft: Stainless steel or steel, with factory-sealed, grease-lubricated ball bearings.
 - 7. Seal: Mechanical.
 - 8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
- B. Controls:
 - 1. Enclosure: NEMA Type 4X wall-mounted 115 V single phase control panel with:
 - a. 20 foot piggyback electrical supply cord
 - b. Audible and light alarms with dry contacts
 - c. Preset 'on' and 'off' points and ability to differentiate oil and water
 - d. Alarm test and silence switches
 - e. 304 Stainless steel probes
 - 2. Control-Interface Features:
 - a.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:

- 1) On-off status of pump.
- 2) Alarm status.

2.2 SUMP PUMP CAPACITIES AND CHARACTERISTICS

- A. As indicated on the equipment schedule on the plans.

2.3 SUMP-PUMP BASINS AND BASIN COVERS

- A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
 1. Material: Polyethylene.
 2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
 3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
- B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
- C. Capacities and Characteristics:
 1. As indicated on the equipment schedule on the plans.

2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors appropriate for the proposed service.
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for plumbing piping to verify actual locations of piping connections before sump pump installation.

3.2 INSTALLATION

- A. Install all equipment, material, accessories, etc. according to the manufacturer's instructions.
- B. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Pumps and controls will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221429

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plumbing Fixture Standards
2. Miscellaneous Fixture Standards
3. Miscellaneous Component Standards

1.2 REFERENCES

A. American National Standards Institute (ANSI) Publications:

1. A117.1 "Accessible and Useable Buildings and Facilities"
2. Z124.1 "Plastic Bathtub Units"
3. Z124.1a, and Z124.1b
4. Z124.5 "Plastic Toilet (Water Closet) Seats"
5. Z124.6 "Plastic Sinks"
6. Z358.1 "Emergency Eyewash and Shower Equipment"

B. Air-Conditioning and Refrigeration Institute (ARI) Publications:

1. 1010 "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers"

C. The American Society of Mechanical Engineers (ASME) Publications:

1. A112.6.1.M "Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use"
2. A112.18.1 "Plumbing Fixture Fittings"
3. A112.19.2 "Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals"
4. A112.19.3 "Stainless Steel Fixtures (Designed for Residential Use)"
5. A112.19.4M "Porcelain Enameled Formed Steel Plumbing Fixtures"
6. A112.19.5 "Trim for Water-Closet Bowls, Tanks and Urinals"
7. A112.19.7M "Whirlpool Bathtub Appliances"
8. A112.19.8M "Suction Fittings for Swimming & Wading Pools Spas Hot Tubs & Whirlpool Bathtub Appliances"
9. A112.21.1M "Floor Drains"
10. B1.20.1 "Pipe Threads, General Purpose, Inch"
11. B1.20.7 "Hose Coupling Screw Threads, Inch"

D. American Society of Sanitary Engineering (ASSE) Publications:

1. 1001 "Performance Requirements for Atmospheric Type Vacuum Breakers"

2. 1008 "Performance Requirements for Household Food Waste Disposer Units"
3. 1011 "Performance Requirements for Hose Connection Vacuum Breakers"
4. 1014 "Performance Requirements for Backflow Prevention Devices for Hand-Held Showers"
5. 1016 "Performance Requirements for Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations"
6. 1025 "Performance Requirements for Diverters for Plumbing Faucets with Hose Spray, Anti-Siphon Type, Residential Applications"
7. 1037 "Performance Requirements for Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures"

E. ASTM International (ASTM) Publications:

1. F444 "Standard Consumer Safety Specification for Scald-Preventing Devices and Systems in Bathing Areas"
2. F445 "Consumer Safety Specification for Thermal-Shock-Preventing Devices and Systems in Showering Areas"
3. F462 "Consumer Safety Specification for Slip-Resistant Bathing Facilities"

F. National Sanitation Foundation Construction (NSF) Publications:

1. 2 "Food Equipment"
2. 61 "Drinking Water System Components - Health Effects"

G. Underwriter's Laboratories, Inc. (UL) Publications:

1. 399 "Drinking Water Coolers"
2. 430 "Waste Disposers"
3. 486A "Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors"
4. 486B "Standard for Wire Connectors for Use With Aluminum Conductors"
5. 1795 "Hydromassage Bathtubs"

1.3 DEFINITIONS

- A. Accessible: Plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped, disabled, and elderly people.
- B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, traps and waste pipes. Pipe fittings, tube fittings, and general-duty valves are included where indicated.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

- B. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.
1. Product Data for each plumbing fixture category and type specified. Include selected fixture, trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
 2. Maintenance data for plumbing fixtures and components to include in the operation and maintenance manuals specified in Division 01.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category from one source and by a single manufacturer.
1. Exception: Where fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for this category.
- B. Regulatory Requirements: Comply with requirements of CABO A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; regarding plumbing fixtures for physically handicapped people.
- C. Energy Policy Act Requirements: Comply with requirements of Public Law 102-486, "Energy Policy Act," regarding water flush and flow rate and water consumption of plumbing fixtures.
- D. Listing and labeling: Provide electrically operated fixtures and components specified in this Section that are listed and labeled.
1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- E. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver plumbing fixtures in manufacturer's protective packing, crating, and covering.
- B. Store plumbing fixtures on elevated platforms in dry location.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Coordinate roughing-in and final fixture locations and verify that plumbing fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. See Plumbing Fixture Matrix for list of which Manufacturer's are approved for use on a specific item.
- B. Approved Manufacturers:
 - 1. American Standard, Inc. (800-442-1902)
 - a. Bathtubs
 - b. Bathtub Drains
 - c. Bath/Shower Diverters, Valves & Trim
 - d. Faucets
 - e. Vanity Sinks
 - f. Laundry Sinks
 - g. Service Sinks
 - h. Sink Strainers
 - i. Toilet Seats
 - j. Urinals
 - k. Water Closets
 - 2. Church Seats, A Division of Bemis Manufacturing Company (800-233-7328)
 - a. Toilet Seats
 - 3. Danze, a brand of Globe Union Branded Products (630-754-0253)
 - a. Vanity Sinks
 - b. Water Closets
 - 4. Delta Faucet Company (800-345-3358)
 - a. Bath/Shower Diverters, Valves & Trim
 - b. Faucets
 - c. Mop Hangers/Hose Holders/
 - d. Sink Strainers
 - 5. Elkay Manufacturing Co. (630-574-8484)
 - a. Sinks
 - b. Water Coolers
 - 6. Gerber Plumbing Fixtures, a brand of Globe Union Branded Products (630-754-0253)
 - a. Bathtub Drains
 - b. Water Closets

7. Halsey Taylor (630-574-3500)
 - a. Water Coolers
8. Haws Corp. (510-525-5801)
 - a. Eye Wash
 - b. Water Coolers
9. Introsul, Inc. (478-987-3185 x 223)
 - a. Shower Base
10. Jay R. Smith Mfg. Co. (334-277-8520)
 - a. Floor Drains
 - b. Floor Sinks
 - c. Cleanouts
 - d. Lint Interceptor
 - e. Roof Drains
 - f. Yard Hydrants
 - g. Wall Hydrants
11. Josam Co. (800-365-6726)
 - a. Floor Drains
 - b. Floor Sinks
 - c. Cleanouts
 - d. Lint Interceptor
 - e. Roof Drains
 - f. Yard Hydrants
 - g. Wall Hydrants
12. Kohler Co. (800-456-4537)
 - a. Bathtubs
 - b. Bathtub Drains
 - c. Bath/Shower Diverters, Valves & Trim
 - d. Faucets
 - e. Laundry Sinks
 - f. Service Sinks
 - g. Shower Heads
 - h. Sinks
 - i. Sink Strainers/Grid Strainers
 - j. Toilet Seats
 - k. Urinals
 - l. Water Closets
13. McGuire Manufacturing Company, Inc. (203-699-1801)
 - a. Bathtub Drains

14. Mincey Marble Manufacturing Co. (800-533-1806)
 - a. Shower Base
15. Moen Incorporated (800-321-8809)
 - a. Bath/Shower Diverters, Valves & Trim
 - b. Faucets
 - c. Mop Hangers/Hose Holders/
 - d. Sink Strainers
16. MPL Corporation (317-835-9000)
 - a. Shower Base
17. E. L. Mustee & Sons, Inc. (800-321-3128)
 - a. Mop Sink
 - b. Mop Hanger/Hose Holder/Wall Guard
 - c. Laundry Sink / Faucet
18. Oasis Industries Inc. (800-323-2748)
 - a. Water Coolers
19. Speakman Company (800-537-2107)
 - a. Shower Heads
20. Sunroc Corp (800-4SUNROC)
 - a. Water Coolers
21. Symmons Industries, Inc. (800-796-6667)
 - a. Bath/Shower Diverters, Valves & Trim
 - b. Faucets
22. Toto USA, Inc. (800-350-8686)
 - a. Toilet Seats
 - b. Water Closets
23. Vitra USA (770-904-6830)
 - a. Corner Sinks
24. Wade Division of Tyler Pipe (800-874-9201)
 - a. Floor Drains
 - b. Floor Sinks

- c. Cleanouts
 - d. Lint Interceptor
 - e. Roof Drains
 - f. Yard Hydrants
 - g. Wall Hydrants
25. Zurn Industries, Inc. (716-665-1132)
- a. Floor Drains
 - b. Floor Sinks
 - c. Cleanouts
 - d. Lint Interceptor
 - e. Roof Drains
 - f. Yard Hydrants
 - g. Wall Hydrants

2.2 PLUMBING FIXTURE STANDARDS

- A. Comply with applicable standards below and other requirements specified.
- 1. Electric Water Coolers: AHRI 1010 and UL 399.
 - 2. Emergency Equipment: ANSI Z358.1.
 - 3. National Sanitation Foundation Construction: NSF 2 and NSF 61.
 - 4. Bathtubs: ANSI Z124.1, ANSI Z124.1a, and ANSI Z124.1b.
 - 5. Plastic Laundry Trays: ANSI Z124.6.
 - 6. Plastic Mop-Service Basins: ANSI Z124.6.
 - 7. Shower Enclosures: ANSI Z124.2 and ANSI Z124.2a.
 - 8. Whirlpool Bathtubs: ANSI Z124.1, ANSI Z124.1a, and ANSI Z124.1b; and ASME A112.19.7M.
 - 9. Porcelain-Enameled Fixtures: ASME A112.19.4M.
 - 10. Slip-Resistant Bathing Surfaces: ASTM F462.
 - 11. Stainless-Steel Fixtures Other than Service Sinks: ASME A112.19.3M.
 - 12. Vitreous-China Fixtures: ASME A112.19.2M.
 - 13. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 14. Water-Closet, Flushometer Tank Trim: ASSE 1037.
 - 15. Whirlpool Bathtub Fittings: ASME A112.19.8M.

2.3 PLUMBING FIXTURE MAXIMUM FLOW RATES

- A. The flowrates of plumbing fixtures shall not exceed the maximum values stated below:
- 1. Employee / Public Restrooms:
 - a. Lavatories: 1.00 GPM
 - b. Water Closets: 1.28 GPF
 - c. Urinals: 0.50 GPF
 - 2. Boardroom / Meeting Room / Bar:

- a. Sink: 1.50 GPM
- 3. Guestrooms:
 - a. Lavatories: 1.50 GPM
 - b. Wet Bar: 1.50 GPM
 - c. Water Closets: 1.28 GPF
 - d. Showerheads: 2.00 GPM
 - e. Kitchen Sink: 1.50 GPM
- 4. Back-of-House:
 - a. Employee Breakroom: 1.50 GPM

2.4 LAVATORY/SINK FAUCET STANDARDS

- A. Comply with ASME A112.18.1, NSF 61 and other requirements specified for lavatory, sink, and similar-type-fixture faucet fittings. Include hot- and cold-water indicators; 2.5-gpm-maximum flow rate; and finish as shown on Plumbing Fixture Matrix on metal body. Coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.
 - 1. Faucet:
 - a. Valve shall be ceramic discs in cartridge assembly.
 - b. Handles as indicated.
 - c. Pop-up or grid drain as indicated.
 - 2. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 3. Faucet Hose: ASTM D3901.
 - 4. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 5. Hose-Coupling Threads: ASME B1.20.7.
 - 6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 7. Pipe Threads: ASME B1.20.1.
 - 8. Sink Spray Hoses: ASTM D3573.

2.5 BATHTUB/SHOWER FAUCET STANDARDS

- A. Comply with ASME A112.18.1 and other requirements specified for bathtub and shower faucet fittings. Include hot- and cold-water indicators; 2.5-gpm-maximum flow rate; and finish as shown on Plumbing Fixture Matrix. Coordinate faucet inlets with supplies and outlet with diverter valve; tub spout; and shower head, arm, and flange.
 - 1. All Trim to be metallic.
 - 2. Valving shall be ceramic discs in cartridge assemblies.
 - 3. Cast brass valve-body with integral cast-in service stops.
 - 4. Combination, Pressure-Equalizing- and Thermostatic-Control, Antiscald Faucets: ASSE 1016.
 - 5. Hand-Held Showers: ASSE 1014.

6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F445.
7. Hose-Coupling Threads: ASME B1.20.1 or ASME B1.20.7.
8. Manual-Control Antiscald Faucets: ASTM F444.
9. Pipe Threads: ASME B1.20.1.

2.6 MISCELLANEOUS FITTING STANDARDS

- A. Comply with ASME A112.18.1 and other requirements specified for fittings, other than faucets. Include finish to coordinate with finishes shown on Plumbing Fixture Schedule. Coordinate fittings with other components and connectors.
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Automatic Flow Restrictors: ASSE 1028.
 3. Brass and Copper, Supplies and Tubular Brass: ASME A112.18.1M.
 4. Fixed Flow Restrictors: ASSE 1034.
 5. Manual-Operation Flushometers: ASSE 1037.

2.7 MISCELLANEOUS COMPONENT STANDARDS

- A. Comply with applicable standards below and other requirements specified for components for plumbing fixtures, equipment, and appliances.
1. Disposers: ASSE 1008 and UL 430.
 2. Floor Drains: ASME A112.21.1M.
 3. Hose-Coupling Threads: ASME B1.20.7.
 4. Pipe Threads: ASME B1.20.1.
 5. Plastic Shower Receptors: ANSI Z124.2 and ANSI Z124.2a.
 6. Plastic Toilet Seats: ANSI Z124.5.
 7. Supply and Drain Insulation Kits: CABO A117.1.
 8. Supports: ASME A112.6.1M.
 9. Whirlpool Bathtub Equipment: UL 1795.

2.8 FITTINGS

- A. Fittings for Plumbing Fixtures: Refer to plumbing fixture schedules in the Appendix for materials for supplies, supply stops, supply risers, traps, and other fittings.
- B. Fittings for Equipment Specified in Other Sections: Fittings include the following:
1. Supply Inlets: Brass pipe or copper tube, size required for final connection.
 2. Supply Stops: Chrome-plated brass, angle or straight; compression, loose-key type; same size as supply inlet and with outlet matching supply riser.
 3. Supply Risers: 3/8-inch NPS (DN10) rigid brass tube with 1/4-inch NPS (DN8) offset, knob-end tailpiece. Use chrome-plated tube for exposed applications.
 4. Traps: Tubular brass with 0.045-inch wall thickness, slip-joint inlet, cleanout, wall flange, escutcheons, and size to match equipment. Use chrome-plated tube for exposed applications.

5. Continuous Waste: Tubular brass, 0.045-inch wall thickness, with slip-joint inlet, and size to match equipment.
6. Indirect Waste: Tubular brass, 0.045-inch wall thickness, and size to match equipment.

2.9 FINISHES

- A. Refer to Plumbing Fixture Matrix for Finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for potable, hot- and cold-water supply piping systems; soil, waste, and vent piping systems; and supports. Verify that locations and sizes of piping and locations and types of supports match those indicated, before installing and connecting fixtures. Use manufacturer's roughing-in data when roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Include supports for plumbing fixtures according to the following:
 1. Carriers: For wall-hanging water closets and fixtures supported from wall construction.
 2. Chair Carriers: For wall-hanging urinals, lavatories, sinks, drinking fountains, and electric water coolers.
 3. Heavy-Duty Chair Carriers: For accessible urinals, lavatories, and other fixtures where indicated.
 4. Reinforcement: For floor-mounted lavatories and sinks that require securing to wall and recessed, box-mounted, electric water coolers.
 5. Fabricate reinforcement from 2-by-4-inch or 2-by-6-inch fire-retardant-treated-wood blocking between studs or 1/4-by-6-inch steel plates attached to studs, in wall construction, to secure fixtures to wall. Include length that will extend beyond ends of fixture mounting bracket and attach to at least 2 studs.
- B. Include fitting insulation kits for accessible fixtures according to the following:
 1. Lavatories: Cover hot- and cold-water supplies, stops and handles, drain, trap, and waste to wall.
 2. Sinks: Cover hot- and cold-water supplies, stops and handles, drain, trap, and waste to wall.
 3. Fixtures with Offset Drain: Cover hot- and cold-water supplies, offset drain, trap, and waste to wall.
 4. Other Fixtures: Cover exposed fittings below fixture.

3.3 PLUMBING FIXTURE INSTALLATION

- A. Assemble plumbing fixtures and trim, fittings, faucets, and other components according to manufacturers' written instructions.
- B. Install fixtures level and plumb according to manufacturers' written instructions, roughing-in drawings, and referenced standards.
- C. Install floor-mounted, floor-outlet water closets with closet flanges and gasket seals.
- D. Install wall-hanging, back-outlet water closets with support manufacturer's tiling frame or setting gage.
- E. Install shower arm elbow fitting secure to backing to prevent movement.
- F. Install toilet seats on water closets.
- G. Install wall-hanging, back-outlet urinals with gasket seals.
- H. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for handicapped people to reach.
- I. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- J. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.
- K. Fasten floor-mounted fixtures to substrate. Fasten fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.
- L. Fasten recessed, wall-mounted fittings to reinforcement built into walls.
- M. Fasten wall-mounted fittings to reinforcement built into walls.
- N. Fasten counter-mounting plumbing fixtures to casework.
- O. Secure supplies to supports or substrate within pipe space behind fixture.
- P. Set shower receptors and mop basins in leveling bed of cement grout.
- Q. Install individual stop valve in each water supply to fixture. Use gate or globe valve where specific stop valve is not specified.
 - 1. Exception: Omit stop valves on supplies to emergency equipment, except when permitted by authorities having jurisdiction. When permitted, install valve chained and locked in OPEN position.
- R. Install water-supply stop valves in accessible locations.

- S. Install faucet, laminar-flow fittings with specified flow rates and patterns in faucet spouts when faucets are not available with required rates and patterns. Include adapters when required.
- T. Install supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
- U. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts when faucets are not available with required rates and patterns. Include adapters when required.
- V. Install shower, flow-control fittings with specified maximum flow rates in shower arms.
- W. Install traps on fixture outlets. Omit traps on fixtures having integral traps. Omit traps on indirect wastes, except where otherwise indicated.
- X. Install disposers in sink outlets, where indicated. Install switch where indicated, or in wall adjacent to sink if location is not indicated.
- Y. Install escutcheons at wall, floor, and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons where required to conceal protruding pipe fittings.
- Z. Seal joints between fixtures and walls, floors, and counters using sanitary-type, 1-part, mildew-resistant, silicone sealant according to sealing requirements specified in Section 07 92 00(07920) - "Joint Sealants." Match sealant color to fixture color.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other Division 22 Sections.
- B. Supply and Waste Connections to Plumbing Fixtures: Refer to plumbing fixture schedules at the end of this Section for fitting sizes and connection requirements for each plumbing fixture.
- C. Supply and Waste Connections to Equipment Specified in Other Sections: Connect equipment with supply inlets, supply stops, supply risers, and traps specified in this Section. Use fitting sizes required to match connected equipment. Connect fittings to plumbing piping.
- D. Ground equipment.
 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- E. Arrange for electric-power connections to fixtures and devices that require power. Electric power is specified in Division 16 Sections.

3.5 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.
- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized and demonstrate proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.6 ADJUSTING AND CLEANING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust disposers, hot-water dispensers, and controls. Replace damaged and malfunctioning units and controls.
- C. Adjust water pressure at drinking fountains, electric water coolers, faucets, shower valves, and flushometer valves having controls, to produce proper flow and stream.
- D. Replace washers and seals of leaking and dripping faucets and stops.
- E. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Include the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities, except when approved in writing by Owner.

3.8 SCHEDULES: See Plumbing Fixture Schedule on drawings.

END OF SECTION 224000

SECTION 224700 - DRINKING FOUNTAINS AND WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following water coolers and related components:
 - 1. Pressure water coolers.
 - 2. Fixture supports.

1.3 SUBMITTALS

- A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

- E. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

- A. Water Coolers:
1. Manufacturers: Subject to compliance with requirements, provide the basis of design products shown on the plans or an equal product by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Halsey Taylor.
 - c. Haws Corporation.
 - d. Oasis Corporation.
 2. Description: Accessible (if indicated), ARI 1010, Type PB, pressure with bubbler, Style W, wall-mounting water cooler.
 - a. Cabinet: Single or Bi-level with two attached cabinets, all stainless steel.
 - b. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
 - c. Control: Push button or Push bar.
 - d. Supply: NPS 3/8 (DN 10) with ball, gate, or globe valve.
 - e. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
 - f. Drain(s): Grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME A112.18.1.
 - g. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant metal storage tank, and adjustable thermostat.
 - 1) Capacity: 8 gph (0.0084 L/s) of 50 deg F (10 deg C) cooled water from 80 deg F (27 deg C) inlet water and 90 deg F (32 deg C) ambient air temperature.
 - h. Support: Type I or II, water cooler carrier. Refer to "Fixture Supports" Article.

2.2 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Josam Co.
 2. Smith, Jay R. Mfg. Co.
 3. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.

4. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 1. Type I: Hanger-type carrier with two vertical uprights.
 2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
 3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Use mounting frames for recessed water coolers, unless otherwise indicated.
- C. Set freestanding and pedestal drinking fountains on floor.
- D. Set remote water coolers on floor, unless otherwise indicated.
- E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
- B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
- C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.6 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

3.7 CLEANING

- A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 224700

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Equipment installation requirements common to equipment sections.
8. Concrete bases.
9. Supports and anchorages.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: The contractor shall submit equipment and layout plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Mechanical Systems:

- a. Roof or ground mounted mechanical equipment including required clearances.
- b. Suspended mechanical equipment including required clearances.
- c. Duct installation, indicating coordination with general construction, building components including structure, hydronic, plumbing, and sprinkler piping, electrical conduits, cable trays, and other building services. Indicate proposed duct sizes, elevations, changes in elevation, etc.
- d. Suspended ceiling components.
- e. Size and location of access to concealed equipment.
- f. Penetrations of smoke barriers and fire-rated construction.

2. Hydronic Systems:

- a. Mechanical Rooms: Hydronic systems equipment including chillers, boilers, pumps, air separators, expansion tanks, water treatment equipment and all other

- hydronic specialties, indicating coordination with general construction, building components including structure, duct, plumbing, and sprinkler piping, electrical conduits, cable trays, and other building services.
- b. Building piping installation, indicating coordination with general construction, building components including structure, duct, plumbing, and sprinkler piping, electrical conduits, and other building services. Indicate proposed sizes, elevations, changes in elevation, etc.
 - c. Suspended ceiling components.
 - d. Size and location of access to concealed equipment.
 - e. Penetrations of smoke barriers and fire-rated construction.

1.4 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Characteristics of Mechanical Equipment: Equipment of equal performance and similar characteristics may be furnished provided such proposed equipment is approved. The contractor is responsible for guaranteeing that the proposed equipment is equal in performance to the specified equipment under all operating conditions. All connecting piping, electrical services, circuit breakers, conduit sizes, etc. are to be appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements. All

costs associated with the substitution of materials and equipment or costs of replacing substituted equipment with equipment with operating characteristics equal to the specified equipment shall be borne by the substituting contractor.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
 1. CPVC Piping: ASTM F 493.
 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Plastic or Carbon steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EQUIPMENT - COMMON REQUIREMENTS

A. Install all equipment, material, etc. according to the manufacturer's instructions.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors whether in exposed, concealed, finished or unfinished spaces.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section 078413 "Penetration Firestopping" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. In areas with no ceilings, install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in other sections of these specifications.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Section 055000 "Metal Fabrications" for structural steel.

- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 230500

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Tel-Tru Manufacturing Company.
 - e. Trerice, H. O. Co.
 - f. Weiss Instruments, Inc.
 - g. Winters Instruments - U.S.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 7-inch (178-mm) nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.

7. Window: Glass or plastic.
8. Stem: Aluminum and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

- A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.4 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ernst Flow Industries.
 - c. Flo Fab Inc.
 - d. Marsh Bellofram.
 - e. Miljoco Corporation.
 - f. Trerice, H. O. Co.

- g. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
- h. Weiss Instruments, Inc.
- 2. Standard: ASME B40.100.
- 3. Case: Liquid-filled type; cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
- 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
- 6. Movement: Mechanical, with link to pressure element and connection to pointer.
- 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
- 8. Pointer: Dark-colored metal.
- 9. Window: Glass.
- 10. Ring: Metal.
- 11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of brass pipe with pipe threads.
- C. Valves: Brass ball, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

- H. Install valve and snubber in piping for each pressure gage for fluids.
- I. Install permanent indicators on walls or brackets in accessible and readable positions.
- J. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic boiler.
 - 3. Inlets and outlets of each chiller.
 - 4. Inlet and outlet of each hydronic coil in air-handling units.
 - 5. Outside-, return-, supply-, and mixed-air ducts.
- K. Install pressure gages in the following locations:
 - 1. Discharge of each pressure-reducing valve.
 - 2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
 - 3. Suction and discharge of each pump.
 - 4. Inlet and outlet of each hydronic coil in air-handling units.

3.2 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

3.3 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 deg F.
- B. Scale Range for Condenser-Water Piping: 0 to 150 deg F.
- C. Scale Range for Air Ducts: 0 to 100 deg F.

3.4 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 psi.
- B. Scale Range for Condenser-Water Piping: -10 to 50 psi.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Bronze ball valves.
2. Iron ball valves.
3. High performance butterfly valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Iron, grooved-end swing-check valves.
7. Bronze globe valves.
8. Iron globe valves.
9. Chainwheels.

1.3 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.4 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 2. ASME B31.1 for power piping valves.
 3. ASME B31.9 for building services piping valves.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.

3. Set angle, gate, and globe valves closed to prevent rattling.
 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Set butterfly valves closed or slightly open.
 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group.
 - c. DeZurik Water Controls.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Nordstrom Valves, Inc.
 - h. Powell Valves.
 - i. Tyco Valves & Controls
 - j. Watts Regulator Co.

2.2 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
 2. Handwheel: For valves other than quarter-turn types.
 3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller.

4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
1. Gate Valves: With rising stem.
 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Grooved: With grooves according to AWWA C606.
 3. Solder Joint: With sockets according to ASME B16.18.
 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
1. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.4 IRON BALL VALVES

- A. Class 125, Iron Ball Valves:
1. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Split body.

- d. Body Material: ASTM A 126, gray iron.
- e. Ends: Flanged.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel.
- i. Port: Full.

2.5 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 150 psig (1035 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

2.6 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

1. Description:

- a. Standard: MSS SP-68.
- b. CWP Rating: 285 psig (1965 kPa) at 100 deg F (38 deg C).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
- e. Seat: Reinforced PTFE or metal.
- f. Stem: Stainless steel; offset from seat plane.
- g. Disc: Carbon steel.
- h. Service: Bidirectional.

2.7 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Design: Horizontal flow.

- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

2.8 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Description:

- a. Standard: MSS SP-71, Type I.
- b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
- c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
- d. Body Design: Clear or full waterway.
- e. Body Material: ASTM A 126, gray iron with bolted bonnet.
- f. Ends: Flanged.
- g. Trim: Bronze.
- h. Gasket: Asbestos free.

2.9 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:

1. Description:

- a. CWP Rating: 300 psig (2070 kPa).
- b. Body Material: ASTM A 536, ductile iron.
- c. Seal: EPDM.
- d. Disc: Spring operated, ductile iron or stainless steel.

2.10 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron.

2.11 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

2.12 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to gate, globe and butterfly valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for butterfly gate and globe valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.
- F. Install check valves for proper direction of flow direction.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 1. Shutoff Service: Ball or butterfly valves.
 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 3. Throttling Service except Steam: Globe or ball valves.
 4. Pump-Discharge Check Valves:
 - a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 (DN 65) and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.

6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
7. For Grooved-End Steel Piping except Steam and Steam Condensate Piping: Valve ends may be grooved.

3.5 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Globe Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves, NPS 2-1/2 to NPS 10 (DN 65 to DN 250): Class 150.
3. High-Performance Butterfly Valves: Class 150, single flange.
4. Iron Swing Check Valves: Class 125, metal nonmetallic-to-metal seats.
5. Iron, Grooved-End Check Valves, NPS 3 to NPS 12 (DN 80 to DN 300): 300 CWP.
6. Iron Globe Valves: Class 125.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper- or epoxy-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Channels: Continuous slotted steel channel with inturned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 2. Base: Plastic or Stainless steel.
 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 2. Bases: One or more; plastic.
 3. Vertical Members: Two or more protective-coated-steel channels.
 4. Horizontal Member: Protective-coated-steel channel.
 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.6 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.7 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- O. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
 - 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper- or epoxy-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).

12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Duct labels.
4. Stencils.
5. Valve tags.

1.3 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
4. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.

6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.3 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- D. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- E. Fasteners: Stainless-steel rivets or self-tapping screws.
- F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- G. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, an arrow indicating flow direction, and the equipment serving the duct system using the equipment's Drawing designation.
1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches (32 mm) for ducts; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.
1. Stencil Material: Aluminum.
 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 CONCEALED EQUIPMENT MARKER

- A. Where mechanical equipment is concealed above removable ceiling tiles, install a marker indicating equipment location on the ceiling grid beneath the equipment. Marker shall be a red adhesive dot, 1/4-inch to 1/2-inch diameter.

3.4 PIPE LABEL INSTALLATION

- A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
 2. Stencil Paint: Use for pipe marking.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule, Per ANSI / ASME Standards:

1. Chilled-Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

3.5 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
1. Blue: For cold-air supply ducts.
 2. Yellow: For return-air ducts.
 3. Green: For exhaust-, outside-, relief-, and mixed-air ducts.
 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Stenciled Duct Label Option: Stenciled labels, including identification of duct service using same designations or abbreviations as used on Drawings, an arrow indicating flow direction, and the equipment serving the duct system using the equipment's plan designation, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch (25 mm) high is needed for proper identification because of distance from normal location of required identification.
- C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 25 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. All: 2 inches (50 mm), round.
 - 2. Valve-Tag Color:
 - a. Chilled-water: Blue
 - b. Heating-water: Red.
 - c. Refrigerant: Blue.
 - d. Natural gas: Red.
 - e. Compressed-air: Green.
 - f. Industrial gas: Green.
 - g. Domestic-water: Blue.
 - 3. Letter Color:
 - a. All piping systems: White.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Balancing Air Systems:
 - a. Constant-volume air systems.
2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - b. Variable-flow hydronic systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- B. Certified TAB reports.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer, Construction Manager and/or Commissioning Authority.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.

6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111 or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.

- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 6. Adjust fan speeds higher or lower than indicated speed as required to produce required airflows. Comply with requirements in Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-

heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check liquid level in expansion tank.
 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.

6. Set system controls so automatic valves are wide open to heat exchangers.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.
- D. Balancing valves and associated balancing shall not be required on devices where pressure independent control valves are installed. Balancing valves and balancing are required if self-contained pressure independent control valves are not installed.

3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Engineer.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated preset settings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.8 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.9 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.10 PROCEDURES FOR CHILLERS

- A. Balance water flow through each chiller to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.

2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.

3.11 PROCEDURES FOR COOLING TOWERS

- A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
 1. Measure condenser-water flow to each cell of the cooling tower.
 2. Measure entering- and leaving-water temperatures.
 3. Measure wet- and dry-bulb temperatures of entering air.
 4. Measure wet- and dry-bulb temperatures of leaving air.
 5. Measure condenser-water flow rate recirculating through the cooling tower.
 6. Measure cooling-tower spray pump discharge pressure.
 7. Adjust water level and feed rate of makeup water system.
 8. Measure flow through bypass.

3.12 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 1. Entering- and leaving-water temperature.
 2. Water flow rate.
 3. Water pressure drop.
 4. Dry-bulb temperature of entering and leaving air.
 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 6. Airflow.
 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
 1. Nameplate data.
 2. Airflow.
 3. Entering- and leaving-air temperature at full load.
 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 5. Calculated kilowatt at full load.
 6. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each refrigerant coil:
 1. Dry-bulb temperature of entering and leaving air.
 2. Wet-bulb temperature of entering and leaving air.

3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.13 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.14 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.15 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report.
Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.

3.16 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

AQUA WAIKIKI WAVE
BUILDING PACKAGE

34-14102-00
FOR REVIEW - NOT FOR CONSTRUCTION

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
 - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 - 7. Outdoor, concealed supply and return.
 - 8. Outdoor, exposed supply and return.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in the insulation schedule on the plans for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290..
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Owens Corning; SOFTR All-Service Duct Wrap.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.

2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. Thermal Ceramics; FireMaster Duct Wrap.
 - d. 3M; Fire Barrier Wrap Products.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 5. Color: Aluminum.
 6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
 5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for ducts.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
- b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
- C. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Sheet and roll stock ready for shop or field sizing.
 3. Finish and thickness are indicated in field-applied jacket schedules.
 4. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 5. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
- D. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with aluminum-foil facing.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Polyguard Products, Inc.; Alumaguard 60.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 11.5 mils (0.29 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 6.5 mils (0.16 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches (50 mm).
 3. Thickness: 6 mils (0.15 mm).

4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches (50 mm).
 3. Thickness: 3.7 mils (0.093 mm).
 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, [1/2 inch (13 mm)] [3/4 inch (19 mm)] wide.
1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
- B. Insulation Pins and Hangers:
1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

- c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, or Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
 - c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
 - 2) GEMCO; Peel & Press.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, or Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
 4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, [galvanized-steel] [aluminum] [stainless-steel] sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-(0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy, 0.062-inch (1.6-mm) soft-annealed, stainless steel, or 0.062-inch (1.6-mm) soft-annealed, galvanized steel.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
 1. Comply with requirements in other sections for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
 2. Seal penetrations through fire-rated assemblies.

3.4 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
 5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.5 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.
- C. Exterior Exposed Insulation: Install specified continuous self-adhesive outdoor jacket per manufacturer's instructions and seal all joints and seams waterproof. In temperatures below 50° F use manufacturer's cold weather activator to insure adhesion.

3.6 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE: Refer to the plans for insulation requirements for individual systems.

END OF SECTION 230713

SECTION 230716 - HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following HVAC equipment that is not factory insulated:

1. Chilled-water pumps.
2. Expansion/compression tanks.
3. Air separators.

- B. Related Sections:

1. Section 230713 "Duct Insulation."
2. Section 230719 "HVAC Piping Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Block Insulation: ASTM C 552, Type I.
 - 2. Special-Shaped Insulation: ASTM C 552, Type III.
 - 3. Board Insulation: ASTM C 552, Type IV.
 - 4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. Provide.
- I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).
 - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 - 3. Solids Content: 60 percent by volume and 66 percent by weight.
 - 4. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Permanently flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
 - 4. Color: White or gray.
 - 5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. FSK and Metal Jacket Flashing Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 - 4. Color: Aluminum.
 - 5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm (0.013 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
6. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm (0.007 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
7. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
8. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for equipment.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Adhesive: As recommended by jacket material manufacturer.
 - 2. Color: White.
 - 3. Factory-fabricated tank heads and tank side panels.
- D. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - 1. Sheet and roll stock ready for shop or field sizing.
 - 2. Finish and thickness are indicated in field-applied jacket schedules.
 - 3. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 - 4. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - 5. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Polyguard Products, Inc.; Alumaguard 60.
- F. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm (0.013 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

- G. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm (0.007 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
- H. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Width: 3 inches (75 mm).
 - 2. Thickness: 11.5 mils (0.29 mm).
 - 3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Width: 3 inches (75 mm).
 - 2. Thickness: 6.5 mils (0.16 mm).
 - 3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Width: 2 inches (50 mm).
 - 2. Thickness: 6 mils (0.15 mm).
 - 3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 - 4. Elongation: 500 percent.
 - 5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Width: 2 inches (50 mm).
 - 2. Thickness: 3.7 mils (0.093 mm).
 - 3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 - 4. Elongation: 5 percent.
 - 5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.
- E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Width: 3 inches (75 mm).
2. Film Thickness: 4 mils (0.10 mm).
3. Adhesive Thickness: 1.5 mils (0.04 mm).
4. Elongation at Break: 145 percent.
5. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

- F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Width: 3 inches (75 mm).
 2. Film Thickness: 6 mils (0.15 mm).
 3. Adhesive Thickness: 1.5 mils (0.04 mm).
 4. Elongation at Break: 145 percent.
 5. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal].
- B. Insulation Pins and Hangers:
1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 - b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-(2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
 - b. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

- a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 - b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-(2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive-backed base with a peel-off protective cover.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, [galvanized-steel] [aluminum] [stainless-steel] sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy.

2.11 CORNER ANGLES

- A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches (50 mm)] [4 inches (100 mm)] o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.3 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

- A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least 3 inches (75 mm).
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 2. Fabricate boxes from aluminum 0.050 inch (1.3 mm) thick.
 3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.4 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

- B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.
- D. Where PVDC jackets are indicated, install as follows:
 - 1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
 - 2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.5 FINISHES

- A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation.

Extent of inspection shall be limited to two location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.7 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment that is not factory insulated.
- C. Chilled-water pump insulation shall be one of the following:
1. Cellular Glass: 3 inches (75 mm) thick.
 2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
- D. Chilled-water expansion/compression tank insulation shall be one of the following:
1. Cellular Glass: 1-1/2 inches (38 mm) thick.
 2. Flexible Elastomeric: 1 inch (25 mm) thick.
 3. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.
- E. Chilled-water air-separator insulation shall be one of the following:
1. Cellular Glass: 2 inches (50 mm) thick.
 2. Flexible Elastomeric: 1 inch (25 mm) thick.
 3. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.

3.8 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
1. None.
- D. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
1. PVC: 20 mils (0.5 mm) thick.

E. Equipment, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):

1. Aluminum, Smooth with 1-1/4-Inch- (32-mm-) Deep Corrugations.

3.9 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Exposed:

1. Aluminum, Smooth

END OF SECTION 230716

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following HVAC piping systems:

1. Chilled-water and brine piping.
2. Condenser-water piping, outdoors

- B. Related Sections:

1. Section 230713 "Duct Insulation."
2. Section 230716 "HVAC Equipment Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

- B. Products located in return air plenums shall be noncombustible with a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Foamglas.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 6. Preformed Pipe Insulation with Factory-Applied [ASJ] [ASJ-SSL]: Comply with ASTM C 552, Type II, Class 2.
 - 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- H. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for pipe.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil face, fiberglass-reinforced scrim with kraft-paper backing.

- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Sheet and roll stock ready for shop or field sizing.
 3. Finish and thickness are indicated in field-applied jacket schedules.
 4. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 5. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 6. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Polyguard Products, Inc.; Alumaguard 60.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches (50 mm).
 3. Thickness: 6 mils (0.15 mm).
 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches (50 mm).
 3. Thickness: 3.7 mils (0.093 mm).
 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- C. Wire: 0.080-inch (2.0-mm) nickel-copper alloy, 0.062-inch (1.6-mm) soft-annealed, stainless steel, or 0.062-inch (1.6-mm) soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. If applicable, coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 1. Comply with requirements in other sections for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of fittings and three locations of specialties such as valves, etc.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable insulation and jacket materials are identified above. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.11 INSULATION SCHEDULE

- A. See the insulation schedule on the plans for insulation thickness, jacket requirements, etc. See below for insulation type per application.

END OF SECTION 230719

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Divisions 21 through 28 of these specifications.
- C. The control diagrams and sequences on the plans.

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for heating and cooling units not supplied with factory-wired controls.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. MS/TP: Master slave/token passing.
- D. PC: Personal computer.
- E. PID: Proportional plus integral plus derivative.
- F. RTD: Resistance temperature detector.

1.4 SYSTEM DESCRIPTION

- A. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface.
- B. System software shall be based on a server/thin client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's local area network, and (at the owner's discretion) over the Internet. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.

- C. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, setpoints, trends and alarms specified in the Sequence of Operations on the plans shall be BACnet objects.

1.5 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
 - a. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
 - b. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
 - c. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
 - d. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
 - e. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
 - f. Relative Humidity: Plus or minus 5 percent.
 - g. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
 - h. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
 - i. Airflow (Terminal): Plus or minus 10 percent of full scale.
 - j. Air Pressure (Space): Plus or minus 0.01-inch wg (2.5 Pa).
 - k. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
 - l. Carbon Dioxide: Plus or minus 50 ppm.
 - m. Electrical: Plus or minus 5 percent of reading.

1.6 SEQUENCES OF OPERATION

- A. Refer to the plans for sequences of operation.

1.7 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 - 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 - 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
 - 4. Details of control panel faces, including controls, instruments, and labeling.
 - 5. Written description of sequence of operation.
 - 6. Schedule of dampers including size, leakage, and flow characteristics.
 - 7. Schedule of valves including flow characteristics.
 - 8. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and floor plans for field sensors and control hardware.
 - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
 - 9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
 - 10. Controlled Systems:
 - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
 - c. Written description of sequence of operation including schematic diagram.
 - d. Points list.
- C. Samples for Initial Selection: For each type of thermostat or sensor with cover.

1.8 INFORMATIONAL SUBMITTALS

- A. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- B. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
- C. Field quality-control test reports.

1.9 CLOSEOUT SUBMITTALS

- A. Project Record Documents. Upon completion of installation, submit three copies of record (as-built) documents of the documents shall be submitted for approval prior to final completion and shall include:
 1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD 2006 (or newer) compatible files on magnetic or optical media (file format: .DWG, .DXF, .VSD, or comparable) and as 11" x 17" prints.
 2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Section 23 09 23 Article 3.16 (Control System Demonstration and Acceptance).
 3. Operation and Maintenance (O&M) Manual.
 4. As-built versions of submittal product data.
 5. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
 6. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 7. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 8. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
 9. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
 10. Graphic files, programs, and database on magnetic or optical media.
 11. List of recommended spare parts with part numbers and suppliers.
 12. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
 13. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
 14. Licenses, guarantees, and warranty documents for equipment and systems.

15. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
- B. Training Materials: Provide course outline and materials for each class at least six weeks before first class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training. Engineer will modify course outlines and materials if necessary to meet Owner's needs. Engineer will review and approve course outlines and materials at least three weeks before first class.
- C. As built drawings indicating the locations and types of each device installed.

1.10 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Replacement Materials: One replacement mechanism for each unique controller, and thermostat.

1.11 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with ASHRAE 135 for DDC system components.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. System Software: Update to latest version of software at Project completion.

1.13 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls" to achieve compatibility with equipment that interfaces with that system.
- C. Coordinate equipment with Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System" to achieve compatibility with equipment that interfaces with that system.

- D. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- E. Coordinate equipment with Section 260913 "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.
- F. Coordinate equipment with Section 262416 "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- G. Coordinate equipment with Section 262419 "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

1.14 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to the receipt of bids of the following codes:
 - 1. National Electric Code (NEC)
 - 2. International Building Code (IBC)
 - a. Section 719 Ducts and Air Transfer Openings
 - b. Section 907 Fire Alarm and Detection Systems
 - c. Section 909 Smoke Control Systems
 - d. Chapter 28 Mechanical
 - 3. International Mechanical Code (IMC)
 - 4. ANSI/ASHRAE Standard 135, BACnet - A Data Communication Protocol for Building Automation and Control Systems

1.15 WARRANTY

- A. Warrant work as follows:
 - 1. In addition to specific warranty requirements describe below, the Contractor shall warrant all products and labor furnished for all phases of the project to be free from defects in material and workmanship under normal use and service for a period of 1 year from the date of substantial completion of Phase 3 Construction as defined on the phasing plan PH1.1.
 - 2. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
 - 3. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
 - 4. If the engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, the engineer will certify in writing that

- control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.
5. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve the contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
 6. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.16 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
 1. Graphics
 2. Record drawings.
 3. Database.
 4. Application programming code.
 5. Documentation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 CONTROL SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Automated Logic Corporation.
 2. Johnson Controls, Inc.
 3. Siemens Building Technologies, Inc.
 4. Staefa Controls.
 5. Schneider Electric.
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

- C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.3 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.
- B. Install new wiring and network devices as required to provide a complete and workable control network.
- C. Use existing Ethernet backbone for network segments.
- D. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- E. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
 2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Section 23 09 93. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.
- F. Workstations, Building Control Panels, and Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight saving and standard time as applicable.
- G. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.
- H. System Software:
1. Operating System: Web server or workstation shall have an industry-standard professional-grade operating system. Operating system shall meet or exceed the DDC System manufacturer's minimum requirements for their software. Typically acceptable

- systems include Microsoft Windows7, Microsoft Vista, Microsoft Windows XP Pro, Windows Server 2003 or 2008, Red Hat Enterprise Linux, or Ubuntu Desktop 10.04.
2. System Graphics: The operator interface software shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.
 - a. Functionality: Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
 - b. Animation: Graphics shall be able to animate by displaying different image files for changed object status.
 - c. Alarm Indication: Indicate areas or equipment in an alarm condition using color or other visual indicator.
 - d. Format: Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Adobe Flash).
 3. Custom Graphics: Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in the same formats as are used for system graphics.
 4. Graphics Library: Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.
- I. System Applications: System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.
1. Automatic System Database Configuration: Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
 2. Manual Controller Memory Download: Operators shall be able to download memory from the system database to each controller.
 3. System Configuration: The workstation software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password protection. Operators shall be able to configure the system.
 4. On-Line Help: Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and

- shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
5. Security: Each operator shall be required to log on to the system with user name and password in order to view, edit, add, or delete data.
 - a. Operator Access: The user name and password combination shall define accessible viewing, editing, adding, and deleting privileges for that operator. Users with system administrator rights shall be able to create new users and edit the privileges of all existing users. System Administrators shall also be able to vary and deny each operator's privileges based on the geographic location, such as the ability to edit operating parameters in Building A, to view but not edit parameters in Building B, and to not even see equipment in Building C.
 - b. Automatic Log Out: Automatically log out each operator if no keyboard or mouse activity is detected. This auto logoff time shall be user adjustable.
 - c. Encrypted Security Data: Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
 6. System Diagnostics: The system shall automatically monitor the operation of all building management panels and controllers. The failure of any device shall be annunciated to the operator.
 7. Alarm Processing: System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 23 09 93 (Sequences of Operation). Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
 8. Alarm Messages: Alarm messages shall use the English language descriptor for the object in alarm in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying on acronyms.
 9. Alarm Reactions: Operator shall be able to configure (by object) what, if any actions are to be taken during an alarm. As a minimum, the workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
 10. Alarm and Event Log: Operators shall be able to view all system alarms and changes of state from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and delete alarms, and archive closed alarms to the workstation or web server hard disk.
 11. Trend Logs: The operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in Section 23 09 93 (Sequences of Operation). Trends shall be BACnet trend objects.
 12. Object and Property Status and Control: Provide a method for the operator to view, and edit if applicable, the status of any object or property in the system. The status shall be available by menu, on graphics, or through custom programs.
 13. Reports and Logs: Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
 14. Standard Reports: Furnish the following standard system reports:

- a. Objects: System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
 - b. Alarm Summary: Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
 - c. Logs: System shall log the following to a database or text file and shall retain data for an adjustable period:
 - 1) Alarm History.
 - 2) Trend Data: Operator shall be able to select trends to be logged.
 - 3) Operator Activity: At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
15. Energy Reports: System shall include an easily configured energy reporting tool that provides the capabilities described in this section.
- a. The energy reporting tool shall be accessible through the same user interface (Web browser or operator workstation software) as is used to manage the BAS.
 - b. The energy reporting tool shall be preconfigured by the Contractor to gather and store energy demand and consumption data from each energy source that provides metered data to the BAS. Meter data shall be stored at 5 minute intervals unless otherwise specified in the Sequence of Operation provided in section 23 09 93. This data shall be maintained in an industry standard SQL database for a period of not less than five years.
 - c. The energy reporting tool shall allow the operator to select an energy source and a time period of interest (day, week, month, year, or date range) and shall provide options to view the data in a table, line graph, bar graph, or pie chart. The tool shall also allow the operator to select two or more data sources and display a comparison of the energy used over this period in any of the listed graph formats, or to total the energy used by the selected sources and display that data in the supported formats.
 - d. The energy reporting tool shall allow the operator to select an energy source and two time periods of interest (day, week, month, year, or date range) and display a graph that compares the energy use over the two time periods in any of the graph formats listed in the previous paragraph. The tool shall also allow the operator to select multiple energy sources and display a graph that compares the total energy used by these sources over the two time periods.
 - e. The energy reporting tool shall allow the operator to easily generate the previously described graphs "on the fly," and shall provide an option to store the report format so the operator can select that format to regenerate the graph at a future date. The tool shall also allow the user to schedule these reports to run on a recurring basis using relative time periods, such as automatically generating a consumption report on the first Monday of each month showing consumption over the previous month. Automatically generated reports shall be archived on the server in a common industry format such as Adobe PDF or Microsoft Excel with copies e-mailed to a user editable list of recipients.

16. The energy reporting tool shall be capable of collecting and displaying data from the following types of meters:
 - a. Electricity
 - b. Gas
 - c. Potable Water
 17. The user shall have the option of using Kw (Kwh) or Btu/hr (Btu) as the units for demand and consumption reports. Multiples of these units (MWH, kBtu, etc.) shall be used as appropriate. All selected sources shall be automatically converted to the selected units. The user shall similarly have the option of entering facility area and occupancy hours and creating reports that are normalized on an area basis, an annual use basis, or an occupied hour basis.
 18. The user shall have the option of entering benchmark data for an individual facility or a group of facilities.
 19. The user shall have the option of displaying any or all of the following data on any chart, line, or bar graph generated by the energy reporting tool:
 - a. Low/High/Average value of the metered value being displayed.
 - b. Heating and/or Cooling Degree Days for the time period(s) being displayed.
 - c. The Environmental Index for the facilities and time periods being displayed.
- J. Environmental Index: System shall monitor all occupied zones and compile an index that provides a numerical indication of the environmental comfort within the zone. As a minimum, this indication shall be based upon the deviation of the zone temperature from the heating or cooling setpoint. If humidity is being measured within the zone then the environmental index shall be adjusted to reflect a lower comfort level for high or low humidity levels. Similarly, if carbon dioxide levels are being measured as an indication of ventilation effectiveness then the environmental index shall be adjusted to indicate degraded comfort at high carbon dioxide levels. Other adjustments may be made to the environmental index based upon additional measurements. The system shall maintain a trend of the environmental index for each zone in the trend log. The system shall also compute an average comfort index for every building included in this contract and maintain trendlogs of these building environmental indices. Similarly, the system shall compute the percentage of occupied time that comfortable conditions were maintained within the zones. Through the UI the user shall be able to add a weighting factor to adjust the contribution of each zone to the average index based upon the floor area of the zone, importance of the zone, or other static criteria.
- K. Custom Reports: Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.
- L. Portable Operator's Terminal: Provide all necessary software to configure an IBM-compatible laptop computer for use as a Portable Operator's Terminal. Operator shall be able to connect configured Terminal to the system network or directly to each controller for programming, setting up, and troubleshooting.

2.4 DDC SYSTEM DATA STORAGE

- A. Include server(s) with disk drive data storage to archive not less than 24 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.
- B. When logged onto a server, operator shall be able to also interact with any DDC controller connected to DDC system as required for functional operation of DDC system.
- C. Server(s) shall be used for application configuration; for archiving, reporting and trending of data; for operator transaction archiving and reporting; for network information management; for alarm annunciation; and for operator interface tasks and controls application management.
- D. Server(s) shall use IT industry-standard database platforms such as Microsoft SQL Server and Microsoft Data Engine (MSDE).

2.5 FUTURE EXPANSION CAPABILITY

- A. Future Expandability:
 - 1. DDC system size shall be expandable to an ultimate capacity of at least two times total I/O points indicated.
 - 2. Additional DDC controllers, I/O and associated wiring shall be all that is needed to achieve ultimate capacity. Initial network infrastructure shall be designed and installed to support ultimate capacity.
 - 3. Operator interfaces installed initially shall not require hardware and software additions and revisions for ultimate capacity.

2.6 CONTROLLER SOFTWARE

- A. Furnish the following applications for building and energy management. All software application shall reside and operate in the system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
- B. Scheduling: Provide the capability to execute control functions according to a user created or edited schedule. Each schedule shall provide the following schedule options as a minimum:
 - 1. Weekly Schedule: Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
 - 2. Exception Schedules: Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule has executed, the system shall discard and replace the exception schedule with the standard schedule for that day of the week.
 - 3. Holiday Schedules: Provide the capability for the operator to define up to 24 special or holiday schedules. These schedules will be repeated each year. The operator shall be able to define the length of each holiday period.

- C. System Coordination: Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
- D. Binary Alarms: Each binary object shall have the capability to be configured to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.
- E. Analog Alarms: Each analog object shall have both high and low alarm limits. The operator shall be able to enable or disable these alarms.
- F. Alarm Reporting: The operator shall be able to determine the action to be taken in the event of an alarm. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display on graphics.
- G. Remote Communication: System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.
- H. Maintenance Management: The system shall be capable of generating maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in 23 09 93 (Sequences of Operation).
- I. PID Control: System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs. The calculation interval, PID gains, and other tuning parameters shall be adjustable by a user with the correct security level.
- J. Staggered Start: System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
- K. Energy Calculations:
 - 1. The system shall accumulate and convert instantaneous power (kW) or flow rates gpm to energy usage data.
 - 2. The system shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.
- L. Anti-Short Cycling: All binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
- M. On and Off Control with Differential: Provide an algorithm that allows a binary output to be cycled based on a controlled variable and a setpoint. The algorithm shall be direct-acting or reverse-acting.
- N. Runtime Totalization: Provide software to totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in Section 23 09 93 (Sequence of Operations).

2.7 DDC EQUIPMENT

- A. Diagnostic Terminal Unit: Portable notebook-style, PC-based microcomputer terminal capable of accessing system data by connecting to system network with minimum configuration as follows:
 - 1. System: With one integrated USB 2.0 port, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
 - 2. Processor: Intel Pentium 4.
 - 3. Random-Access Memory: 128 MB.
 - 4. Graphics: Video adapter, minimum 800 x 600 pixels, 64-MB video memory.
 - 5. Monitor: 17 inches, LCD color.
 - 6. Keyboard: QWERTY 105 keys in ergonomic shape.
 - 7. Floppy-Disk Drive: 1.44 MB.
 - 8. Hard-Disk Drive: 800 MB.
 - 9. CD-ROM Read/Write Drive: 48x24x48.
 - 10. Pointing Device: Touch pad or other internal device.
 - 11. Software: Loaded with all required software for accessing the control system.
- B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
 - 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
 - 3. Standard Application Programs:
 - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
 - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
 - c. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
 - d. Remote communications.
 - e. Maintenance management.
 - f. Units of Measure: Inch-pound.

4. Local operator interface provides for download from or upload to diagnostic terminal unit.
 5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 3. Local operator interface provides for download from or upload to diagnostic terminal unit.
 4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
 7. Universal I/Os: Provide software selectable binary or analog outputs.
- E. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
 2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- F. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.8 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
 3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
 4. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).
 5. Enclosure: Waterproof rated for operation at 40 to 150 deg F (5 to 65 deg C).

2.9 ANALOG CONTROLLERS

- A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F (minus 23 to plus 21 deg C), and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
- D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

2.10 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Temperature Sensors and Transmitters:
 - 1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BEC Controls Corporation.
 - b. Dwyer
 - c. Ebtron, Inc.
 - d. Heat-Timer Corporation.
 - e. I.T.M. Instruments Inc.
 - f. MAMAC Systems, Inc.
 - g. RDF Corporation.
 - 2. Accuracy: Plus or minus 0.5 deg F (0.3 deg C) at calibration point.
 - 3. Wire: Twisted, shielded-pair cable.
 - 4. Insertion Elements in Ducts: Single point, 8 inches (200 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
 - 5. Averaging Elements in Ducts: 36 inches (915 mm) long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
 - 6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
 - 7. Room Sensors:
 - a. Classrooms and Occupied Areas Supervised by School Personnel (Classrooms, Offices, etc.): Wall mounted hand adjustable thermostats. Program to limit up or down adjustment to 3° F (adjustable). Thermostat shall not display zone temperature or setpoint and shall indicate setpoint adjustment by '+' or '-', 'warmer' or 'cooler' indication.
 - b. Common, Unattended, Open Areas (Gymnasium, Commons, Corridors, etc.): Wall mounted metal plate sensors adjustable through the BMS only.
- C. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - 1. Set-Point Adjustment: Exposed. Set-point adjustment shall be indicated by 'warmer/cooler', '+/-' or similar indication.
 - 2. Set-Point Display: Sensor shall not display set-point.
 - 3. Set-Point Indication: Sensor shall not display set-point.
 - 4. Space Temperature Indication: Sensor shall not display space temperature.
 - 5. Orientation: Vertical.
- D. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
- E. Humidity Sensors: Bulk polymer sensor element.

1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BEC Controls Corporation.
 - b. Dwyer
 - c. General Eastern Instruments.
 - d. MAMAC Systems, Inc.
 - e. ROTRONIC Instrument Corp.
 - f. TCS/Basys Controls.
 - g. Vaisala.
2. Accuracy: 5 percent full range with linear output.
3. Room Sensor Range: 20 to 80 percent relative humidity.
4. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Orientation: Vertical.
5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 32 to 120 deg F (0 to 50 deg C).
7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

F. Pressure Transmitters/Transducers:

1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BEC Controls Corporation.
 - b. Dwyer
 - c. General Eastern Instruments.
 - d. MAMAC Systems, Inc.
 - e. ROTRONIC Instrument Corp.
 - f. TCS/Basys Controls.
 - g. Vaisala.
2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0- to 0.25-inch wg (0 to 62 Pa).
 - d. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).
3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure; linear output 4 to 20 mA.
4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); linear output 4 to 20 mA.
5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

6. Outdoor static pressure sensors: To provide average outdoor air pressure signal for reference in building pressurization application – Equal to Dwyer A-306-A.
 7. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.
- G. Room sensor accessories include the following:
1. Insulating Bases: For sensors located on exterior and block walls. On block walls seal penetrations to prevent air transfer to sensor or space.

2.11 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa), piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.
 1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BEC Controls Corporation.
 - b. I.T.M. Instruments Inc.

2.12 FLOW MEASURING STATIONS

- A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station.
1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Monitor Corporation.
 - b. Wetmaster Co., Ltd.
 - c. Ebtron
 2. Casing: Galvanized-steel frame.
 3. Flow Straightener: Aluminum honeycomb, 3/4-inch (20-mm) parallel cell, 3 inches (75 mm) deep.
 4. Sensing Manifold: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.

2.13 THERMOSTATS

- A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Erie Controls.
 2. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
 3. Heat-Timer Corporation.
 4. Sauter Controls Corporation.
 5. tekmar Control Systems, Inc.
 6. Theben AG - Lumilite Control Technology, Inc.
- B. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.
- C. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.
1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
 2. Selector Switch: Integral, manual on-off-auto.
- D. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- E. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

- F. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below set point.
1. Bulb Length: Minimum 20 feet (6 m).
 2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.
- G. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or above set point.
1. Bulb Length: Minimum 20 feet (6 m).
 2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.

2.14 HUMIDISTATS

- A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. MAMAC Systems, Inc.
 2. ROTRONIC Instrument Corp.
- B. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

2.15 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
1. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
 4. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
 5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
 6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Belimo Aircontrols (USA), Inc.
2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
3. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft (49.6 kg-cm/sq. m) of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.
 - e. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.
4. Coupling: V-bolt and V-shaped, toothed cradle.
5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
7. Power Requirements (Two-Position Spring Return): 24-V ac.
8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating: Minus 22 to plus 122 deg F (Minus 30 to plus 50 deg C).
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (Minus 30 to plus 121 deg C).
12. Run Time: 12 seconds open, 5 seconds closed.

2.16 CONTROL VALVES

A. Hydronic Actuated Control Valves:

1. Actuated control valves shall be pressure independent actuated ball valves and cartridge (PIC-V).
2. The modulating control valves shall be pressure independent.
3. The pressure independent modulating control valve shall include a pressure compensating cartridge, actuated ball valve, and manual isolation ball in a single valve housing.
4. Valve housing shall consist of forged brass, rated at no less than 360 psi at 250 deg F.
5. Valve shall have a fixed end or union end connection with factory installed air vent to allow for venting of the coil or heat pump.
6. The control valve shall accurately control the flow from 0 to 100% full rated flow.
7. A flow tag shall be furnished with each valve.

8. A universal mounting plate shall allow installation of actuators meeting the system electrical requirements and valve torque requirements as provided by the following:
 - a. Belimo.
 - b. Honeywell.
 - c. Johnson Controls.
 - d. KMC.
 - e. Neptronics.
 - f. Siemens.
 9. The actuator and plate can be rotated after mounting.
 10. Pressure Compensating Cartridge (PCC):
 - a. PCC shall automatically compensate for pressure changes in valve and shall maintain a constant pressure drop across the flow limiting actuated ball.
 - b. The operating pressure range shall be available with the minimum range requiring 5.8 PSID to actuate the mechanism.
 - c. Valve internal control mechanism includes a diaphragm and full travel linear coil spring.
 - d. Valves shall include an accessible/replaceable cartridge.
 - e. Dual pressure/temperature test valves for verifying the pressure differential across the cartridge and flow limiting ball shall be standard.
 11. Actuated Ball Valve:
 - a. Valve ball shall consist of chemically plated nickel brass or stainless steel.
 - b. Actuator stem shall be removable/replaceable without removing valve from line.
 - c. Manufacturer shall be able to provide ball insert to limit flow to maximum flow rate with $\pm 5\%$ accuracy.
 - d. Valve shall have EPDM O-rings behind the seals to allow for a minimum close-off pressure of 100 psi with 35 in-lbs of torque for 1/2-inch to 2-inch sizes.
 - e. Actuator shall provide minimum torque required for full valve shutoff position.
 12. Isolation Ball Valve:
 - a. Valve shall include a 600 WOG manual isolation ball valve.
 13. Pressure Independent Control Valves: Provide products by the following:
 - a. Griswold Controls.
 14. The control valve actuator may be furnished by the controls contractor or by the pressure independent control valve manufacturer.
- B. Hydronic system globe valves shall have the following characteristics:
1. NPS 2 (DN 50) and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
 2. NPS 2-1/2 (DN 65) and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.

3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
 - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
 - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
 4. Sizing: 3-psig (21-kPa) maximum pressure drop at design flow rate or the following:
 - a. Two Position: Line size.
 - b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
 - c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
 5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
- C. Butterfly Valves: 200-psig (1380-kPa), 150-psig (1034-kPa) maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Body Style: Wafer.
 2. Disc Type: Nickel-plated ductile iron.
 3. Sizing: 1-psig (7-kPa) maximum pressure drop at design flow rate.
- D. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
 2. Sizing: 3-psig (21-kPa) maximum pressure drop at design flow rate, to close against pump shutoff head.
 3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
- E. Self-Contained Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.

2.17 DAMPERS

- A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.
 2. Ruskin
 3. TAMCO (T. A. Morrison & Co. Inc.).
 4. United Enertech Corp.
 5. Vent Products Company, Inc.
- B. Dampers: AMCA-rated, parallel-blade design; 0.108-inch- (2.8-mm-) minimum thick, galvanized-steel or 0.125-inch- (3.2-mm-) minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).
1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
 4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. (50 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1000 Pa) when damper is held by torque of 50 in. x lbf (5.6 N x m); when tested according to AMCA 500D.

2.18 CONTROL CABLE

- A. Electronic cables for control wiring are specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

2.19 POWER WIRING

- A. Furnish and install power wiring and circuit breakers to temperature control panels, motorized dampers, heat pumps, terminal boxes, and other devices as required. Circuits shall be run from spares in local panels. Coordinate with other trades.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units.

3.2 INSTALLATION

- A. Install software in control units and Diagnostic Terminal Unit. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 60 inches (1530 mm) above the floor.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- D. Install guards on thermostats in the following locations:
 - 1. Entrances.
 - 2. Public areas.
 - 3. Where indicated.
- E. Install automatic dampers according to Section 233300 "Air Duct Accessories."
- F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- G. Install labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."
- H. Install hydronic instrument wells, valves, and other accessories according to Section 232116 Hydronic Piping Specialties."
- I. Install duct volume-control dampers according to Section 233113 "Metal Ducts"
- J. Install electronic and fiber-optic cables according to Section 271500 "Communications Horizontal Cabling."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Section 260533 "Raceways and Boxes for Electrical Systems."
- B. Install building wire and cable according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Section 271500 "Communications Horizontal Cabling."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Install concealed cable in raceway.

4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 2. Test and adjust controls and safeties.
 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 4. Pressure test control air piping at 30 psig (207 kPa) or 1.5 times the operating pressure for 24 hours, with maximum 5-psig (35-kPa) loss.
 5. Pressure test high-pressure control air piping at 150 psig (1034 kPa) and low-pressure control air piping at 30 psig (207 kPa) for 2 hours, with maximum 1-psig (7-kPa) loss.
 6. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 7. Test each point through its full operating range to verify that safety and operating control set points are as required.
 8. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 9. Test each system for compliance with sequence of operation.
 10. Test software and hardware interlocks.
- C. DDC Verification:
1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 2. Check instruments for proper location and accessibility.
 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 4. Check instrument tubing for proper fittings, slope, material, and support.
 5. Check installation of air supply for each instrument.

6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

- A. Calibrating and Adjusting:
1. Calibrate instruments.
 2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
 3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliamperes meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
 5. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.
 6. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
 8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
 10. Provide diagnostic and test instruments for calibration and adjustment of system.
 11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature and humidity set points.
- C. Occupancy Adjustments: When requested, the contractor shall provide on-site assistance in adjusting system controls to suit actual occupied conditions. Provide up to three visits for two heating and cooling seasons (12 total visits) to the site during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section requirements for demonstration and training.

END OF SECTION 230900

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:

1. Chilled-water piping.
2. Makeup-water piping.
3. Condensate-drain piping.
4. Condenser water piping
5. Air-vent piping.
6. Safety-valve-inlet and -outlet piping.

- B. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.
3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: The contractor shall submit general building piping and mechanical room layout plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Mechanical Rooms: Hydronic systems equipment including chillers, boilers, pumps, air separators, expansion tanks, water treatment equipment and all other hydronic specialties, indicating coordination with general construction, building components including structure, duct, plumbing, and sprinkler piping, electrical conduits, and other building services.
 2. Building piping installation, indicating coordination with general construction, building components including structure, duct, plumbing, and sprinkler piping, electrical conduits,

- and other building services. Indicate proposed sizes, elevations, changes in elevation, etc.
3. Suspended ceiling components.
 4. Size and location of access to concealed equipment.
 5. Penetrations of smoke barriers and fire-rated construction.
- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
1. Chilled-Water Piping: 150 psig at 200 deg F.
 2. Condenser Water Piping: 150 at 150 deg F (66 deg C)
 3. Makeup-Water Piping: 100 psig at 150 deg F.
 4. Condensate-Drain Piping: 150 deg F (66 deg C).
 5. Air-Vent Piping: 200 deg F (93 deg C).
 6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

- A. Type M (Type C), drawn-temper copper tubing, wrought-copper fittings, and soldered joints

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Grooved Mechanical-Joint Fittings and Couplings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Anvil International, Inc.
 - b. Central Sprinkler Company.
 - c. Star Pipe Products.
 - d. Victaulic Company.
2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 3. Couplings: Ductile- or malleable-iron housing and EPDM or nitrile gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

2.4 PLASTIC PIPE AND FITTINGS

- A. CPVC Plastic Pipe: ASTM F 441/F 441M, with wall thickness as indicated in "Piping Applications" Article.
 1. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.
- B. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.
 1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.5 SMOKE AND FIRE RATINGS

- A. Where indicated on the drawings that a Plenum-rated Piping System is needed, then the pipe shall be pre-insulated or field insulated, and when tested with standard un-insulated fittings per CAN/ULC-S102.2-03 or ASTM E84, the system consisting of wrapped pipe and bare fittings shall have a Flame Spread Classification of less than 25 and Smoke Development rating of less than 50.

2.6 JOINING MATERIALS

- A. Solvent Cements for Joining Plastic Piping:
 1. CPVC Piping: ASTM F 493.
 - a. CPVC solvent cement shall have a VOC content of 490 g/L or less.
 - b. Adhesive primer shall have a VOC content of 550 g/L or less.
 - c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Health Services') "Standard Method for the Testing and Evaluation of

Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - a. PVC solvent cement shall have a VOC content of 510 g/L or less.
 - b. Adhesive primer shall have a VOC content of 550 g/L or less.
 - c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Capitol Manufacturing Company.
 - c. Central Plastics Company.
 - d. Hart Industries International, Inc.
 - e. Jomar International Ltd.
 - f. Matco-Norca.
 - g. Watts Regulator Co.
 - h. Zurn Industries, LLC.

2.8 BYPASS CHEMICAL FEEDER

- A. Description: Welded steel construction; 125-psig (860-kPa) working pressure; 5-gal. (19-L) capacity; with fill funnel and inlet, outlet, and drain valves.
1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

PART 3 - EXECUTION

3.1 PLENUM PIPING

- A. With the approval of the jurisdiction having authority, piping located in return air plenums may be plastic and shall be wrapped with noncombustible insulation with a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84.

3.2 PIPING APPLICATIONS

- A. Chilled- water piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:
1. Type L (Type B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 2. Schedule 40, Grade B, Type 96 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Chilled -water piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be any of the following:
1. Type L (Type B), drawn-temper copper tubing, wrought-copper fittings, and joints.
 2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- C. Condenser-water piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be any of the following:
1. Type M (Type C), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
 4. Schedule 80 CPVC plastic pipe and fittings and solvent-welded joints.
- D. Makeup-water piping installed aboveground shall be the following:

1. Type L (Type B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- E. Makeup-Water Piping Installed Belowground and within Slabs: Type K (Type A), annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- F. Condensate-Drain Piping
 1. Indoor piping in return air plenums: Type M (Type C), drawn-temper copper tubing, wrought-copper fittings, and soldered joints
 2. Indoor piping not in return air plenums: Schedule 40 PVC or CPVC plastic pipe and fittings and solvent-welded joints.
 3. Outdoor piping: Schedule 40 PVC or CPVC plastic pipe and fittings and solvent-welded joints.
- G. Air-Vent Piping:
 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
 2. Outlet: Type K (Type A), annealed-temper copper tubing with soldered or flared joints.
- H. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.

- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at all low points in piping system mains and everywhere else required to drain the system.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.
- S. Install shutoff valve immediately upstream of each dielectric fitting.
- T. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- U. Install sleeves for piping penetrations of walls, ceilings, and floors.
- V. Install sleeve seals for piping penetrations of concrete walls and slabs.
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.5 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
 2. Adjustable roller hangers for individual horizontal piping 20 feet (6 m) or longer.
 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 4. Spring hangers to support vertical runs.
 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m).
 2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m).
 3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m).
 4. NPS 2 (DN 50): Maximum span, 10 feet (3 m).
 5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m).
 6. NPS 3 (DN 80) and Larger: Maximum span, 12 feet (3.7 m).
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
 2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
 3. NPS 1-1/4 (DN 32): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).
 4. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
 5. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
 6. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
 7. NPS 3 (DN 80) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
- E. Polypropylene Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- G. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.6 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- F. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with details on the plans.

3.8 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.9 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Circulate hydronic piping systems with clean water and cleaning agents for a minimum of 48 hours; Flush hydronic piping systems with clean water for a minimum of 24 hours; then remove and clean or replace strainer screens. Extend circulating and flush durations as necessary achieve clean, like new, system.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 60 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment, such as chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes special-duty valves and specialties for the following:

1. Chilled-water piping.
2. Makeup-water piping.
3. Condensate-drain piping.
4. Condenser-water piping.
5. Air-vent piping.
6. Safety-valve-inlet and -outlet piping.
7. Flexible supply and return hoses

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:

1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air-control devices.
3. Hydronic specialties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. ASME Compliance: Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Package equipment for export shipping in totally enclosed crate with bagging.
- C. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- D. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components (parts and labor) that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One (1) year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
 - 1. Chilled-Water Piping: 150 psig at 200 deg F.
 - 2. Condenser Water Piping: 150 at 150 deg F (66 deg C)
 - 3. Makeup-Water Piping: 100 psig at 150 deg F.
 - 4. Condensate-Drain Piping: 150 deg F (66 deg C).
 - 5. Air-Vent Piping: 200 deg F (93 deg C).
 - 6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.
 - 7. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES

- A. Bronze, Calibrated-Orifice, Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Griswold Controls.

- d. Nexus Valve, Inc.
 - e. Taco.
2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 3. Ball: Brass or stainless steel.
 4. Plug: Resin.
 5. Seat: PTFE.
 6. End Connections: Threaded or socket.
 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 8. Handle Style: Lever, with memory stop to retain set position.
 9. CWP Rating: Minimum 125 psig (860 kPa).
 10. Maximum Operating Temperature: 250 deg F (121 deg C).
- B. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.
1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Conbraco Industries, Inc.
 - e. Watts Regulator Co.
 2. Body: Bronze or brass.
 3. Disc: Glass and carbon-filled PTFE.
 4. Seat: Brass.
 5. Stem Seals: EPDM O-rings.
 6. Diaphragm: EPT.
 7. Low inlet-pressure check valve.
 8. Inlet Strainer: Removable without system shutdown.
 9. Valve Seat and Stem: Noncorrosive.
 10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
- C. Diaphragm-Operated Safety Valves: ASME labeled.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Conbraco Industries, Inc.
 - e. Watts Regulator Co.
 2. Body: Bronze or brass.
 3. Disc: Glass and carbon-filled PTFE.
 4. Seat: Brass.

5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: Removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

D. Automatic Flow-Control Valves:

1. Balancing valves and associated balancing shall not be required on devices where pressure independent control valves are installed. Balancing valves and balancing are required where self-contained pressure independent control valves are not installed.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flow Design Inc.
 - b. Griswold Controls.
 - c. Nexus Valve, Inc.
3. Body: Brass or ferrous metal.
4. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.
5. Combination Assemblies: Include bonze or brass-alloy ball valve.
6. Identification Tag: Marked with zone identification, valve number, and flow rate.
7. Size: Same as pipe in which installed.
8. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
9. Minimum CWP Rating: 175 psig (1207 kPa).
10. Maximum Operating Temperature: 200 deg F (93 deg C).

E. Actuated Control Valves:

1. Actuated Control Valves shall be Pressure Independent Actuated Ball Valves and Cartridge (PIC-V).
2. The modulating control valves shall be pressure independent.
3. The pressure independent modulating control valve shall include a Pressure Compensating Cartridge, Actuated Ball Valve, and Manual Isolation Ball in a single valve housing.
4. Valve housing shall consist of forged brass, rated at no less than 360 psi at 250°F.
5. Valve shall have a fixed end or union end connection with factory installed air vent to allow for venting of the coil or heat pump.
6. The control valve shall accurately control the flow from 0 to 100% full rated flow.
7. A flow tag shall be furnished with each valve.
8. A universal mounting plate shall allow installation of actuators meeting the system electrical requirements and valve torque requirements as provided by Belimo, ELO Drive, Honeywell, Johnson Controls, KMC, Nepronics, Siemens, or Snyder Electric.
9. The actuator and plate can be rotated after mounting.
10. Pressure Compensating Cartridge (PCC):

- a. PCC shall automatically compensate for pressure changes in valve and shall maintain a constant pressure drop across the flow limiting actuated ball.
 - b. The operating pressure range shall be available with the minimum range requiring 5.8 PSID to actuate the mechanism.
 - c. Valve internal control mechanism includes a diaphragm and full travel linear coil spring.
 - d. Valves shall include an accessible/ replaceable cartridge.
 - e. Dual pressure/temperature test valves for verifying the pressure differential across the cartridge and flow limiting ball shall be standard.
11. Actuated Ball Valve:
- a. Valve ball shall consist of chemically plated nickel brass or stainless steel.
 - b. Actuator stem shall be removable/replaceable without removing valve from line.
 - c. Manufacturer shall be able to provide ball insert to limit flow to maximum flow rate with $\pm 5\%$ accuracy.
 - d. Valve shall have EPDM O-rings behind the seals to allow for a minimum close-off pressure of 100 psi with 35 in-lbs of torque for 1/2-inch to 2-inch sizes.
 - e. Actuator shall provide minimum torque required for full valve shutoff position.
12. Isolation Ball Valve:
- a. Valve shall include a 600 WOG manual isolation ball valve.
13. Pressure Independent Control Valves shall be by Griswold Controls.
14. The control valve actuator may be furnished by the controls contractor or by the Pressure Independent Control Valve manufacturer.

2.3 AIR-CONTROL DEVICES

- A. Manual Air Vents:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Flo Fab
 - e. Nexus Valve, Inc.
 - f. Taco, Inc.
2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2 (DN 15).
6. Discharge Connection: NPS 1/8 (DN 6).
7. CWP Rating: 150 psig (1035 kPa).
8. Maximum Operating Temperature: 225 deg F (107 deg C).

B. Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Flo Fab
 - e. Taco, Inc.
2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature, with taps in bottom of tank for tank fitting. Tanks shall be factory tested after taps are fabricated and shall be labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. (379-L) unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig (860-kPa) working pressure and 250 deg F (121 deg C) maximum operating temperature.
4. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig (860-kPa) working pressure and 240 deg F (116 deg C) maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.

C. In-Line Air Separators:

1. Products: Subject to compliance with requirements, provide the product scheduled on the plans or an equal project by one of the following manufacturers:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Flo Fab
 - e. Taco, Inc.
2. Tank: Fabricated to ASME Section VIII, Division 1 and constructed to maximize air and dirt separation.
3. Maximum Working Pressure: Up to 150 psig.
4. Maximum Operating Temperature: Up to 270 deg F.
5. Maximum Velocity: 10 feet per second.

2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: Stainless-steel, 20-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig (860 kPa).

B. Flexible Supply and Return Hoses:

1. Suitable for use in chilled water and hot water systems, up to 50% glycol.
2. All hoses shall be equipped with swivel end connections at terminal unit. All end connections shall be crimped to meet standard pressure ratings. Serrated/Slip fit connections shall not be acceptable.
3. Hose material shall be stainless steel braided over a synthetic polymer liner.
4. Hoses shall meet or exceed the ASTM-D380-83 standard.
5. Hoses shall meet or exceed flame retardant testing per standards UL #723, NEPA #225, ANSI 2.5, UBC 42-1, and ASTM-E84A after ten minutes.
6. Insulated Hoses:
 1. Hose materials shall be high quality polyethylene pipe insulation over a stainless steel braided inner core.

C. Expansion Fittings: Comply with requirements in other sections of the specifications.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install throttling-duty valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.
- D. Install expansion tanks per the manufacturer's recommendations. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
 1. Install tank fittings that are shipped loose.

2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

END OF SECTION 232116

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Close-coupled, end-suction centrifugal pumps.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of pump.
- B. Shop Drawings: For each pump.
 1. Show pump layout and connections.
 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE:

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.
- B. Ensure pump operation at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate to ANSI/HI 9.6.3.1 standard for Preferred Operating Region (POR) unless otherwise approved by the engineer. The pump NPSH shall confirm to the ANSI/HI 9.6.1-1997 standards for *Centrifugal and Vertical Pumps for NPSH Margin*.
- C. Pump selections shall contain an impeller no more than 86% the size of the maximum impeller available for the selected pump.

- D. Ensure pump pressure ratings are at least equal to system's maximum operating pressure at point where installed, but not less than specified.
- E. Equipment manufacturer shall be a company specializing in manufacture, assembly, and field performance of provided equipment with a minimum of 20 years experience.
- F. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New pump start-up shall be for the purpose of determining pump alignment, lubrication, voltage, and amperage readings. All proper electrical connections, pump's balance, discharge and suction gauge readings, and adjustment of head, if required. A copy of the start-up report shall be made and sent to both the contractor and to the Engineer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pumps as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Package equipment for export shipping in totally enclosed crate with bagging.
- C. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- D. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of the hydronic pumps (parts and labor) that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Armstrong Pumps Inc.
 - 2. Grundfos Pumps Corporation.
 - 3. ITT Corporation; Bell & Gossett.
 - 4. PACO Pumps.
 - 5. Patterson Pump Co.
 - 6. TACO Incorporated.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, end-suction pump; designed for base mounting, with pump and motor shafts horizontal.
- C. Pump Construction:
 - 1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections.
 - 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
 - 3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
 - 4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N or EPT bellows and gasket.
 - 5. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.
 - 6. Pump selections shall contain an impeller no more than 85% the size of the maximum impeller available for the selected pump.
- D. Shaft Coupling: EPDM coupling sleeve for variable-speed applications.
- E. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.
- F. Motor: Variable speed, secured to mounting frame, with adjustable alignment.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Enclosure: Open, dripproof.
 - b. Enclosure Materials: Cast iron.

- c. Motor Bearings: Permanently lubricated ball bearings.
- d. Unusual Service Conditions:

- 1) Ambient Temperature: 120 deg F.
- 2) Altitude: 1500 feet above sea level.
- 3) High humidity.

- e. Efficiency: Premium efficient.

G. Capacities and Characteristics: As indicated on the equipment schedules on the plans.

2.2 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

- 1. Angle pattern.
- 2. 175-psig (1204-kPa) pressure rating, cast-iron body and end cap, pump-inlet fitting.
- 3. Bronze startup and bronze or stainless-steel permanent strainers.
- 4. Bronze or stainless-steel straightening vanes.
- 5. Drain plug.
- 6. Factory-fabricated support.

PART 3 - EXECUTION

3.1 EQUIPMENT - COMMON REQUIREMENTS

A. Install all equipment, material, etc. according to the manufacturer's instructions.

3.2 PUMP INSTALLATION

A. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

B. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

C. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment bases.

- 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
- 2. Construct bases to withstand, without damage to equipment, seismic force required by code.
- 3. Construct concrete bases 4 inches (100 mm) high and extend base not less than 6 inches (150 mm) in all directions beyond the maximum dimensions of base-mounted pumps unless otherwise indicated or unless required for seismic-anchor support.

D. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers of size required to support weight of in-line pumps.

1. Comply with requirements for hangers and supports specified in other sections of the specifications.

3.3 ALIGNMENT

- A. Engage a factory-authorized service representative to perform alignment service.
- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to pump, allow space for service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install check valve and shut off valve on discharge side of pumps.
- F. Install suction diffuser and shutoff valve on suction side of pumps.
- G. Install flexible connectors on suction and discharge sides of pumps between pump casing and valves.
- H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.
- I. Ground equipment according to Division 26.
- J. Connect wiring according to Division 26.

END OF SECTION 232123

SECTION 232500 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following HVAC water-treatment systems:

1. Bypass chemical-feed equipment and controls.
2. Chemical treatment test equipment.
3. HVAC water-treatment chemicals.

1.3 PERFORMANCE REQUIREMENTS

- A. The water for all HVAC systems shall be chemically treated to minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

- B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

- C. Closed hydronic systems, including chilled-water, shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. Boron: Maintain a value within 100 to 200 ppm.
3. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
4. Soluble Copper: Maintain a maximum value of 0.20 ppm.
5. Ammonia: Maintain a maximum value of 20 ppm.
6. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
 - b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
 - c. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
 - d. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

- D. Open hydronic systems, including cooling-tower water, shall have the following water qualities:

1. pH: Maintain a value within 8.0 to 9.1.
2. "P" Alkalinity: Maintain a maximum value of 100 ppm.
3. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.

4. Soluble Copper: Maintain a maximum value of 0.20 ppm.
 5. TDS: Maintain a maximum value of 10 ppm.
 6. Ammonia: Maintain a maximum value of 20 ppm.
 7. Free "OH" Alkalinity: Maintain a maximum value of 0 ppm
 8. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maintain a maximum value of 10,000 organisms/ml.
 - b. Total Anaerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
 - c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
 - d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
 - e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.
 9. Polymer Testable: Maintain a minimum value within 10 to 40.
- E. Passivation for Galvanized Steel: For the first 60 days of operation.
1. pH: Maintain a value within 7 to 8.
 2. Calcium Carbonate Hardness: Maintain a value within 100 to 300 ppm.
 3. Calcium Carbonate Alkalinity: Maintain a value within 100 to 300 ppm.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
1. Bypass feeders.
 2. Water meters.
 3. Inhibitor injection timers.
 4. pH controllers.
 5. TDS controllers.
 6. Chemical solution tanks.
 7. Injection pumps.
 8. Chemical test equipment.
 9. Chemical material safety data sheets.
- B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.
1. Wiring Diagrams: Power and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For sensors, injection pumps, RO equipment, water filtration units, and controllers to include in emergency, operation, and maintenance manuals.
- E. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
2. Water Analysis: Illustrate water quality available at Project site.
3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to Architect.

1.5 QUALITY ASSURANCE

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling tower and chilled water, and other related equipment. Services and chemicals shall be provided for a period of two years from date of Substantial Completion, and shall include the following:
 1. Initial water analysis and HVAC water-treatment recommendations.
 2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
 3. Periodic field service and consultation.
 4. Customer report charts and log sheets.
 5. Laboratory technical analysis.
 6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 - PRODUCTS

2.1 MANUAL CHEMICAL-FEED EQUIPMENT

- A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch (89-mm) fill opening in the top, and NPS 3/4 (DN 20) bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
 1. Capacity: 5 gal. (19 L).
 2. Minimum Working Pressure: 175 psig (1210 kPa).

2.2 AUTOMATIC CHEMICAL-FEED EQUIPMENT

A. Water Meter:

1. AWWA C701, turbine-type, totalization meter.
2. Body: Bronze.
3. Minimum Working-Pressure Rating: 100 psig (690 kPa).
4. Maximum Pressure Loss at Design Flow: 3 psig (20 kPa).
5. Registration: Gallons (Liters) or cubic feet (cubic meters).
6. End Connections: Threaded.
7. Control: Low-voltage signal capable of transmitting 1000 feet (305 m).
8. 250-V ac; and that will close at adjustable increments of total flow.
9. System make up water meter shall interface with BAS system providing water usage data.

B. Inhibitor Injection Timers:

1. Microprocessor-based controller with LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door.
2. Programmable timers with infinite adjustment over full range, and mounted in cabinet with hand-off-auto switches and status lights.
3. Test switch.
4. Hand-off-auto switch for chemical pump.
5. Illuminated legend to indicate feed when pump is activated.
6. Programmable lockout timer with indicator light. Lockout timer to deactivate the pump and activate alarm circuits.
7. LCD makeup totalizer to measure amount of makeup and bleed-off water from two water meter inputs.

C. pH Controller:

1. Microprocessor-based controller, 1 percent accuracy in a range from zero to 14 units. Incorporate solid-state integrated circuits and digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door.
2. Digital display and touch pad for input.
3. Sensor probe adaptable to sample stream manifold.
4. High, low, and normal pH indication.
5. High or low pH alarm light, trip points field adjustable; with silence switch.
6. Hand-off-auto switch for acid pump.
7. Internal adjustable hysteresis or deadband.

D. TDS Controller:

1. Microprocessor-based controller, 1 percent accuracy in a range from zero to 5000 micromhos. Incorporate solid-state integrated circuits and digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door.
2. Digital display and touch pad for input.
3. Sensor probe adaptable to sample stream manifold.
4. High, low, and normal conductance indication.
5. High or low conductance alarm light, trip points field adjustable; with silence switch.

6. Hand-off-auto switch for solenoid bleed-off valve.
7. Bleed-off valve activated indication.
8. Internal adjustable hysteresis or deadband.
9. Bleed Valves:
 - a. Hydronic Systems: Forged-brass body, globe pattern, general-purpose solenoid with continuous-duty coil, or motorized valve.

E. Biocide Feeder Timer:

1. Microprocessor-based controller with digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door.
2. 24-hour timer with 14-day skip feature to permit activation any hour of day.
3. Precision, solid-state, bleed-off lockout timer and clock-controlled biocide pump timer. Prebleed and bleed lockout timers.
4. Solid-state alternator to enable use of two different formulations.
5. 24-hour display of time of day.
6. 14-day display of day of week.
7. Battery backup so clock is not disturbed by power outages.
8. Hand-off-auto switches for biocide pumps.
9. Biocide A and Biocide B pump running indication.

F. Chemical Solution Tanks:

1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.
2. Molded cover with recess for mounting pump.
3. Capacity: 30 gal. (114 L).

G. Chemical Solution Injection Pumps:

1. Self-priming, positive-displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
2. Adjustable flow rate.
3. Metal and thermoplastic construction.
4. Built-in relief valve.
5. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

H. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints except ASTM A 269.

I. Injection Assembly:

1. Quill: Minimum NPS 1/2 (DN 15) with insertion length sufficient to discharge into at least 25 percent of pipe diameter.
2. Ball Valve: Two-piece, stainless steel as described in "Stainless-Steel Pipes and Fittings" Article below; and selected to fit quill.
3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.

4. Assembly Pressure/Temperature Rating: Minimum 600 psig (4137 kPa) at 200 deg F (93 deg C).

2.3 CHEMICAL TREATMENT TEST EQUIPMENT

- A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; and oxidizing biocide test for open cooling systems.
- B. Sample Cooler:
 1. Tube: Sample.
 - a. Size: NPS 1/4 (DN 8) tubing.
 - b. Material: ASTM A 666, Type 316 stainless steel.
 - c. Pressure Rating: Minimum 2000 psig (13 790 kPa).
 - d. Temperature Rating: Minimum 850 deg F (454 deg C).
 2. Shell: Cooling water.
 - a. Material: ASTM A 666, Type 304 stainless steel.
 - b. Pressure Rating: Minimum 250 psig (1725 kPa).
 - c. Temperature Rating: Minimum 450 deg F (232 deg C).
- C. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.
 1. Two-station rack for closed-loop systems.
 2. Four-station rack for open systems.

2.4 CLOSE COUPLED, IN-LINE, SEALLESS CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Armstrong Pumps Inc.
 2. Bell & Gossett Domestic Pump; ITT Industries.
 3. Grundfos Pumps Corp.
 4. Taco, Inc.
- B. Description: Factory-assembled and -tested, single-stage, close-coupled, in-line, sealless centrifugal pumps as defined in HI 5.1-5.6.
 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge-type unit with motor and impeller on common shaft and designed for installation with pump and motor shaft mounted horizontally.
 2. Casing: Bronze, with threaded companion-flange connections.

3. Impeller: Corrosion-resistant material.
- C. Motors:
 1. Single speed, unless otherwise indicated.
 2. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
 3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range.
 4. Temperature Rating: 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class A Insulation).
 5. Service Factor: 1.15 for polyphase motors.
 6. Motor Construction: NEMA MG-1, general purpose, continuous duty, Design B.
 - a. Ball or roller bearings with inner and outer shaft seals.
 7. Enclosure Type: Open dripproof motors.
 8. Overload Protection: Built-in, automatic reset, thermal overload protection.
 9. Efficiency: Energy-efficient motors shall have a minimum efficiency as scheduled according to IEEE 112, Test Method B. If efficiency is not specified, motors shall have a higher efficiency than "average standard industry motors" according to IEEE 112, Test Method B.

2.5 CHEMICALS

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

- A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- B. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. Refer to Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for seismic restraints.
- C. Install water testing equipment on wall near water chemical application equipment.

- D. Install interconnecting control wiring for chemical treatment controls and sensors.
- E. Mount sensors and injectors in piping circuits.
- F. Bypass Feeders: Install in closed hydronic systems, including chilled-water, and equipped with the following:
 - 1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
 - 2. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
 - 3. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
 - 4. Install a swing check on inlet after the isolation valve.
- G. Install automatic chemical-feed equipment for fluid-cooler spray water and include the following:
 - 1. Install makeup water RO equipment.
 - 2. Install water meter in makeup water supply.
 - 3. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.
 - a. Pumps shall operate for timed interval on contact closure at water meter in makeup water supply connection.
 - 4. Install test equipment and provide test-kit to Owner. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
 - 5. Install TDS controller with sensor and bleed valves.
 - a. Bleed valves shall cycle to maintain maximum TDS concentration.
 - 6. Install pH sensor and controller with injection pumps and solution tanks.
 - a. Injector pumps shall operate to maintain required pH.
 - 7. Install biocide feeder alternating timer with two sets of injection pumps and solution tanks.
 - a. Injection pumps shall operate to feed biocide on an alternating basis.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

- C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 23 Section "Common Work Results for HVAC."
- D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- E. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers required in makeup water connections to potable-water systems.
- F. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.
- G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
 - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
 - 3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
 - 4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
 - 5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 - 7. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test

- source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
8. Repair leaks and defects with new materials and retest piping until no leaks exist.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. At four-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.
- F. Comply with ASTM D 3370 and with the following standards:
1. Silica: ASTM D 859.
2. Acidity and Alkalinity: ASTM D 1067.
3. Iron: ASTM D 1068.
4. Water Hardness: ASTM D 1126.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 232500

SECTION 232923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes variable frequency controllers (VFCs).

1.3 DEFINITIONS

- A. BMS: Building management system.
- B. IGBT: Integrated gate bipolar transistor.
- C. LAN: Local area network.
- D. PID: Control action, proportional plus integral plus derivative.
- E. PWM: Pulse-width modulated.
- F. VFC: Variable frequency controller.

1.4 SUBMITTALS

- A. Product Data: For each type of VFC. Include dimensions, mounting arrangements, location for conduit entries, shipping and operating weights, and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.
- B. Shop Drawings: For each VFC.
 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short-circuit current rating of integrated unit.
 - d. Listed and labeled for series rating of overcurrent protective devices in combination controllers by an NRTL acceptable to authorities having jurisdiction.

- e. Features, characteristics, ratings, and factory settings of each motor-control center unit.
- 2. Wiring Diagrams: Power, signal, and control wiring for VFCs. Provide schematic wiring diagram for each type of VFC.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For VFCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for VFCs and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- E. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- F. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with NFPA 70.

- F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, minimum clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.6 SOURCE QUALITY CONTROL

- A. In-circuit testing of all printed circuit boards shall be conducted, to insure the proper mounting and correct value of all components.
- B. Final printed circuit board assemblies shall be functionally tested, via computerized test equipment. All tests and acceptance criteria shall be preprogrammed. All test results shall be stored as detailed quality assurance data.
- C. All fully assembled controls shall be functionally tested, with fully loaded induction motors. The combined test data shall then be analyzed, to insure adherence to quality assurance specifications.
- D. Inspect and production test, under load, each completed VFC assembly.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver VFCs that can be moved past obstructions in delivery path as indicated.
- B. Package equipment for export shipping in totally enclosed crate with bagging.
- C. Store VFCs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFCs from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- D. If stored in areas subject to weather, cover VFCs to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:
 1. Ambient Temperature: 0 to 40 deg C.
 2. Humidity: Less than 90 percent (noncondensing).
 3. Altitude: Not exceeding 3300 feet (1005 m).
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.9 COORDINATION

- A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.
- D. Coordinate features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- E. Coordinate features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
 - 2. Indicating Lights: Two of each type installed.

1.11 WARRANTY

- A. Provide VFC warranty, for two (2) years from date of substantial completion. Warranty shall include parts, and labor allowance for repair hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
 - 2. Danfoss Inc.; Danfoss Electronic Drives Div.
 - 3. Eaton Corporation; Cutler-Hammer Products.
 - 4. General Electric Company; GE Industrial Systems.
 - 5. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
 - 6. Siemens Energy and Automation; Industrial Products Division.
 - 7. Square D.
 - 8. Toshiba International Corporation.

9. Yaskawa America, Inc.

2.2 DESCRIPTION

- A. Provide enclosed variable frequency drives suitable for operation at the current, voltage, and horsepower indicated on the schedule. Conform to requirements of NEMA ICS 3.1.

2.3 VARIABLE FREQUENCY CONTROLLERS

- A. VFC must operate, without fault or failure, when voltage varies plus 10% or minus 15% from rating, and frequency varies plus or minus 5% from rating.
- B. VFC shall be as required by the scheduled equipment listed on the equipment schedules on the plans.
- C. Displacement Power Factor: 0.98 over entire range of operating speed and load.
- D. Service factor: 1.0
- E. Operating Ambient Temperature:
NEMA 1 (IP20): -10°C to 40°C (14°F to 104°F)
- F. Ambient storage temperature: -20°C to 70°C (-4°F to 158°F)
- G. Humidity: 0% to 95% non-condensing.
- H. Altitude: to 3,300 feet (1000m), higher altitudes achieved by derating.
- I. Vibration: 9.81m/s² (1 G) maximum at 10 to 20 Hz, 2.0 m/s² (0.2 G) at 20 Hz to 55 Hz.
- J. Minimum Efficiency: 96% at half speed; 98% at full speed.
- K. Starting Torque: 100% starting torque shall be available from 0.5 Hz. to 60 Hz.
- L. Overload capability: 110% of rated FLA (Full Load Amps) for 60 seconds; 150% of rated FLA peak.
- M. Controlled speed range of 40:1
- N. The VFC's shall include EMI/RFI filters. The onboard RFI filter shall allow the entire VFC assembly to be CE Marked and the VFC shall meet product standard EN 61800-3 for the First Environment restricted. No Exceptions.
- O. Total Harmonic Distortion (THD) compliance:

Given the information provided by the customer's electric power single line diagram and distribution transformer data, the VFC manufacturer shall carry out an analysis of the system. The analysis reviews the potential for the proposed equipment, and any existing equipment, to meet IEEE 519 (tables 10.2 and 10.3) recommendations at the Point of Common Coupling (PCC). The result of the analysis shall determine if additional power quality improvement measures should be included in the proposal to meet the THD recommendations of IEEE 519. The PCC shall be at the primary side of the main distribution transformer.

- P. VFCs must be suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes.

2.4 DESIGN

- A. VFC shall employ microprocessor based inverter logic, isolated from all power circuits.
- B. VFC shall include surface mount technology with protective coating.
- C. VFC shall employ a PWM (Pulse Width Modulated) power electronic system, consisting of:
 - 1. Input Section:
 - a. VFC input power stage shall convert three-phase AC line power into a fixed DC voltage via a solid state full wave diode rectifier, with MOV (Metal Oxide Varistor) surge protection.
 - b. A minimum of 5% DC bus impedance to minimize reflected current.
 - 2. Intermediate Section:
 - a. DC bus as a supply to the VFC output Section shall maintain a fixed voltage with filtering and short circuit protection.
 - b. DC bus shall be interfaced with the VFC diagnostic logic circuit, for continuous monitoring and protection of the power components.
 - 3. Output Section
 - a. Insulated Gate Bipolar Transistors (IGBTs) shall convert DC bus voltage to variable frequency and voltage.
 - b. The VFC shall employ PWM sine coded output technology to power the motor.
- D. The VFC must be rated for operation at a carrier frequency of 5 kHz to satisfy the conditions for current, voltage, and horsepower as indicated on the equipment schedule.
- E. VFC shall have an adjustable carrier frequency, from 1 kHz to 12.5 kHz (Above 250 HP from 1 kHz to 5 kHz)
- F. VFC Must include an adjustable dynamic noise control for quiet motor operation
- G. VFC shall have embedded Building Automation System (BAS) protocols for network communications; BACnet. These protocols shall be accessible via a RS-422/485 communication port.
- H. VFC shall include two independent analog inputs. Selectable for either 0-10 VDC or 4-20 mA. Either input shall respond to a programmable bias and gain.
- I. VFC shall include a minimum of seven multi-function digital input terminals, capable of being

- programmed to determine the function on a change of state. These terminals shall include, but not limited to:
1. Remote/Local operation selection
 2. Customer Safeties
 3. BAS / Damper Interlock
 4. Emergency Override
 5. Preset Speed
 6. PI control enable / disable
- J. VFC shall include two selectable 0-10 VDC or 4-20 mA analog outputs for monitoring, or "speed tracking" the VFC. The analog output signal will be proportional to output frequency, output current, output power, PI (Proportional & Integral control) feedback or DC bus voltage.
- K. VFC shall provide terminals for remote input contact closure, to allow starting in the automatic mode.
- L. VFC shall provide 24 Vdc, 150ma transmitter power supply
- M. VFC shall include at least one external fault input, which shall be programmable for a normally open or normally closed contact. These terminals can be used for connection of firestats, freezestats, high pressure limits or similar safety devices.
- N. VFC shall include three programmable form "A" contacts and one fixed "Fault" form "C" contact, capable of being programmed to determine conditions that must be met in order for them to change state. These output relay contacts shall be rated for at least 2A at 120 VAC and shall include, but not limited to:
1. Speed agree detection
 2. Damper control
 3. Hand / Auto Status
 4. No load detection (broken belt alert)
 5. Contactor Control for External Bypass
 6. Drive Faulted
 7. Serial communication status
- O. VFC shall include a power loss ride through capable of 2 seconds.
- P. VFC shall have DC injection braking capability, to prevent fan "wind milling" at start or stop, adjustable, current limited.
- Q. VFC shall have a motor preheat function to prevent moisture accumulation in an idle motor.
- R. VFC shall include diagnostic fault indication, time and date stamped faults storage and heatsink cooling fan operating hours.
- S. VFC shall have a digital operator with program copy and storage functions to simplify set up of multiple drives. The digital operator shall be interchangeable for all drive ratings.
- T. VFC shall include a front mounted, sealed keypad operator, with an English language illuminated LCD display. The operator will provide complete programming, program

- copying, operating, monitoring, real time clock and diagnostic capability. Keys provided shall include industry standard commands for Hand, Off, and Auto functions.
- U. VFC plain language display shall provide readouts of; output frequency in hertz, PI feedback in percent, output voltage in volts, output current in amps, output power in kilowatts, D.C. bus voltage in volts, interface terminal status, heatsink temperature and fault conditions. All displays shall be viewed in an easy-to-read illuminated LCD.
 - V. VFC shall have an internal time clock. The internal time clock shall include a back up via battery. The time clock will be used to date and time stamp faults and record operating parameters at the time of fault. The internal time clock can be programmable to control start/stop functions, constant speeds, PID parameter sets and output Form-C relays.
 - W. VFC unit shall include the following meters to estimate use of energy:
 1. Elapsed Time Meter
 2. Kilowatt Meter
 3. Kilowatt Hour Meter
 - X. VFC shall include a user selectable PI control loop, to provide closed loop set point control capability, from a feedback signal, eliminating the need for closed loop output signals from a building automation system. The PI controller shall have a differential feedback capability for closed loop control of fans and pumps for pressure, flow or temperature regulation in response to dual feedback signals.
 - Y. VFC shall have an independent, PI loop that can be used with a second analog input that will vary the VFC analog output and maintain a set point of an independent process (valves, dampers, etc).
 - Z. The VFC shall include HVAC specific application macros. The macros can be used to help facilitate start-up. The macros will provide initialization to program all parameters and customer interfaces for a particular application (Fans, Pumps and Cooling Towers) to reduce programming time
 - AA. An energy saving sleep function shall be available in both open loop (follower mode) and closed loop (PI) control, providing significant energy savings while minimizing operating hours on driven equipment. When the sleep function senses a minimal deviation of a feedback signal from set point, or low demand in open loop control, the system reacts by stopping the driven equipment. Upon receiving an increase in speed command signal deviation, the drive and equipment resume normal operation.
 - BB. VFC shall include loss of input signal protection, with a selectable response strategy including speed default to a percent of the most recent speed.
 - CC. VFC shall include electronic thermal overload protection for both the drive and motor. The electronic thermal motor overload shall be approved by UL. If the electronic thermal motor overload is not approved by UL, a separate UL approved thermal overload relay shall be provided in the VFC enclosure.
 - DD. VFC shall include the following program functions:

1. Critical frequency rejection capability: 3 selectable, adjustable dead bands.
2. Auto restart capability: 0 to 10 attempts with adjustable delay between attempts.
3. Ability to close fault contact after the completion of all fault restart attempts.
4. Stall prevention capability.
5. "S" curve soft start / soft stop capability.
6. Bi-directional "Speed search" capability, in order to start a rotating load.
7. 14 preset and 1 custom volts per hertz pattern.
8. Heatsink over temperature speed fold back capability
9. Terminal status indication.
10. Program copy and storage in a removable digital operator.
11. Programmable security code
12. Current limit adjustment capability, from 30% to 200% of rated full load current of the VFC.
13. Motor pre-heat capability
14. Input signal or serial communication loss detection and response strategy.
15. Anti "wind-milling" function capability.
16. Automatic energy saving function.
17. Undertorque/Overtorque Detection.
18. Fan failure detection and selectable drive action
19. Bumpless" transfer between Hand and Auto modes
20. Seven preset speeds
21. VFC shall include factory settings for all parameters, and the capability for those settings to be reset.
22. VFC shall include user parameter initialization capability to re-establish project specific parameters
23. VFC shall include programmable HVAC specific application macros
24. USB Type B port for quick and easy PC Connection
25. VFC shall include the capability to adjust the following functions, while the VFC is running:
 1. Speed command input.
 2. Acceleration adjustment from 0 to 6000 seconds.
 3. Deceleration adjustment from 0 to 6000 seconds.
 4. Select from 7 preset speeds.
 5. Analog monitor display.
 6. Removal of digital operator.

2.5 VFC OPTIONS

- A. Each VFC shall be provided with a Manual Bypass. VFC and bypass package shall be NEMA 1 rated, fully pre-wired and ready for installation as a single UL listed device. Bypass shall include the following:
 1. Drive output, and bypass contactors, to isolate the VFC from the motor, when the motor is running in the bypass mode. These contactors shall be electrically and software interlocked to ensure safe operation.
 2. 120 VAC control transformer, with fused primary.
 3. Electronic motor overload relay, to display motor amps and protect the motor while operating in

- the bypass mode.
4. Disconnect switch, with a pad-lockable through-the-door handle mechanism.
 5. Control and safety circuit terminal strip.
 6. Current transformers on the output of the Drive/Bypass package for displaying motor current in both modes of operation as well as verification that the motor is running.
 7. Provide BACnet and Modbus communication protocols as standard, with the ability to configure controller parameters view controller monitors, control I/O, clear faults and view controller status in both drive and bypass modes.
 8. Door mounted control panel with; Drive/Bypass selector keys, Hand/Off/Auto selector keys, Normal/Test selector keys.
 9. Door mounted control keypad with LCD display for "Control Power", "Drive Ready", "Drive Run", "Drive Selected", "Drive Fault", "Drivel Test", "Bypass Selected", "Bypass Run", "Motor OL", "Safety Open" "BAS Interlock", "Auto Run", Auto Transfer", "Emergency Override", "Hand Mode", "Off Mode", and "Auto Mode".
 10. Drive/Bypass selector keys, to allow switching between the Drive and Bypass mode.
 11. Hand/Off/Auto selector keys shall provide the following operation and be programmed to operate in any of these modes upon power-up:
 - Hand Position - The drive is given a start command, operation is via the local speed input (digital operator/keypad). If in bypass mode, the motor is running.
 - Off Position - The start command is removed, all speed inputs are ignored, power is still applied to the drive. If in bypass mode, the motor is stopped.
 - Auto Position - The drive is enabled to receive a start command and speed input from a building automation system. If in bypass mode, the motor start/stop is controlled by the building automation system
 12. Eight Programmable digital inputs (24Vdc, 8mA) shall be provided for Auto Transfer to bypass, Safety Interlock, BAS Interlock, and numerous other bypass specific functions.
 13. Four Programmable form C relays (24Vdc/120 VAC, 2 Amp) for: "Motor Run", "Damper Actuator", "Auto Transfer", "Drive Run", "Hand Mode", "Auto Mode", "System Fault", "Bypass Run" or "Serial Com Run".
 14. Damper control circuit with end of travel feedback capability. This circuit shall also include two adjustable wait time functions. One is a run delay time where the drive will operate at a preset speed before the damper opens to pressurize the system. The other time function is an interlock wait time, so if the damper has not fully opened within the specified time, a fault will be declared.
 15. Line voltage sensors to monitor for brownout, blackout and single phase conditions. Fault levels for each condition must be adjustable to ensure the proper settings pursuant to each application.
 16. Selectable energy savings and harmonic reduction mode. Drive automatically switches to Bypass (Across-the-line) when motor is running 60 Hz for a set time and automatically switches back when frequency reference changes.

2.4 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
- C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Standard Displays:

1. Output frequency (Hz).
2. Set-point frequency (Hz).
3. Motor current (amperes).
4. DC-link voltage (VDC).
5. Motor torque (percent).
6. Motor speed (rpm).
7. Motor output voltage (V).

F. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

G. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested VFCs before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Install all equipment, material, accessories, etc. according to the manufacturer's instructions.
- B. Examine areas, surfaces, and substrates to receive VFCs for compliance with requirements, installation tolerances, and other conditions affecting performance.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.

- B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. Anchor each VFC assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with mounting surface.
- B. Install VFCs on concrete bases.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- D. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.4 CONCRETE BASES

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 26 Section "Common Work Results for Electrical," and concrete materials and installation requirements are specified in Division 03.

3.5 IDENTIFICATION

- A. Identify VFCs, components, and control wiring according to Division 26 Section "Identification for Electrical Systems."
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.6 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.7 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 26 "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 2. Report results in writing.
- C. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- D. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- E. Perform the following field tests and inspections and prepare test reports:
 1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.9 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain variable frequency controllers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 232923

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: The contractor shall submit duct layout plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation, indicating coordination with general construction, building components including structure, hydronic, plumbing, and sprinkler piping, electrical conduits, and other building services. Indicate proposed duct sizes, elevations, changes in elevation, etc.
 2. Suspended ceiling components.
 3. Suspended mechanical equipment including required clearances.
 4. Size and location of access to concealed equipment.
 5. Penetrations of smoke barriers and fire-rated construction.

1.4 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Ductwork shall be delivered and stored on the site palletized and tagged with an identification number consistent with the shop drawings. Openings of duct shall be covered with shrink-wrap after fabrication through shipment and storage. Contractor shall remove shrink-wrap just prior to installation. Contractor shall repair ductwork packaging to maintain a clean environment within the duct during construction.
- B. Deliver sealant and fire-stopping materials to site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- C. Store and handle sealant fire-stopping materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- D. Deliver and store stainless steel sheets with mill-applied adhesive protective paper, maintained through fabrication and installation.

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
 - 2. Round ducts exposed to view shall have spiral lock seams only. Longitudinal snap lock seams are not allowed for exposed duct.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Round ducts exposed to view shall have spiral lock seams only. Longitudinal snap lock seams are not allowed for exposed duct.

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Finished for Surfaces Galvanized Coating Designation: G60 (Z180).
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 3 inches (76 mm).
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
 - 8. Service: Indoor or outdoor.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.6 DOUBLE WALL INSULATED DUCTWORK

- A. Where indicated on the plans, provide double wall insulated ductwork with perforated interior liner and exterior paint grip surface. Interior ductwork shall have 1" insulation. Exterior ductwork shall have minimum 2" insulation.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls whether exposed to view or concealed, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Flanges to have a mill phosphatized finish for painting. Overlap openings on four sides by at least 1-1/2 inches (38 mm).
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers.

- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Round ducts exposed to view shall have spiral lock seams only. Longitudinal snap lock seams are not allowed for exposed duct.
- C. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- D. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- E. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- F. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 2. Outdoor, Supply-Air Ducts: Seal Class A.
 3. Outdoor, Exhaust Ducts: Seal Class C.
 4. Outdoor, Return-Air Ducts: Seal Class C.
 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- D. Hangers Exposed to View: Wire rope hanger and clutcher equal to Ductmate. Install with wire clutcher as close as possible to top of duct.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 DUCT CLEANING

- A. Mechanical equipment including air handlers, rooftop package units, ducts and air distribution devices shall be sealed to maintain clean, dust and debris free interiors and are to remain sealed until mechanical systems are fully installed and started. The architect, engineer, general contractor, construction manager, and/or owner may inspect duct and air distribution devices at any time. If ducts and air distribution devices are found to contain contaminants, the entire duct system is to be cleaned. Duct systems are to be cleaned before testing, adjusting, and balancing.

3.7 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.
- B. Supply Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 12.
 - 2. Ducts Connected to Constant-Volume Air-Handling Units:
 - a. Pressure Class: Positive 3-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 6.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.
 - 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 3-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 6.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.
- C. Return Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 12.
 - 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 6.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.
 - 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 6.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.
- D. Exhaust Ducts:
 - 1. Ducts Connected to Fans Exhausting Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 12.

- c. SMACNA Leakage Class for Round and Flat Oval: 6.
 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 6.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.
 3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
 - b. Concealed: Carbon-steel sheet.
 - c. Welded seams and joints.
 - d. Pressure Class: Positive or negative 3-inch wg.
 - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - f. SMACNA Leakage Class: 3.
 4. Ducts Connected to Dishwasher Hoods:
 - a. Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Welded seams and flanged joints with watertight EPDM gaskets.
 - e. Pressure Class: Positive or negative 2-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.
 - h. Pressure Class: Positive or negative 3-inch wg.
 - i. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - j. SMACNA Leakage Class for Rectangular: 6.
 - k. SMACNA Leakage Class for Round and Flat Oval: 6.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 6.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.
 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 3.
 - c. SMACNA Leakage Class for Round and Flat Oval: 3.
- F. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel.

2. PVC-Coated Ducts:

- a. Exposed to Airstream: Match duct material.
- b. Not Exposed to Airstream: Match duct material.

3. Stainless-Steel Ducts:

- a. Exposed to Airstream: Match duct material.
- b. Not Exposed to Airstream: Match duct material.

4. Aluminum Ducts: Aluminum.

G. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm (5 m/s) or Lower:

- 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
- 2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):

- 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
- 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm (7.6 m/s) or Higher:

- 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
- 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

- a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
- b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
- c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
 - c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Smoke dampers.
6. Flange connectors.
7. Turning vanes.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

1.3 ACTION SUBMITTALS

- 1. Product Data: For each backdraft, pressure relief damper, control damper, fire damper, smoke damper, flexible duct, flexible duct connector, and combination fire/smoke damper to be used on the project.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Control-damper installations.
 - b. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
 - c. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Package equipment for export shipping in totally enclosed crate with bagging.
- C. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- D. Lift and support units with manufacturer's designated lifting or supporting points.

1.6 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of power ventilators (parts and labor) that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One (1) year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Greenheck Fan Corporation.
 - 5. Lloyd Industries, Inc.
 - 6. Nailor Industries Inc.
 - 7. NCA Manufacturing, Inc.
 - 8. Pottorff.
 - 9. Ruskin Company.
 - 10. Vent Products Company, Inc.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 3-inch wg (0.8 kPa).
- E. Frame: Hat-shaped, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.
- F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch (150-mm) width, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Felt.

I. Blade Axles:

1. Material: Nonferrous metal.
2. Diameter: 0.20 inch (5 mm).

J. Tie Bars and Brackets: Aluminum.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20 gage (1.0 mm) minimum.
 - b. Sleeve Length: 6 inches (152 mm) minimum.
6. Screen Mounting: Rear mounted.
7. Screen Material: Galvanized steel.
8. Screen Type: Bird for exhaust systems, Insect for intake systems.
9. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. Nailor Industries Inc.
 - f. Pottoroff.
 - g. Ruskin Company.
 - h. Trox USA Inc.
 - i. Vent Products Company, Inc.

2. Standard leakage rating, with linkage outside airstream.
 3. Suitable for horizontal or vertical applications.
 4. Frames:
 - a. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
 6. Blade Axles: Galvanized steel.
 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 8. Tie Bars and Brackets: Galvanized steel.
- B. Jackshaft:
1. Size: 0.5-inch (13-mm) diameter.
 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- C. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
 2. Include center hole to suit damper operating-rod size.
 3. Include elevated platform for insulated duct mounting.

2.5 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. CESCO Products; a division of Mestek, Inc.
 2. Greenheck Fan Corporation.
 3. Lloyd Industries, Inc.
 4. McGill AirFlow LLC.
 5. Metal Form Manufacturing, Inc.

6. Nailor Industries Inc.
7. NCA Manufacturing, Inc.
8. Pottorff.
9. Ruskin Company.
10. Vent Products Company, Inc.
11. Young Regulator Company.

B. Frames:

1. Hat shaped.
2. 0.094-inch- (2.4-mm-) thick, galvanized sheet steel
3. Mitered and welded corners.

C. Blades:

1. Multiple blade with maximum blade width of 6 inches (152 mm).
2. Parallel-blade design.
3. Galvanized-steel.
4. 0.064 inch (1.62 mm) thick single skin.
5. Blade Edging: Closed-cell neoprene.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

D. Blade Axles: 1/2-inch- (13-mm-) diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

E. Bearings:

1. Oil-impregnated bronze.
2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.6 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Nailor Industries Inc.
6. NCA Manufacturing, Inc.
7. Pottorff.
8. Prefco; Perfect Air Control, Inc.
9. Ruskin Company.

10. Vent Products Company, Inc.
 11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity.
- D. Fire Rating: 1-1/2 or 3 hours as required. See architectural plans for wall rating.
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-(0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 1. Minimum Thickness: 0.05 (1.3 mm) thick, as indicated, and of length to suit application.
 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.024-inch- (0.61-mm) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

2.7 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Air Balance Inc.; a division of Mestek, Inc.
 2. Cesco Products; a division of Mestek, Inc.
 3. Greenheck Fan Corporation.
 4. Nailor Industries Inc.
 5. Pottorff.
 6. Ruskin Company.
- B. General Requirements: Dynamic; rated and labeled according to UL 555S by an NRTL.
- C. Smoke Detector: Integral, factory wired for single-point connection.
- D. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with welded, interlocking, gusseted corners and mounting flange.

- E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel.
- F. Leakage: Class I.
- G. Rated pressure and velocity to exceed design airflow conditions.
- H. Mounting Sleeve: Factory-installed, 0.039-inch- (1.0-mm-) thick, galvanized sheet steel; length to suit wall or floor application.
- I. Damper Motors: Two-position action.
- J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.
- K. Accessories:
 - 1. Auxiliary switches for signaling or position indication.
 - 2. Test and reset switches.

2.8 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.9 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Elgen Manufacturing.
 - 4. METALAIR, Inc.
 - 5. SEMCO Incorporated.
 - 6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vaness and Vane Runners," and 4-4, "Vane Support in Elbows."
- E. Vane Construction: Double wall.

2.10 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Ductmate Industries, Inc.
 - 4. Elgen Manufacturing.
 - 5. Flexmaster U.S.A., Inc.
 - 6. Greenheck Fan Corporation.
 - 7. McGill AirFlow LLC.
 - 8. Nailor Industries Inc.
 - 9. Pottoroff.

10. Ventfabrics, Inc.
 11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
1. Door and Frame Material: Galvanized sheet steel.
 2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
 4. Factory set at 3.0- to 8.0-inch wg.
 5. Doors close when pressures are within set-point range.
 6. Hinge: Continuous piano.
 7. Latches: Cam.
 8. Seal: Neoprene or foam rubber.
 9. Insulation Fill: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.11 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Ductmate Industries, Inc.
 2. Flame Gard, Inc.

3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch (1.3-mm) carbon steel.
- D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).
- F. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

2.12 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Elgen Manufacturing.
 4. Ventfabrics, Inc.
 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
 2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
 3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

2.13 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
 - 1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
 - 2. Maximum Air Velocity: 4000 fpm (20 m/s).
 - 3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
- C. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
 - 2. Maximum Air Velocity: 4000 fpm (20 m/s).
 - 3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
 - 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.
- D. Flexible Duct Connectors:
 - 1. Clamps: Nylon strap in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.
 - 2. Non-Clamp Connectors: Tape, plus sheet metal screws.

2.14 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.15 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dynasonics.
 - 2. Industrial Noise Control, Inc.
 - 3. McGill AirFlow LLC.
 - 4. Ruskin Company.

5. Vibro-Acoustics.
- B. General Requirements:
1. Factory fabricated.
 2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Shape; as shown on the equipment schedules on the plans:
1. Rectangular straight with splitters or baffles.
 2. Round straight with center bodies or pods.
 3. Rectangular elbow with splitters or baffles.
 4. Round elbow with center bodies or pods.
 5. Rectangular transitional with splitters or baffles.
- D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90 (Z275), galvanized sheet steel, minimum 0.034 inch (0.85 mm) thick.
- E. Round Silencer Outer Casing: ASTM A 653/A 653M, G90 (Z275), galvanized sheet steel.
1. Sheet Metal Thickness for Units up to 24 Inches (600 mm) in Diameter: 0.034 inch (0.85 mm) thick.
 2. Sheet Metal Thickness for Units 26 through 40 Inches (660 through 1000 mm) in Diameter: 0.040 inch (1.02 mm) thick.
 3. Sheet Metal Thickness for Units 42 through 52 Inches (1060 through 1300 mm) in Diameter: 0.05 inch (1.3 mm) thick.
 4. Sheet Metal Thickness for Units 54 through 60 Inches (1370 through 1500 mm) in Diameter: 0.064 inch (1.62 mm) thick.
- F. Inner Casing and Baffles: ASTM A 653/A 653M, G90 (Z275) galvanized sheet metal, 0.034 inch (0.85 mm) thick, and with 1/8-inch- (3-mm-) diameter perforations.
- G. Connection Sizes: Match connecting ductwork unless otherwise indicated.
- H. Principal Sound-Absorbing Mechanism:
1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
 2. Dissipative type with fill material.
 - a. Fill Material: Media shall be of acoustic quality, shot-free glass fiber insulation with long, resilient fibers bonded with a thermosetting resin. Glass fiber density and compression shall be as required to insure conformance with laboratory test data. Glass fiber shall be packed with a minimum of 15% compression during silencer assembly. Media shall be resilient such that it will not crumble or break, and conform to irregular surfaces. Media shall not cause or accelerate corrosion of

- aluminum or steel. Mineral wool will not be permitted as a substitute for glass fiber.
- b. Erosion Barrier: media shall be encapsulated in glass fiber cloth to help prevent shedding, erosion and impregnation of the glass fiber.
- I. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
1. Joints: Lock formed and sealed, continuously welded or flanged connections.
 2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
 3. Reinforcement: Cross or trapeze angles for rigid suspension.
- J. Accessories:
1. Factory-installed end caps to prevent contamination during shipping.
 2. Removable splitters.
 3. Airflow measuring devices.
- K. Source Quality Control: Test according to ASTM E 477.
1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm (10-m/s) face velocity.
 2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg (1500-Pa) static pressure, whichever is greater.
- L. Capacities and Characteristics: As indicated on the equipment schedules on the plans.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Unless otherwise indicated on the plans, install backdraft or control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan and at outside air intakes as close as possible to the exterior.
- D. Install volume dampers at all points on supply, return, and exhaust systems where branches extend from larger ducts. Install as close as possible to the take off from the larger duct. Install the damper arm on the side or bottom of duct. Where dampers are installed in ducts having duct

liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Connect ducts to duct silencers either with flexible duct connectors or rigidly per silencer manufacturer's recommendations.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated.
- H. Install fire and smoke dampers according to UL listing.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
1. On both sides of duct coils.
 2. Upstream from duct filters.
 3. At outdoor-air intakes and mixed-air plenums.
 4. At drain pans and seals.
 5. Downstream from control dampers, backdraft dampers, and equipment.
 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 7. At each change in direction and at maximum 50-foot (15-m) spacing.
 8. Upstream and downstream from turning vanes in ducts larger than 14" on one side.
 9. Upstream or downstream from duct silencers.
 10. Control devices requiring inspection.
 11. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.
- K. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
 5. Body Access: 25 by 14 inches (635 by 355 mm).
 6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).
- L. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- M. Install flexible connectors to connect ducts to equipment.

- N. Connect terminal units to supply ducts with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.
- O. Connect flexible ducts to metal ducts with draw bands, plus sheet metal screws.
- P. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Centrifugal roof ventilators.
2. Ceiling-mounting ventilators.
3. Upblast centrifugal roof ventilators.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 1. Certified fan performance curves with system operating conditions indicated.
 2. Certified fan sound-power ratings.
 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 4. Material thickness and finishes, including color charts.
 5. Dampers, including housings, linkages, and operators.
 6. Roof curbs.
 7. Fan speed controllers.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 1. Wiring Diagrams: Power, signal, and control wiring.
 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

- C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Roof framing and support members relative to duct penetrations.
 - 2. Ceiling suspension assembly members.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Package equipment for export shipping in totally enclosed crate with bagging.
- C. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- D. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of power ventilators (parts and labor) that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acme Engineering & Mfg. Corp.
 2. Barry/Penn Ventilation.
 3. Greenheck.
 4. Loren Cook Company.
- B. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Housing: Removable, spun-aluminum, dome top and outlet baffle, one-piece, aluminum base with venturi inlet cone.
1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 4. Fan and motor isolated from exhaust airstream.
- F. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
 4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.

2.2 CEILING-MOUNTING VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Barry/Penn Ventilation.
 - 2. Carnes Company.
 - 3. Dayton Electric Manufacturing Co.
 - 4. Greenheck.
 - 5. Loren Cook Company.
 - 6. NuTone Inc.
- B. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.
- C. Housing: Steel, lined with acoustical insulation.
- D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- E. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- G. Accessories:
 - 1. Manual Starter Switch: Single-pole rocker switch assembly with cover.
 - 2. Isolation: Rubber-in-shear vibration isolators.
 - 3. Manufacturer's standard roof jack and transition fittings.
 - 4. Integral backdraft damper.

2.3 UPBLAST CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acme Engineering & Mfg. Corp.
 - 2. Barry/Penn Ventilation.
 - 3. Captive Aire.
 - 4. Greenheck.
 - 5. Loren Cook Company.
- B. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Housing: Removable, spun-aluminum, dome top and outlet baffle, one-piece, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector if used with a kitchen hood application.
 2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 4. Fan and motor isolated from exhaust airstream.
- F. Accessories:
1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 2. Grease Drain: For kitchen exhaust fans, drain and collector to comply with NFPA 96.

2.4 ROOF CURBS

- A. General: Provide roof curbs capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs.
- B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 0.0747-inch, structural-quality, hot-dip galvanized steel sheet ASTM A 653/A 653M with G90 coating designation, commercial quality; factory primed and prepared for painting with welded or sealed mechanical corner joints.
- C. Coordinate dimensions and installation with architectural, structural, and other applicable disciplines. Construction shall comply with NRCA standards. The minimum structural integrity shall assume one center support transversing the short dimension of the curb. Roof curb manufacturer shall design and provide any bracing, supports, or other structural members, integral to the curb, required to limit the deflection of the curb to a level suitable for the supported equipment.
- D. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick. Provide preservative-treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof.
- E. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
- F. Sloping Roofs: Fabricate curb units tapered to match the slope of the roof to achieve a level top for supporting equipment.

- G. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other non-corrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.
- H. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

2.5 ELECTRICAL

- A. Motors:
 - 1. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
 - 2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range.
 - 3. Temperature Rating: 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class A Insulation).
 - 4. Service Factor: 1.15 for polyphase motors.
 - 5. Motor Construction: NEMA MG-1, general purpose, continuous duty, Design B.
 - a. Ball or roller bearings with inner and outer shaft seals.
 - 6. Bearings: The following features are required.
 - a. Ball or roller bearings with inner and outer shaft seals.
 - b. Grease lubricated.
 - c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
 - 7. Enclosure Type: Open dripproof motors.
 - 8. Overload Protection: Built-in, automatic reset, thermal overload protection.
 - 9. Efficiency: Energy-efficient motors shall have a minimum efficiency as scheduled according to IEEE 112, Test Method B. If efficiency is not specified, motors shall have a higher efficiency than "average standard industry motors" according to IEEE 112, Test Method B.
- B. Factory wired to a single point connection. Provide NEMA 3R control panel.
- C. Provide non-fused disconnect rated for service.
- D. Provide control circuit transformer.
- E. Provide all motor starters.

2.6 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware.
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- D. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch (25 mm).
- E. Install units with clearances for service and maintenance.
- F. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. Verify that shipping, blocking, and bracing are removed.
 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 3. Verify that cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 5. Adjust belt tension.
 6. Adjust damper linkages for proper damper operation.
 7. Verify lubrication for bearings and other moving parts.
 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 10. Shut unit down and reconnect automatic temperature-control operators.
 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required achieving design airflow.
- E. Lubricate bearings.

END OF SECTION 233423

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Anemostat Products; a Mestek company.
- b. Carnes.
- c. Krueger
- d. METALAIR, Inc.
- e. Nailor Industries Inc.
- f. Price Industries.
- g. Titus.

2.2 See the equipment schedules on the plans for descriptions, accessories, performance, etc.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 233723 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Roof hoods.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.

1.5 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 or T-52.

- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) zinc coating, mill phosphatized.
- D. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.

2.2 FABRICATION, GENERAL

- A. Factory fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.

2.3 ROOF HOODS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Acme Engineering & Mfg. Corporation.
 2. Aerovent.
 3. Carnes.
 4. Greenheck Fan Corporation.
 5. JencoFan.
 6. Loren Cook Company.
 7. PennBarry.
- B. Factory fabricated according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 6-6 and 6-7.
- C. Materials: Aluminum sheet, minimum 18-gauge-thick hood; suitably reinforced.
- D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailing. Size as required to fit roof opening and ventilator base.
- E. Bird Screening: Aluminum, 1/2-inch- (12.7-mm-) square mesh, 0.063-inch (1.6-mm) wire.
- F. Insect Screening: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh, 0.012-inch (0.30-mm) wire.

G. Capacities and Characteristics: As indicated on the equipment schedules on the plans.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Secure gravity ventilators to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible.
- C. Install gravity ventilators with clearances for service and maintenance.
- D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses.
- F. Label gravity ventilators.
- G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

END OF SECTION 233723

SECTION 236416 - CENTRIFUGAL WATER CHILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Packaged, water-cooled, electric-motor-driven centrifugal chillers.

1.3 PERFORMANCE REQUIREMENTS

- A. Condenser-Fluid Temperature Performance:

1. Startup Condenser-Fluid Temperature: Chiller shall be capable of starting with an entering condenser-fluid temperature of 60 deg F (16 deg C) and providing stable operation until the system temperature is elevated to the minimum operating entering condenser-fluid temperature.
2. Minimum Operating Condenser-Fluid Temperature: Chiller shall be capable of continuous operation over the entire capacity range indicated with an entering condenser-fluid temperature of 65 deg F (18 deg C).
3. Make factory modifications to standard chiller design if necessary to comply with performance indicated.

- B. Site Altitude: Chiller shall be suitable for altitude at which installed without affecting performance indicated. Make adjustments to affected chiller components to account for site altitude.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

- A. Certificates: For certification required in "Quality Assurance" Article.
- B. Startup service reports.

C. Warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

A. ARI Certification: Certify chiller according to ARI 550 certification program.

B. ARI Rating: Rate chiller performance according to requirements in ARI 506/110.

C. ASHRAE Compliance:

1. ASHRAE 15 for safety code for mechanical refrigeration.

2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

E. ASME Compliance: Fabricate and label chillers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, as applicable to chiller design. For chillers charged with R-134a refrigerant, include an ASME U-stamp and nameplate certifying compliance.

F. Comply with NFPA 70.

G. Comply with requirements of UL and UL Canada, and include label by a qualified testing agency showing compliance.

1.8 WARRANTY

A. Warranty: Manufacturer's form in which manufacturer agrees to repair or replace components of chillers that fail in materials or workmanship within specified warranty period.

1. Extended warranty including, but are not limited to, the following:

- a. Complete chiller including refrigerant and oil charge.
- b. Complete compressor and drive assembly including refrigerant and oil charge.
- c. Refrigerant and oil charge.
- d. Parts and labor.
- e. Loss of refrigerant charge for any reason.

2. Warranty Period: Two (2) years from date of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Ship chillers from the factory fully charged with refrigerant.

- B. Ship each chiller with a full charge of refrigerant. Charge each chiller with nitrogen if refrigerant is shipped in containers separate from chiller.
- C. Ship each oil-lubricated chiller with a full charge of oil.
- D. Package chiller for export shipping in totally enclosed crate with bagging.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Corporation.
 - 2. Daikin.
 - 3. Trane.
 - 4. York – Johnson Controls

2.2 MANUFACTURED UNIT

- A. Description: Factory-assembled and -tested chiller complete with compressor, compressor motor, compressor motor controller, evaporator, condenser, controls, interconnecting unit piping and wiring, and indicated accessories.
 - 1. Disassemble chiller into major assemblies as required by the installation after factory testing and before packaging for shipment.
 - 2. For chillers with dual compressors, provide each compressor with a dedicated motor and motor controller, and provide for continued operation when either compressor-drive assembly fails or is being serviced.
- B. Fabricate chiller mounting base with reinforcement strong enough to resist chiller movement during a seismic event when chiller is anchored to field support structure.
- C. Chiller will be installed in an exterior location with a roof to protect from the exterior elements. Provide all accessories and features required for this application.

2.3 COMPRESSOR-DRIVE ASSEMBLY

- A. Description: Variable speed, magnetic bearing, centrifugal-type compressor driven by an electric motor.
- B. Chiller should be able to unload to 20 percent of design tonnage with constant entering water temperature.
- C. Compressor assembly shall be vibration tested at the factory. Vibration shall not exceed 0.15 inches per second. The test data shall be recorded and provided to the customer for approval.

- D. The motor shall be hermetic and either suction or liquid refrigerant cooled. Hot gas motor cooling is not acceptable. If an open drive motor is provided, a motor-compressor shaft seal leakage containment system shall be provided.
- E. An oil reservoir shall collect any oil and refrigerant that leaks past the seal.
- F. A float device shall be provided to open when the reservoir is full, directing the refrigerant/oil mixture back into the compressor housing.
- G. Manufacturer shall warrant the shaft seal, reservoir, and float valve system against leakage of oil and refrigerant to the outside of the chiller for a period of 5 years from initial start-up, including parts and labor to replace a defective seal and any refrigerant required to trim the charge to original specifications. Inspections shall be performed a minimum of once a year.
- H. Motors shall have winding RTD's for temperature sensing on each phase. These temperatures shall be furnished to the unit control panel for monitoring and alarm.
- I. Manufacturers with speed increasing transmissions shall not exceed 10,000 RPM compressor speeds and shall annually inspect the gears and all bearings. A report shall be forwarded to the owner each year over the first five years to confirm completion.
- J. The impellers shall be fully shrouded and made of a high strength aluminum alloy. Impellers shall be dynamically balanced and over-speed tested at 1.25 times impeller shaft speed.

2.4 REFRIGERATION

- A. Refrigerant:
 - 1. Type: R-123; ASHRAE 34, Class B1 or R-134a; ASHRAE 34, Class A1.
 - 2. Compatibility: Chiller parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
- B. Refrigerant Flow Control: Manufacturer's standard refrigerant flow-control device satisfying performance requirements indicated.
- C. Pressure Relief Device:
 - 1. Comply with requirements in ASHRAE 15 and in applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. For Chillers Using R-123: Rupture disc constructed of frangible carbon.
 - 3. For Chillers Using R-134a: ASME-rated, spring-loaded, pressure relief valve; single- or multiple-reseating type. Pressure relief valve(s) shall be provided for each heat exchanger. Condenser shall have dual valves with one being redundant and configured to allow either valve to be replaced without loss of refrigerant.
- D. Refrigeration Transfer: Provide service valves and other factory-installed accessories required to facilitate transfer of refrigerant from chiller to a remote refrigerant storage and recycling system. Comply with requirements in ASHRAE 15 and ASHRAE 147.

E. Refrigerant Isolation for Chillers Using R-134a: Factory install positive shutoff, manual isolation valves in the compressor discharge line to the condenser and the refrigerant liquid line leaving the condenser to allow for isolation and storage of full refrigerant charge in the chiller condenser shell. In addition, provide isolation valve on suction side of compressor from evaporator to allow for isolation and storage of full refrigerant charge in the chiller evaporator shell.

F. Purge System:

1. For chillers operating at subatmospheric pressures (using R-123 refrigerant), factory install an automatic purge system for collection and return of refrigerant and lubricating oil and for removal of noncondensables including, but not limited to, water, water vapor, and noncondensable gases.
2. System shall be a thermal purge design, refrigerant or air cooled, equipped with a carbon filter that includes an automatic regeneration cycle.
3. Factory wire to chiller's main power supply and system complete with controls, piping, and refrigerant valves to isolate the purge system from the chiller.
4. Construct components of noncorroding materials.
5. Controls shall interface with chiller control panel to indicate modes of operation, set points, data reports, diagnostics, and alarms.
6. Efficiency of not more than **0.02 lb of refrigerant per pound of air (9 g of refrigerant per gram of air)** when rated according to ARI 580.
7. Operation independent of chiller per ASHRAE 147.

G. Positive-Pressure System:

1. For chillers operating at subatmospheric pressures (using R-123 refrigerant), factory install an automatic positive-pressure system.
2. During nonoperational periods, positive-pressure system shall automatically maintain a positive pressure for atmosphere in the refrigerant pressure vessel of not less than **0.5 psig (3 kPa)** adjustable up to a pressure that remains within the vessel design pressure limits.
3. System shall be factory wired and include controller, electric heat, pressure transmitter, or switch.

2.5 EVAPORATOR

- A. The evaporator and condenser shall be built in accordance with ANSI/ASHRAE 15-2001 Safety Code for Mechanical Refrigeration.
- B. Evaporator tubes shall be internally enhanced. The minimum tube wall thickness shall be 0.025 inch.
- C. The evaporator water piping connections shall be vicalic.
- D. The evaporator waterboxes shall be standard non-marine type.

- E. Supply and return head waterboxes shall be designed for a working pressure of 150 psig and shall be factory hydrostatic pressure tested at 150 percent of the design pressure. Provide drain and vent connections in water boxes.
- F. Units with multi-stage compressors shall incorporate an interstage flash vessel "economizer". All units with single stage compressors shall have the condensers circuited for liquid subcooling and be provided with a thermometer well to monitor the amount of subcooling.
- G. Adjustable or float type refrigerant metering devices and thermal expansion valves shall be inspected and adjusted by the manufacturer at the end of each year for the first five years of operation to assure equivalent reliability and maintenance to a fixed orifice system. A written report shall be forwarded to the owner each year to confirm completion.

2.6 CONDENSER

- A. The condenser shall be built in accordance with ANSI/ASHRAE 15-2001 Safety Code for Mechanical Refrigeration.
- B. Condenser tubes shall be internally enhanced. The minimum tube wall thickness shall be 0.028 inch.
- C. The condenser water piping connections shall be vicalic.
- D. The condenser waterboxes shall be marine type.
- E. Supply and return head waterboxes shall be designed for a working pressure of 150 psig and shall be factory hydrostatic pressure tested at 150 percent of the design pressure. Provide drain and vent connections in water boxes.

2.7 ELECTRICAL

- A. Factory installed and wired, and functionally tested at factory before shipment.
- B. Single-point, field-power connection to circuit breaker. Minimum withstand rating shall be as required by electrical power distribution system, but not less than 42,000A.
 - 1. Branch power circuit to each motor, electric heater, dedicated electrical load, and controls with disconnect switch or circuit breaker.
 - a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 - b. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit-trip set point.
 - 2. NEMA ICS 2-rated motor controller for auxiliary motors, hand-off-auto switch, and overcurrent protection for each motor. Provide variable frequency controller for each variable-speed motor furnished.

3. Control-circuit transformer with primary and secondary side fuses.
- C. Terminal blocks with numbered wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.
- D. Factory-installed wiring outside of enclosures shall be in metal raceway except make terminal connections with not more than a 24-inch (610-mm) length of liquidtight or flexible metallic conduit.

2.8 STARTERS

A. Variable Speed Drive (VSD), Unit Mounted:

1. The centrifugal water chiller shall be furnished with a liquid cooled variable speed drive (VSD). The VSD shall be factory mounted on the chiller and shipped completely factory assembled, wired and tested.
2. The VSD will be specifically designed to interface with the centrifugal water chiller controls and allow for the operating ranges and specific characteristics of the chiller. The VSD control logic shall optimize chiller efficiency by coordinating compressor motor speed and compressor inlet guide vane position to maintain the chilled water setpoint while avoiding surge. If a surge is detected, VSD surge avoidance logic will make adjustments to move away from and avoid surge at similar conditions in the future.
3. The VSD efficiency shall be 97% or better at full speed and full load. Fundamental displacement power factor shall be a minimum of 0.96.
4. The VSD shall be solid state, microprocessor based pulse-width modulated (PWM) design. The VSD shall be voltage and current regulated. Output power devices shall be IGBT transistors.
5. Power semi-conductor and capacitor cooling shall be from a liquid cooled heatsink.
6. The centrifugal water chiller shall be furnished with a refrigerant cooled variable speed drive (VSD) to minimize maintenance and maximize cooling efficiency. If a water cooling design is used, especially an open loop condenser water design, a cleanable shell and tube heat exchanger must be supplied. Plate and frame heat exchangers are not allowed. The VSD shall be factory mounted on the chiller and shipped completely factory assembled, wired and tested.
7. The VSDs shall each be furnished in a NEMA 1 metal enclosure having as minimum a short circuit withstand rating of 65,000 amps per UL 508. It will include three phase input lugs plus a grounding lug for electrical connections, output motor connection via factory installed bus bars and all components properly segregated and completely enclosed in a single metal enclosure.
8. Enclosure shall include a padlockable, door-mounted circuit breaker with shunt trip and AIC rating of 65,000 amps.
9. The entire chiller package shall be UL/CUL listed.
10. The VSD shall be tested to ANSI/UL Standard 508 and shall be listed by a Nationally Recognized Testing Laboratory (NRTL) as designated by OSHA.
11. Compliance to recommendations stated in IEEE 519-1992.
12. The VSD design shall include as standard integrated active rectification control system to limit total demand distortion (TDD) in current at the VSD to less than or equal to 5-percent as measured at the VSD input. If optional active filters are used to meet the less

- than or equal to 5% TDD, then the losses associated with the filter shall be included in the chiller performance on the selection.
- 13. Input shall be nominal 480 volts, three phase, 60 hertz AC power, \pm 10 percent of nominal voltage.
 - 14. Line frequency 38-60 hertz.
 - 15. The VSD shall include the following features:
 - 16. All control circuit voltages are physically and electrically isolated from power circuit voltage.
 - 17. 150% instantaneous torque available for improved surge control.
 - 18. Soft start, adjustable linear acceleration, coast-to-stop.
 - 19. Adjustable current limiting and UL approved electronic motor overload protection.
 - 20. Insensitivity to incoming power phase sequence.
 - 21. VSD and motor protection from the following faults: - Output line-to-line short circuit protection - Line-to-ground short circuit protection - Phase loss at AFD input - Phase reversal / Imbalance - Over-voltage - Under-voltage - Over temperature
 - 22. The following VSD status indicators shall be available to facilitate startup and maintenance: - Output speed in hertz and rpm - Input line voltage - Input line kW - Output/load amps - Average current in percent RLA - Load power factor - Fault - VSD transistor temperature
 - 23. Service Conditions - at full output power. No external venting or heat exchangers shall be required.
 - 24. Operating ambient temperature 32°F-104°F (0°C-40°C).
 - 25. Room ambient up to 95% relative humidity.
 - 26. Elevation to 3300 feet (1000 meters). For every 300 feet above 3300 feet, the rated output current shall be decreased by one percent.
 - 27. Warranties
 - 28. The variable speed drive shall be warranted by the manufacturer for a period of twelve months from the date of installation. The warranty shall include parts, labor, travel costs, and living expenses incurred by the manufacturer to provide factory-authorized on-site service.

2.9 INSULATION

- A. Closed-cell, flexible elastomeric thermal insulation complying with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Thickness: **3/4 inch (19 mm)**.
- B. Adhesive: As recommended by insulation manufacturer.
- C. Factory-applied insulation over all cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator shell and end tube sheets, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.
 - 1. Apply adhesive to 100 percent of insulation contact surface.
 - 2. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
 - 3. Seal seams and joints to provide a vapor barrier.

4. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.

2.10 CONTROLS

- A. Control: Standalone and microprocessor based, with all memory stored in nonvolatile memory so that reprogramming is not required on loss of electrical power.
- B. Enclosure: Unit mounted, hinged or lockable; factory wired with a single-point, field-power connection and a separate control circuit.
- C. Operator Interface: Multiple-character digital or graphic display with dynamic update of information and with keypad or touch-sensitive display located on front of control enclosure. In either imperial or metric units selectable through the interface, display the following information:
 1. Date and time.
 2. Operating or alarm status.
 3. Fault history with not less than last 10 faults displayed.
 4. Set points of controllable parameters.
 5. Trend data.
 6. Operating hours.
 7. Number of chiller starts.
 8. Outdoor-air temperature or space temperature if required for chilled-water reset.
 9. Entering- and leaving-fluid temperatures of evaporator and condenser.
 10. Difference in fluid temperatures of evaporator and condenser.
 11. Fluid flow of evaporator and condenser.
 12. Fluid pressure drop of evaporator and condenser.
 13. Refrigerant pressures in evaporator and condenser.
 14. Refrigerant saturation temperature in evaporator and condenser shell.
 15. Compressor refrigerant suction and discharge temperature.
 16. Compressor bearing temperature.
 17. Motor bearing temperature.
 18. Motor winding temperature.
 19. Oil temperature.
 20. Oil discharge pressure.
 21. Phase current.
 22. Percent of motor rated load amperage.
 23. Phase voltage.
 24. Demand power (kilowatts).
 25. Energy use (kilowatt-hours).
 26. Power factor.
 27. For chillers equipped with variable frequency controllers and harmonic filters, include the following:
 - a. Output voltage and frequency.
 - b. Voltage total harmonic distortion for each phase.
 - c. Supply current total demand distortion for each phase.
 - d. Inlet vane position.

- e. Controller internal ambient temperature.
 - f. Heatsink temperature.
28. Purge suction temperature if purge system is provided.
 29. Purge elapsed time if purge system is provided.
- D. Control Functions:
1. Manual or automatic startup and shutdown time schedule.
 2. Entering and leaving chilled-water temperatures, control set points, and motor load limits. Evaporator fluid temperature shall be reset based on return-water temperature.
 3. Current limit and demand limit.
 4. Condenser-fluid temperature.
 5. External chiller emergency stop.
 6. Variable evaporator flow.
 7. Thermal storage.
 8. Heat reclaim.
- E. Manually Reset Safety Controls: The following conditions shall shut down chiller and require manual reset:
1. Low evaporator pressure or temperature; high condenser pressure.
 2. Low evaporator fluid temperature.
 3. Low oil differential pressure.
 4. High or low oil pressure.
 5. High oil temperature.
 6. High compressor-discharge temperature.
 7. Loss of condenser-fluid flow.
 8. Loss of evaporator fluid flow.
 9. Motor overcurrent.
 10. Motor overvoltage.
 11. Motor undervoltage.
 12. Motor phase reversal.
 13. Motor phase failure.
 14. Sensor- or detection-circuit fault.
 15. Processor communication loss.
 16. Motor controller fault.
 17. Extended compressor surge.
 18. Excessive air-leakage detection for chillers using R-123 refrigerant.
- F. Trending: Capability to trend analog data of up to five parameters simultaneously over an adjustable period and frequency of polling.
- G. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: view only; view and operate; and view, operate, and service.
- H. Control Authority: At least four conditions: Off, local manual control at chiller, local automatic control at chiller, and automatic control through a remote source.

- I. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display chiller status and alarms.
 1. Hardwired Points:
 - a. Monitoring: On-off status, common trouble alarm.
 - b. Control: On-off operation, chilled-water, discharge temperature set-point adjustment.
 2. ASHRAE 135 (BACnet) communication interface with the BAS shall enable the BAS operator to remotely control and monitor the chiller from an operator workstation. Control features and monitoring points displayed locally at chiller control panel shall be available through the BAS.

2.11 FINISH

- A. Paint chiller, using manufacturer's procedures for costal environments, except comply with the following minimum requirements:
 1. Provide at least one coat of primer with a total dry film thickness of at least **2 mils (0.05 mm)**.
 2. Paint surfaces that are to be insulated before applying the insulation.
 3. Paint installed insulation to match adjacent uninsulated surfaces.
 4. Color of finish coat to be.
- B. Provide Owner with quart container of paint used in application of topcoat to use in touchup applications after Project Closeout.

2.12 ACCESSORIES

- A. Flow Switches:
 1. Chiller manufacturer shall furnish a switch for each evaporator and condenser and confirm field-mounting location before installation.
 2. Paddle Flow Switches:
 - a. Vane operated to actuate a double-pole, double-throw switch with one pole field wired to the chiller control panel and the other pole field wired to the BAS.
 - b. Contacts: Platinum alloy, silver alloy, or gold-plated switch contacts with a rating of 10 A at 120-V ac.
 - c. Pressure rating equal to pressure rating of heat exchanger.
 - d. Construct body and wetted parts of Type 316 stainless steel.
 - e. House switch in a NEMA 250, Type 4 enclosure constructed of die-cast aluminum.
 - f. Vane length to suit installation.
 3. Pressure Differential Switches:

- a. Construction: Wetted parts of body and trim constructed of Type 316 stainless steel.
- b. Performance: Switch shall withstand, without damage, the full-pressure rating of the heat exchanger applied to either port and exhibit zero set-point shift due to variation in working pressure.
- c. Set Point: Screw type, field adjustable.
- d. Electrical Connections: Internally mounted screw-type terminal blocks.
- e. Switch Enclosure: NEMA 250, Type 4.
- f. Switch Action: Double-pole, double-throw switch with one pole field wired to the chiller control panel and the other pole field wired to the BAS.

B. Vibration Isolation:

- 1. Chiller manufacturer shall furnish vibration isolation for each chiller.
- 2. Neoprene Pad:
 - a. Two layers of 0.375-inch- (10-mm-) thick, ribbed- or waffle-pattern neoprene pads separated by a 16-gage, stainless-steel plate.
 - b. Fabricate pads from 40- to 50-durometer neoprene.
 - c. Provide stainless-steel square bearing plate to load the pad uniformly between 20 and 40 psig (138 and 276 kPa) with a 0.12- to 0.16-inch (3- to 4-mm) deflection.

2.13 CAPACITIES AND CHARACTERISTICS

- A. As shown on the equipment schedules on the plans.

2.14 SOURCE QUALITY CONTROL

- A. Perform functional run tests of chillers before shipping.
- B. For chillers using R-123 refrigerant, factory test and inspect evaporator and condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Pressure test fluid side of heat exchangers, including water boxes, to 1.5 times the rated pressure. Pressure proof test refrigerant side of heat exchangers to a minimum of 45 psig (310 kPa). Vacuum and pressure test for leaks.
- C. For chillers located indoors, rate sound power level according to ARI 575.

PART 3 - EXECUTION

3.1 CHILLER INSTALLATION

- A. Install all equipment, material, accessories, etc. according to the manufacturer's instructions.
- B. Install chillers on support structure indicated.

C. Equipment Mounting:

1. Install chillers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in other sections of the specifications.
 2. Comply with requirements for vibration isolation and seismic control devices.
- D. Maintain manufacturer's recommended clearances for service and maintenance.
- E. Charge chiller with refrigerant and fill with oil if not factory installed.
- F. Install separate devices furnished by manufacturer and not factory installed.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 232113 "Hydronic Piping," Section 232116 "Hydronic Piping Specialties" and Section 232300 "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to chiller to allow service and maintenance.
- C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, pressure gage and drain connection with valve.
- D. Condenser-Fluid Connections: Connect to condenser inlet with shutoff valve, strainer, flexible connector, thermometer, and pressure gage. Connect to condenser outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, pressure gage, and drain
- E. Refrigerant Pressure Relief Device Connections: For chillers installed indoors, extend separate vent piping for each chiller to the outdoors without valves or restrictions. Comply with ASHRAE 15. Connect to chiller pressure relief device with flexible connector and dirt leg with drain valve.
- F. For chillers equipped with a purge system, extend to the outdoors. Comply with ASHRAE 15 and ASHRAE 147.
- G. Connect each chiller drain connection with a union and drain pipe, and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Verify that refrigerant charge is sufficient and chiller has been leak tested.
 3. Verify that pumps are installed and functional.
 4. Verify that thermometers and gages are installed.

5. Operate chiller for run-in period.
 6. Check bearing lubrication and oil levels.
 7. Verify that refrigerant pressure relief device is vented outside.
 8. Verify proper motor rotation.
 9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.
 10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator and condenser.
 11. Verify and record performance of chiller protection devices.
 12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.
- C. Prepare test and inspection startup reports.

END OF SECTION 236416

SECTION 238219 - FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes fan-coil units and accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for each fan-coil unit is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by another manufacturer.

2.2 FAN-COIL UNITS

- A. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.
- B. Coil Section Insulation: 1/2-inch (13-mm) thick, foil-covered insulation complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Main and Auxiliary Drain Pans: Non-corrosive pans and drain connections to comply with ASHRAE 62.1.
- D. Chassis: Galvanized steel where exposed to moisture. Floor-mounting units shall have leveling screws.
- E. Cabinet: Steel with baked-enamel finish in manufacturer's standard paint color where installed in concealed areas, baked-enamel finish in manufacturer's custom paint color as selected by Architect where installed in exposed areas.
1. Vertical Unit Front Panels: Removable, steel, with discharge grille and channel-formed edges, cam fasteners, and insulation on back of panel.
 2. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge and attached with safety chain; with integral stamped discharge grilles.
 3. Steel recessing flanges for recessing fan-coil units into ceiling or wall.
- F. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.
- G. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.

H. Fan and Motor Board: Removable.

1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
 2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board.
 3. Wiring Termination: Connect motor to chassis wiring with plug connection.
- I. Control devices and operational sequences are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls."
- J. Basic Unit Controls:
1. Control voltage transformer.
 2. Wall-mounted temperature sensor.
 3. Unoccupied-period-override push button.
- K. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all equipment, material, accessories, etc. according to the manufacturer's instructions.
- B. Install fan-coil units to comply with NFPA 90A.
- C. Suspend fan-coil units from structure with spring vibration isolation hangers.
- D. Install new filters in each fan-coil unit within two weeks after Substantial Completion.
- E. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
 1. Install piping adjacent to machine to allow service and maintenance.
 2. Connect piping to fan-coil-unit factory hydronic piping package. Install piping package if shipped loose.
 3. Connect condensate drain to indirect waste.
 - a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.
- F. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Section 233300 "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 238219

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Fire Rated Sleeves for cables.
4. Grout.
5. Common electrical installation requirements.
6. Utility company coordination requirements.

1.3 DEFINITIONS

- A. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- B. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- C. "Provide": Furnish and install, complete and ready for the intended use.

1.4 SUBMITTALS

- A. Product Data: For Fire Rated Sleeves for cables.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping and conduit installed at required slope so connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

1.6 SERVING UTILITY COMPANIES

- A. Serving Electric Utility is as follows:
 1. Hawaiian Electric Company (HECO)
 - a. Contact: Allyson Hironga-Ahakuelo
 - b. Telephone: 808-543-5604
 - c. E-mail: a.hironaga-ahakuelo@hawaiianelectric.com
 - B. Pay all charges and/or fees levied by the serving utility companies relative to this project.
 - C. Obtain and pay all fees for permits, licensing, and inspections applicable to work of Division 26.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. All persons performing electrical work shall be Qualified Personnel and thoroughly knowledgeable of all applicable codes related to all electrical systems for this project. All installations shall be performed by skilled electrician tradesmen fully aware of the latest techniques, practices, and standards of the industry. Refer to N.E.C. Article 100-Definitions, Qualified Person.
- C. Electrical equipment and components shall be installed in a neat and workmanlike manner in accordance with recognized practices and industry standards. Refer to N.E.C.110-12. Haphazard or poor installation practice will be cause for rejection of the work.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than **50 inches** (**1270 mm**) and no side more than **16 inches** (**400 mm**), thickness shall be **0.052 inch** (**1.3 mm**).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, **50 inches** (**1270 mm**) and 1 or more sides equal to, or more than, **16 inches** (**400 mm**), thickness shall be **0.138 inch** (**3.5 mm**).
- C. EMT: Electrical Metallic Tubing.
- D. PVC: Schedule 40 or 80.

2.2 FIRE RATED SLEEVES FOR CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M
 - 2. Hilti
 - 3. Specified Technologies, Inc (STI)
 - 4. Wiremold.
- B. Factory assembled rectangular steel pathway containing an intumescent insert material that adjusts automatically to cable addition or subtraction.
- C. Sleeve shall have an F Rating equal to or greater than the rating of the wall in which the sleeve is installed.
- D. Sleeve shall be UL listed and bear the UL Classification marking.
- E. Sleeve shall be tested in accordance with ASTM E814 (ANSI/UL1479).
- F. Provide square wall plate kits for single sleeve applications. Provide multi-gang wall/floor plate kits for ganged applications.
- G. Subject to compatibility with requirements and field conditions, i.e. sleeve size, wall thickness, etc., acceptable products include the following:
 - 1. 3M Fire Barrier Pass-Through Devices
 - 2. Hilti Speed Sleeves

3. Specified Technologies Inc. EZ-Path Fire Rated Pathway (series 33).
4. Wiremold Flamestopper FS4 Series

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete, masonry and gypsum board walls, or fire-rated floor and wall assemblies.
- B. Sleeves are required where cables (not in raceway) penetrate walls or floors. Sleeves are not required where raceways penetrate walls, except where raceways penetrate exterior walls/foundations below grade.
- C. Concrete Slabs and Walls: Install sleeves during erection of slabs and walls.
- D. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

- F. Provide insulated bushings on EMT sleeves for cable not in conduit. Bushings shall be plenum rated where installed in a plenum.
- G. Extend sleeves installed in floors **4 inches (100 mm)** above finished floor level unless noted otherwise.
- H. Size pipe sleeves to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe or PVC, schedule 40 or 80, sleeves. Size sleeves to allow for **1-inch (25-mm)** annular clear space between raceway and sleeve. Cut sleeves to length for mounting flush with both surfaces of walls.
- M. Fire Rated Sleeves for cables: Fabricate openings in wall or floor assemblies per manufacturer's recommendations.

3.3 SLEEVE APPLICATION

- A. Sleeves for cables not in conduit:
 - 1. Through Non-Rated Interior Walls: EMT sleeves.
 - 2. Through Non-Rated Floors: EMT sleeves.
 - 3. Through Fire Rated Interior Walls: Fire Rated Sleeves for cables.
 - 4. Through Fire Rated Floors: Fire Rated Sleeves for cables.
- B. Sleeves for conduits:
 - 1. Through Exterior Walls Below Grade: Cast iron pipe or PVC, Schedule 40 or 80.
- C. Sleeves for Cable Trays:
 - 1. Through Non-Rated Interior Walls: Rectangular galvanized sheet metal opening.
 - 2. Through Fire Rated Walls: Stop cable tray 6 inches maximum for each side of wall and provide multiple fire rated sleeves for cables with combined allowable area for cable equal to the capacity of the cable tray unless noted otherwise.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500

SECTION 260503 – DEMOLITION OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 1. Demolition and removal of selected portion of electrical systems, including special systems normally specified in division 27 and 28.
 2. Salvage of existing items to be reused.
 3. Salvage of existing items to be delivered to the Owner.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Remove and salvage items noted as ‘salvage’, ‘return to Owner’ or similar manner on the Drawings.
- C. Remove and salvage items as requested by the Owner. Conduct a meeting with the Owner prior to commencing demolition to determine items that the Owner wishes to retain.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ELECTRICAL SYSTEMS DEMOLITION

- A. Remove items depicted or denoted for demolition on the Drawings. Unless noted otherwise, removal of the items shall include devices, boxes, cable, supporting elements, etc. associated with the item back to the panelboard or nearest j-box or device to remain.
- B. Provide plugs on boxes to remain where conduits have been removed.
- C. Conduits concealed in masonry walls or under concrete slabs may be cut back, sealed and abandoned.
- D. Provide blank cover-plates on all abandoned boxes to remain in existing masonry or stud walls. Plate color and material shall match wiring devices plates specified for the project. In the absence of such specification, match the color and material of existing wiring devices in the area.
- E. Maintain power to end-of-line or downstream devices to remain. Provide raceways, boxes, conductors and all other necessary materials as required to re-establish damaged or interrupted feeders and branch circuits. Intercept existing feeders or branch circuits at nearest accessible space or device and reconnect to original feeder or branch circuit source.

3.2 SPECIAL SYSTEMS DEMOLITION

- A. Remove items depicted or denoted for demolition on the Drawings. Unless noted otherwise, removal of the items shall include devices, boxes, cable, supporting elements, etc. associated with the item back to the control panel, terminal block, punch block, patch panel, or similar type of termination point.

END OF SECTION 260503

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cerro Wire
 2. Encore Wire Corporation
 3. General Cable.
 4. Houston Wire & Cable Company.
 5. Southwire Company.
- B. Copper and Aluminum Conductors: Comply with NEMA WC 70.
 1. Aluminum conductors shall be permitted for feeders 100 amps and larger only
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and XHHW.

- D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC mineral-insulated, metal-sheathed cable, Type MI, and Type SO with ground wire.
- E. All conductors shall be rated 75 degrees C, minimum.
- F. Refer to Division 26 Section "Raceway and Boxes for Electrical Systems" for types of raceways permitted. Cable assemblies, such as Type AC or MC cable, shall not be permitted unless noted otherwise.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ideal Industries, Inc.
 - 2. Ilsco.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Feeders to Distribution Equipment and Panelboards: Type XHHW-2, single conductors in raceway.
- C. Other Feeders and Branch Circuits: Type THHN-THWN, single conductors in raceway.
- D. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.
- E. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- F. Class 2 Control Circuits: Type THHN-THWN, in raceway.

- G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- H. Minimum Wire Size (Interior Work): No. 12 AWG, except No. 14 AWG shall be permitted for signal, pilot control circuits and fixture whips.
- I. Minimum Wire Size (Exterior Work): No 10 AWG.
- J. Three-Phase Wiring: A maximum of three phase conductors, each of a different phase, and one common neutral shall be installed per conduit homerun. Derating factors for additional conductors installed in the same conduit shall be applied per NEC Table 310.
- K. Use #10 AWG minimum conductor size in lieu of #12 AWG minimum for 20 ampere, 120 volt branch circuits where homeruns are longer than 75 feet and for 20 ampere, 277 volt branch circuits where homeruns are longer than 175 feet. Increase in size as required for a maximum of 3 percent voltage drop from panel to load.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least **6 inches (150 mm)** of slack.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

- A. Product Data: Submit product data for each of the following:

1. Telecommunications Grounding Busbars
2. Connectors
3. Ground rods
4. Grounding clamps

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 TELECOMMUNICATIONS GROUNDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper B-Line
 2. Chatsworth
 3. Erico.
 4. Harger
 5. Legrand Ortronics
 6. Panduit

- B. Products shall be UL listed meet the specification of TIA/EIA 607 and conform to BICSI recommendations.
- C. Copper busbar, 0.25-inch thick minimum, insulated stand-offs, factory predrilled standard size holes per TIA/EIA 607 standard.
- D. Telecommunications Main Grounding Busbars: Height shall be 4-inches. Length shall be 20-inches minimum unless indicated otherwise on Drawings. Chatsworth 40153 series or equal.
- E. Telecommunications Grounding Busbars: Height shall be 2-inches. Length shall be 10-inches minimum unless indicated otherwise on Drawings. Chatsworth 13622 series or equal.
- F. Connector Lugs: Lugs for connecting to telecommunications grounding busbars shall be UL listed two-hole, long barrel, electro tinplated compression lugs.

2.2 CONDUCTORS

- A. Insulated Conductors: Tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, **1/4 inch (6 mm)** in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; **1-5/8 inches (41 mm)** wide and **1/16 inch (1.6 mm)** thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; **1-5/8 inches (41 mm)** wide and **1/16 inch (1.6 mm)** thick.

2.3 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; **3/4 inch by 10 feet (19 mm by 3 m)** in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least **24 inches (600 mm)** below grade.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors, except as otherwise indicated.
 - 3. Connections to Structural Steel: Bolted connectors except where connection can be inspected after the completion of the project. Welded connectors where connection will be conceal and not accessible upon the completion of the project.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Provide grounding as required by the serving utility company. Grounding shall be provided at, but not limited to, the following locations:
 - 1. Transformer
 - 2. Meter

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 TELECOMMUNICATIONS GROUNDING

- A. Provide grounding in accordance with EIA/TIA 607 and as indicated on Drawings.

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are **2 inches (50 mm)** below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 3. Prepare dimensioned drawings locating each ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. If resistance to ground values at the ground rod exceeds 10 ohms, provide another sectional ground rod connected to the original ground rod for a total of 20ft rod and drive rod deep into earth. Repeat tests as described above, record and submit test results. If soil conditions (rock) do not allow for a deep driven ground rod, provide two additional rods spaced at least one-rod length from each other and the original rod and locate at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor. Repeat tests as described above, record and submit test results.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 SUBMITTALS

- A. Product Data: For roof top conduit supports.

1.5 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. PW Industries.
 - f. Thomas & Betts Corporation.
 - g. Unistrut; Tyco International, Ltd.
 - h. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel Hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Support for conduits routed horizontally on roofs: Factory assembled UV-stabilized rubber base with galvanized steel channel for attachment of conduit(s). Size and type of support as recommended by manufacturer for the quantity and weight of conduits supported. Provide one of the following products:

1. Cooper B-Line Dura-Blok Rooftop supports
 2. Erico Caddy Pyramid Rooftop Supports
 3. Miro Industries Inc. Conduit Supports
 4. RoofTop Accessories Curb Supports
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; MasterSet Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be **1/4 inch (6 mm)** in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus **200 lb (90 kg)**.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete **4 inches (100 mm)** thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than **4 inches (100 mm)** thick.
 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than **4 inches (100 mm)** larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use **3000-psi (20.7-MPa)**, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of **2.0 mils (0.05 mm)**.
- B. Touchup: Comply with requirements in Division 09 Painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. HDPE: High Density Polyethylene.
- F. IMC: Intermediate metal conduit.
- G. LFMC: Liquidtight flexible metal conduit.
- H. LFNC: Liquidtight flexible nonmetallic conduit.
- I. NBR: Acrylonitrile-butadiene rubber.
- J. RNC: Rigid nonmetallic conduit.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc., a Tyco International Ltd. Co.
 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 3. Anamet Electrical, Inc.; Anaconda Metal Hose.
 4. Electri-Flex Co.
 5. O-Z Gedney; a brand of EGS Electrical Group
 6. Republic Conduit
 7. Southwire
 8. Western Tube & Conduit Corporation
 9. Wheatland Tube Company
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit
 1. Comply with NEMA RN 1.
 2. Coating Thickness: **0.040 inch (1 mm)**, minimum.
- E. EMT: ANSI C80.3.
- F. FMC: Zinc-coated steel
- G. LFMC: Flexible steel conduit with PVC jacket.
- H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 2. Fittings for EMT: Steel compression type.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, **0.040 inch (1 mm)**, with overlapping sleeves protecting threaded joints.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CANTEX Inc.
 2. Lamson & Sessions; Carlon Electrical Products.
 3. RACO; a Hubbell Company.
 4. Thomas & Betts Corporation.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.
- D. HDPE: NEMA TC 7, Type EPEC 40, UL 651B listed, NEC compliant, smoothwall coilable PE Electrical Plastic Conduit.

2.3 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.
 2. Hoffman.
 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type.
- E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Adalet; a division of Scott Fetzer Co..
 2. Appleton Electric, a brand of EGS Electrical Group
 3. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 4. Hoffman.
 5. Killark Electric Manufacturing Co; a Hubbell Company
 6. Lew Electric Floor Box and Fittings Company
 7. O-Z Gedney; a brand of EGS Electrical Group
 8. RACO; a Hubbell Company.
 9. Spring City Electrical Manufacturing Company.
 10. Stahlin; a division of Robroy Industries
 11. Steel City; Thomas & Betts Corporation.

12. Wiremold Company (The); Legrand.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.
- F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- G. Cabinets:
 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.
 5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 1. Exposed Conduit: Rigid steel conduit or IMC.
 2. Concealed Conduit, Aboveground: Rigid steel conduit or IMC.
 3. Underground Conduit, Service entrance and feeders: RNC, Type EPC-40-PVC, direct buried.
 4. Underground Conduit, branch circuits: RNC, Type EPC-40-PVC, or HDPE, Type EPEC-40 direct buried.
 5. Underground Conduit, Telecommunications: RNC, Type EPC-40-PVC, or HDPE, Type EPEC-40 direct buried.
 6. Under Concrete Building Slabs: RNC, Type EPC-40-PVC. For raceways 1.5 inches in diameter and less, use PVC coated rigid steel elbows to transition from below slab, through slab to above slab, indoor raceway.
 7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC
 8. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or Type 4.
- B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT. Includes raceways in the following locations:
 - a. Unfinished, dry spaces.
 - b. Within joist space of finished spaces with exposed structure ceilings.
 2. Exposed and Subject to Physical Damage: Rigid steel conduit. Includes raceways up to 8 feet above the finished floor in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 3. Concealed in Ceilings and Interior Walls and Partitions: EMT
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 5. Damp or Wet Locations: Rigid steel conduit
 6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- C. Minimum Raceway Size: **3/4-inch (21-mm)** trade size diameter for lighting and branch circuit homeruns and exterior work; 1/2-inch (16-mm) diameter for other interior work, unless shown or specified otherwise.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least **6 inches (150 mm)** away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 - 1. Run conduit larger than **1-inch (27-mm)** trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than **200-lb (90-kg)** tensile strength. Leave at least **12 inches (300 mm)** of slack at each end of pull wire.
- L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
 - 1. **3/4-Inch (19-mm)** Trade Size and Smaller: Install raceways in maximum lengths of **50 feet (15 m)**.
 - 2. **1-Inch (25-mm)** Trade Size and Larger: Install raceways in maximum lengths of **75 feet (23 m)**.
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- N. Flexible Conduit Connections: Use maximum of **72 inches (1830 mm)** of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations
- O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than **6 inches (150 mm)** in nominal diameter.
 2. Install backfill as specified in Division 31 Section "Earth Moving."
 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within **12 inches (300 mm)** of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
 4. Install manufactured PVC coated rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor, unless noted otherwise.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with **3 inches (75 mm)** of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of **60 inches (1500 mm)** from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
 5. Where feeder and communications conduits 2-inches in diameter and larger transition from below concrete floor slab to above slab, RNC may continue up to 36inches maximum to destination (i.e. panelboard) without converting to the indoor raceway system specified above.

3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.5 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Identification for conductors and cable.
2. Underground-line warning tape.
3. Equipment identification labels.

1.3 SUBMITTALS

- A. Product Data: For warning tape.
- B. Sample: Submit sample for typical panelboard label.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.145.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND -CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than **3 mils (0.08 mm)** thick by **1 to 2 inches (25 to 50 mm)** wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- C. Write-On Tags: Polyester tag, **0.015 inch (0.38 mm)** thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.2 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 - 1. Not less than **6 inches (150 mm)** wide by **4 mils (0.102 mm)** thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend shall indicate type of underground line.

2.3 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be **3/8 inch (10 mm)**.
- B. Stenciled Legend: In nonfading, waterproof, ink or paint, black letters on white background or white letters on black background. Minimum letter height shall be **1 inch (25 mm)**.
- C. Refer to drawings for information required to be displayed on labels.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Raceways of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands or snap-around, color-coding bands:
 - 1. Fire Alarm System: Red.
 - 2. Security System: Blue and yellow.
 - 3. Telecommunication System: Green and yellow.

- B. Junction Boxes for Fire Alarm Systems: Provide red coverplates or paint coverplates red in the field.
- C. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list future load (if known), source and circuit number. Where located in an unfinished space or concealed in an accessible space above finished ceiling, label cover with permanent marker or adhesive label.
- D. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for direct-buried cables, cables in raceway, and empty raceway.
- E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Where required by NEC or local codes comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
- F. Provide labels for the following equipment unless noted otherwise:
 - 1. Panelboards:
 - a. Provide label on exterior of panelboard above panelboard door.
 - b. Provide typed directory. The directory shall reflect final room numbers as assigned by the Owner, which may not match room numbers indicated on construction document drawings. Install directory in a metal frame or plastic pouch mounted on the inside cover of the panelboard.
 - 2. Load Centers:
 - a. Provide label on exterior of load center where installed in an unfinished space. For load centers installed in a finish space, identify load center designation on the typed directory (see below) and do not provide a label. Install directory in a metal frame or plastic pouch mounted on the inside cover of the load center.
 - b. Provide typed directory. The directory shall reflect final room numbers as assigned by the Owner, which may not match room numbers indicated on construction document drawings.
 - 3. Switchboards:
 - a. Provide labels for switchboards.
 - b. Provide a label for each branch switch or breaker identifying the load served.
 - 4. Transformers.
 - 5. Motor-Control Centers:
 - a. Provide label for motor control centers indicating all information required for panelboards, i.e. equipment designation, voltage, source, etc
 - b. Provide a label for each branch switch or breaker identifying the load served.
 - 6. Disconnect switches:

- a. Provide labels for heavy duty safety switches, combo disconnect starters and enclosed controllers.
 - b. Labels are not required for motor rated toggle switches or switches with thermal overloads.
 7. Enclosed circuit breakers.
 8. Motor starters:
 - a. Label shall identify the load served.
 9. Power transfer equipment.
 10. Contactors.
- G. Provide additional identification as required by NEC or local codes.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Color-Coding for Phase Identification, 600 V and Less: Use the colors listed below for service, feeder, and branch-circuit conductors.
 1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - e. Ground: Green.
 - f. Isolated Ground: Green with yellow stripe.
 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Gray.
 - e. Ground: Green.

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of **6 inches (150 mm)** from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- F. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at **4 to 6 inches (100 to 150 mm)** below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds **16 inches (400 mm)** overall.

END OF SECTION 260553

SECTION 260570 - OVERCURRENT PROTECTIVE DEVICE STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes a coordination and arc-flash study to determine the following:
 1. Recommended settings for adjustable overcurrent devices.
 2. Arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.
 3. Overcurrent protective devices in the emergency distribution system are coordinated as required by NEC article 700.
- B. A coordination study is required for the emergency distribution system if and only if the contractor opts to provide breakers in lieu of fuses for overcurrent protection at any point within the emergency distribution system.

1.3 DEFINITIONS

- A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- C. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 SUBMITTALS

- A. Report Data: Submit output for the computer program used to perform the study. Result of study should include the following:
 1. Arc Flash information for each piece of distribution equipment, i.e. switchboards, panelboards, and disconnect switches.
 2. Recommended setting for each overcurrent protection device with adjustable settings
 3. Coordination-Study Report validating that the overcurrent protection devices in the emergency system as indicated in the Drawings meet the requirements for selective

coordination of emergency systems as required by NEC article 700. Perform this study and submit report prior to submitting the shop drawings for emergency distribution components such as panelboards or the generator.

B. Product Data: Arc Flash Warning Labels.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
- B. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide the following:
 - 1. Maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.
 - 2. Recommended settings for overcurrent protection devices with adjustable settings.

1.6 QUALITY ASSURANCE

- A. Employ the manufacturer of the electrical distribution equipment, i.e. switchboards and panelboards, to perform the study specified herein.

PART 2 - PRODUCTS

2.1 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch (76-by-127-mm) thermal transfer label of high-adhesion polyester for each work location included in the analysis.
- B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - 1. Location designation.
 - 2. Nominal voltage.
 - 3. Flash protection boundary.
 - 4. Hazard risk category.
 - 5. Incident energy.
 - 6. Working distance.
 - 7. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study.

3.2 LABELING

- A. Apply one arc-flash label for each 600-V ac, 480-V ac, and applicable 208-V ac panelboard and disconnect and for each of the following locations:
 1. Low-voltage switchboard.
 2. Motor Control Center.

3.3 APPLICATION OF WARNING LABELS

- A. Install the arc-fault warning labels.

END OF SECTION 260570

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following lighting control devices:

1. Indoor occupancy sensors.
2. Lighting contactors.
3. Emergency transfer devices.

- B. Related Sections include the following:

1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.
2. Division 26 Section "Theatrical Lighting" for theatrical lighting controls.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Controls, Greengate
 2. Hubbell, H-MOSS.
 3. Leviton Mfg. Company Inc.
 4. Sensor Switch
 5. Watt Stopper (The).
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a **1/2-inch (13-mm)** knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 6. Bypass Switch: Override the on function in case of sensor failure.
 7. Automatic Light-Level Sensor: Adjustable from **2 to 200 fc (21.5 to 2152 lx)**; keep lighting off when selected lighting level is present.
- C. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage or by use of microphonic detection technology.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than **12 inches (305 mm)** in either a horizontal or a vertical manner at an approximate speed of **12 inches/s (305 mm/s)**.
 2. Time delay: 30 seconds to 30 minutes.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of **1000 sq. ft. (93 sq. m)** when mounted on a **96-inch- (2440-mm-) high ceiling**.
 - a. Provide one of the following products:
 - 1) Cooper OMC-U-2000
 - 2) Hubbell Omni-ATU1000C
 - 3) Leviton OSC10-U0W
 - 4) Sensor Switch CM-PDT
 - 5) Wattstopper WT-1100
 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of **2000 sq. ft. (186 sq. m)** when mounted on a **96-inch- (2440-mm-) high ceiling**.
 - a. Provide one of the following products:
 - 1) Cooper OMC-U-2000
 - 2) Hubbell Omni-ATU2000C
 - 3) Leviton OSC20-U0W
 - 4) Sensor Switch CM-PDT-10
 - 5) Wattstopper WT-2200
 5. Detector Coverage (180-degree Devices): Detect occupancy anywhere within a 180-degree field-of-view up to 1000 sq. ft. (93 sq. m.) when mounted on a 96-inch- (2440-mm-) high ceiling. Device shall be 180-degree “one-way” version of product lines listed above.
 - a. Cooper OMC-1001, or approved equal.
- D. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage or by use of microphonic detection technology. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of **6-inch- (150-mm-)** minimum movement of any portion of a human body that presents a target of not less than **36 sq. in. (232 sq. cm)**, and detect a person of average size and weight moving not less than **12 inches (305 mm)** in either a horizontal or a vertical manner at an approximate speed of **12 inches/s (305 mm/s)**.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of **1000 sq. ft. (93 sq. m)** when mounted on a **96-inch- (2440-mm-) high ceiling**.
 - a. Provide one of the following:
 - 1) Cooper OMC DT-2000R

- 2) Hubbell Omni-DT1000
 - 3) Leviton OSC20-M0W
 - 4) Sensor Switch CM-PDT
 - 5) Wattstopper DT-300
4. Detector Coverage (180-degree Devices): Detect occupancy anywhere within a 180-degree field-of-view up to 1000 sq. ft. (93 sq. m.) when mounted on a 96-inch- (2440-mm-) high ceiling. Device shall be 180-degree or “one-way” version of product lines listed above.
- a. Cooper OMC-DT-0701-R, or approved equal.
- E. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.
- 1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
 - 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
- a. Cooper OMC-P-1200-R, or approved equal.

2.2 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 2. General Electric
 - 3. Siemens
 - 4. Square D; Schneider Electric.
- B. Description: Electrically operated and mechanically held, complying with NEMA ICS 2 and UL 508.
- 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 - 3. Enclosure: Comply with NEMA 250.

2.3 EMERGENCY TRANSFER DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Bodine.
 - 2. Chloride Systems.

3. Dual Lite.
 4. Iota.
- B. Devices shall be capable of transferring power from a normal switched power source to an unswitched emergency power source. Device shall monitor the normal power source ahead of any local switching (voltage sensing) and automatically switch to the emergency source upon loss of normal power.
- C. Individual devices at fixtures:
1. Devices shall be rated for 3 amps at 120 or 277 volts:
 - a. Bodine GTD.
 - b. Chloride APTC
 - c. Dual Lite ATSD.
 - d. Iota ETS.
- D. Devices controlling multiple fixtures:
1. Devices shall be rated for 20 amps at 120 or 277 volts:
 - a. Bodine GTD20.
 - b. Chloride LightSTAR.
 - c. Dual Lite ASTD20.
- E. UL 924 listed.

2.4 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve 100 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be **1/2 inch (13 mm)**.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 EMERGENCY TRANSFER DEVICES

- A. Mount device in light fixture ballast channel or in fixture housing where available, or in a metallic NEMA enclosure outside of fixture. Where device is serving a fixture in a finished room with exposed structure (no ceiling), and is outside of fixture, locate device in NEMA 1 enclosure in accessible space above finished ceiling in the adjacent corridor, only if device cannot be placed within the light fixture.

3.4 SENSOR COMMISSIONING

- A. Prior to final completion, sensors shall be adjusted for proper operation. Proper operation includes:
 1. Lights are turned 'on', immediately upon entering the space.
 2. Lights stay 'on' while the space is occupied.
 3. Lights turn 'off' when the space is unoccupied after a preset time delay since last detecting occupancy. Time delay shall be 10 minutes unless directed otherwise by the Owner.
 4. Recommended settings are incorporated via dipswitch settings for all non-adaptive technology devices.
 5. Provide final walk-thru with Owner to verify accuracy of settings.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.

2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

- A. Prior to final completion, sensors shall be adjusted for proper operation. Proper operation includes:
 1. Lights are turned ‘on’, immediately upon entering the space.
 2. Lights stay ‘on’ while the space is occupied.
 3. Lights turn ‘off’ when the space is unoccupied after a preset time delay since last detecting occupancy. Time delay shall be 20 minutes unless directed otherwise by the Owner.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

- A. Provide a minimum of 30 minutes of training for Owner’s maintenance personnel on adjusting sensitivity and time delays of occupancy sensors.

END OF SECTION 260923

SECTION 260943 - LIGHTING CONTROL RELAY PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Lighting control panels using mechanically held relays for switching.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. IP: Internet protocol.
- C. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- D. PC: Personal computer; sometimes plural as "PCs."
- E. RS-485: A serial network protocol, similar to RS-232, complying with TIA-485-A.

1.4 SUBMITTALS

- A. Product Data: For each type of product.
 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, relays, manual switches and plates, and conductors and cables.
 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each relay panel and related equipment.
 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 3. Detail wiring partition configuration, current, and voltage ratings.
 4. Short-circuit current rating of relays.
 5. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panels for installation according to NECA 407.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Input signal from field-mounted manual switches, or digital signal sources, shall open or close one or more lighting control relays in the lighting control panels. Any combination of inputs shall be programmable to any number of control relays.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.
- D. Comply with UL 916.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide functionality of system as described in the Relay Panel schedules on Drawings.
- B. BAS Interface: Provide hardware and software to enable the BAS to monitor, control, display, and record data for use in processing reports.
 1. The communications protocol shall be compatible with the BAS, **< BAC Net > or < LonWorks >**. Coordinate with division 23.

2.3 LIGHTING CONTROL RELAY PANELS

- A. Products: Subject to compliance with requirements, provide one of the following:
 1. Acuity Brands, Inc., Lighting Control & Design, Inc.; GR2400.
 2. Cooper Lighting Controls, Greengate Control Keeper TouchScreen.
 3. General Electric Company, GE Consumer & Industrial - Electrical Distribution; LVRC.
 4. NexLight, NX series.
 5. WattStopper, a Legrand Group brand; Lighting Integrator.

- B. Description: Lighting control panel(s) using mechanically latched relays to control lighting and appliances.
1. All panels shall be interconnected with digital communications to appear to the operator as a single lighting control system. Programming for the entire system shall be possible from one control panel. Each panel shall contain a control unit as described below allowing the panel to operate independently in the event the connection(s) between panels is lost.
- C. Lighting Control Panel:
1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
 2. A vertical barrier separating branch circuits from control wiring.
- D. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.
1. Timing Unit:
 - a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
 - b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
 - c. Four independent schedules, each having 24 time periods.
 - d. Schedule periods settable to the minute.
 - e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
 2. Sequencing Control with Override:
 - a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
 - b. Sequencing control shall operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
 - c. Override control shall allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
 - d. Override control "blink warning" shall warn occupants approximately five minutes before actuating the off sequence.
 3. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation, including accurate time of day and date.
- E. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at specified voltage. Short-circuit current rating shall be not less than 10 kA. Control shall be three-wire, 24-V ac.
- F. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the

line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and photo sensors.

G. Operator Interface:

1. Integral alphanumeric keypad and digital display, and intuitive drop-down menus to assist in programming.
2. Log and display relay on-time.
3. Connect relays to one or more time and sequencing schemes.

H. EMERGENCY OPERATIONS

1. Where indicated on Relay Panel schedules on drawings, panels shall monitor normal power and close relays (turn loads 'on') upon loss of normal power.
2. UL 924 listed.

2.4 MANUAL SWITCHES AND PLATES

A. Master Stations: Multi-button digital low voltage control switches with labels.

1. Quantity of switches and number of buttons per switch as indicated on Drawings.
2. Labeling: Provide custom machine printed labeling or engraving to reflect actual loads as indicated on Drawings. Coordinate terminology on labels with the Owner.
3. Integral LED relay status indicators at each switch.
4. Color: Color shall match wiring devices as specified in Section 262726 "Wiring Devices. If color is not available, submit color options with shop drawings for A/E to select from manufacturer's standard color offering.
5. Provide one of the following:
 - a. Cooper Digita Switch series
 - b. GE equal
 - c. LC&D KnightsBridge series
 - d. NexLight Commerical series
 - e. Watt Stopper equal

B. Low Voltage Control Switches: Heavy duty low voltage momentary toggle or key operated switches shall be used in all areas as indicated on Drawings.

1. Momentary Toggle: Cooper GMT-G or equal.
2. Key Operated Switches: Cooper GMTL-N or equal.
3. Device Color shall match wiring devices as specified in Section 262726 "Wiring Devices."

C. Wall Plates: Color and material of plates shall match plates for wiring devices as specified in Section 262726 "Wiring Devices."

2.5 FIELD-MOUNTED SIGNAL SOURCES

- A. Indoor Occupancy Sensors: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal shall be compatible with the relays.

2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than recommended by system manufacturer, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than recommended by system manufacturer, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Digital and Multiplexed Signal Cables: Cable as recommended by system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panels according to NECA 407.
- B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRING INSTALLATION

- A. Wiring Method: Install cables in raceways meeting the requirements for branch circuit wiring as specified in Division 26 Section "Raceways and Boxes for Electrical Systems:" in all locations except as follows:
 1. Cable is not required to be installed in raceway where concealed in an accessible space above finished ceilings. Install plenum cable in environmental air spaces, including plenum ceilings. Provide sleeves as specified in Division 26 Section "Common Work Results for Electrical Systems" where cable passes through walls. See Open-Cable Installation below.

- B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- C. Open-Cable Installation.
 - 1. Utilize cable tray where available.
 - 2. Suspend cable not in a cable tray or pathway a minimum of 6 inches (200 mm) above ceiling by cable supports not more than 60 inches (1524 mm) apart.
 - 3. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
 - 4. Route cable parallel or perpendicular to building structure.

3.3 PANEL INSTALLATION

- A. Comply with NECA 1.
- B. Install panels and accessories according to NECA 407.
- C. Mount panel cabinet plumb and rigid without distortion of box.
- D. Install filler plates in unused spaces.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.
- D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Acceptance Testing Preparation:
1. Test continuity of each circuit.
- D. Lighting control panel will be considered defective if it does not pass tests and inspections.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system according to approved configuration schedules, time-of-day schedules, and input override assignments.
 3. Obtain scheduling information from Owner and program all system relays and control switches with time schedules and off-sweeps as requested by the Owner.
 4. Provide programming of master switches as directed by the Owner.
 5. Label switches with terminology agreed upon with the Owner.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the control unit and operator interface.

END OF SECTION 260943.23

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 03 Section, Cast-in-Place concrete”

1.2 SUMMARY

- A. This Section includes service and distribution switchboards rated 600 V and less.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPD: Surge protection device.
- F. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of switchboards and overcurrent protective devices.

- d. Utility company's metering provisions with indication of approval by utility company.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
2. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
- 1. Routine maintenance requirements for switchboards and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 3. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain switchboards through one source from a single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NEMA PB 2, "Deadfront Distribution Switchboards."
- E. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in sections or lengths that can be moved past obstructions in delivery path.
- B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C. Handle switchboards according to NEMA PB 2.1 and NECA 400.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding **6600 feet (2000 m)**.

1.8 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
 1. Eaton Corporation; Cutler-Hammer Products.
 2. General Electric Co.; Electrical Distribution & Protection Div.
 3. Siemens Energy & Automation, Inc.
 4. Square D.

2.2 MANUFACTURED UNITS

- A. Front-Connected, Front-Accessible Switchboard: Fixed, individually mounted main device(s), panel-mounted branches, and sections rear aligned.
- B. Nominal System Voltage: As indicated on Drawings.
- C. Main-Bus Continuous: As indicated on Drawings.
- D. Enclosure: Steel, NEMA 250, Type 1 unless noted otherwise.
- E. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- F. Utility Metering Compartment: Fabricated compartment and section complying with utility company's requirements. If separate vertical section is required for utility metering, match and align with basic switchboard.
- G. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- H. Buses and Connections: Three phase, four wire, unless otherwise indicated.
 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity or tin-plated, high-strength, electrical-grade aluminum alloy.

- a. If bus is aluminum, use copper- or tin-plated aluminum for circuit-breaker line connections.
 - b. If bus is copper, use copper for feeder circuit-breaker line connections.
2. Ground Bus: **1/4-by-2-inch- (6-by-50-mm-)** minimum-size, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 3. Contact Surfaces of Buses: Silver plated.
 4. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections, unless noted otherwise. Provide for future extensions from ends where indicated.
 5. Neutral Buses: 100 percent of the ampacity of phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus are braced.
- I. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of compartment.
- 2.3 SURGE PROTECTIVE DEVICES (SPD)
- A. Factory installed, integrally mounted, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules.
 - B. UL 1449 3rd Edition Type 1 Device, 20kA nominal (L-N) rating.
 - C. Minimum single-impulse current rating per phase shall be as follows:
 1. Line to Neutral: 200,000A.
 2. Line to Ground: 200,000A.
 - D. Protection modes shall be as follows:
 1. Line to neutral.
 2. Line to ground.
 - E. EMI/RFI Noise Attenuation per UL 1283: -50 dB at 100 kHz.
 - F. Maximum UL 1449 Listed Voltage Protection Ratings (VPR's) shall not exceed the following:
 1. 1200 V, line to neutral and line to ground on 277/480 V systems.
 2. 1800 V, line to line on 277/480 V systems.
 - G. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) shall not exceed the following:
 1. 15%, allowable system voltage fluctuation on 277/480 V systems.
 2. 320 V, MCOV on 277/480 V systems.

H. Accessories:

1. Audible alarm activated on failure of any surge diversion module.
2. Six-digit transient-counter set to total transient surges that deviate from the sine-wave envelope by more than 125 V.

2.4 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting capacity to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. GFCI Circuit Breakers: Single- and two-pole configurations with [5][30]-mA trip sensitivity.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Ground-Fault Protection (Where Indicated): Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 4. Shunt Trip (Where Indicated): 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
- C. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.
- D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- E. Fuses are specified in Division 26 Section "Fuses."

2.5 INSTRUMENTATION

- A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:
 1. Integrally mounted and factory installed.
 2. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
 3. Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
 4. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.

5. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondaries to ground overcurrent relays to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Megawatts: Plus or minus 2 percent.
 - e. Power Factor: Plus or minus 2 percent.
 - f. Frequency: Plus or minus 0.5 percent.
 - g. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.
 - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent. Accumulated values unaffected by power outages up to 72 hours.
 2. Meter shall be compatible with and monitored by the Building Management System, BMS. Coordinate requirements with division 23.
 3. Mounting: Display and control unit flush or semiflush mounted in switchboard.

2.6 CONTROL POWER

- A. Control Circuits: 120 V, supplied through secondary disconnecting devices from control-power transformer.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.2 EXAMINATION

- A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1 and NECA 400.
- B. Install and anchor switchboards level on concrete bases, **4-inch (100-mm)** nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete".
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Install overcurrent protective devices.

3.4 IDENTIFICATION

- A. Switchboard Nameplates: Label switchboard and each branch breaker or switch per Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- B. Perform the following field tests and inspections and prepare test reports:
 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

AQUA WAIKIKI WAVE
BUILDING PACKAGE

34-14102-00
FOR REVIEW - NOT FOR CONSTRUCTION

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Load centers.
4. Surge protective device (SPD) panelboards.
5. Motor control panelboards

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.

- c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices.
- C. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- D. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2000 m).

1.7 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cutler-Hammer Products, Eaton Corporation.
 2. General Electric Co.; Electrical Distribution & Protection Div.
 3. Siemens Energy & Automation, Inc.
 4. Square D.

2.2 MANUFACTURED UNITS

- A. Enclosures: Flush or surface-mounted cabinets as indicated. NEMA PB 1, Type 1 unless noted otherwise.
1. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 2. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
 3. Directory Card: With transparent protective cover, mounted in metal frame or plastic pouch, inside panelboard door.
- B. Phase and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
 3. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
- C. Conductor Connectors: Suitable for use with conductor material.
1. Main and Neutral Lugs: Mechanical type.
 2. Ground Lugs and Bus Configured Terminators: Compression type.
 3. Feed-Through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- D. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. Fully rated to interrupt symmetrical short-circuit current available at terminals. Series rated devices are not acceptable.

2.4 DISTRIBUTION PANELBOARDS

- A. Main Overcurrent Protective Devices: Breakers or fused switches as indicated on Drawings.
- B. Branch Overcurrent Protective Devices:
 - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
 - 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
 - 3. Fused switches.
- C. Fusible Distribution Panelboard: Square D QMB Series, or approved equal.
- D. Circuit Breaker Distribution Panelboard: Square D I-Line Series, or approved equal

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.6 LOAD CENTERS

- A. Overcurrent Protective Devices: Plug-in, full-module circuit breaker.
- B. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.
- C. Recess mount unless noted otherwise. Recessed load centers shall be capable of mounting in a standard 2x4 wood stud wall.
- D. Square D Type QO or approved equal.

2.7 SURGE PROTECTIVE DEVICE (SPD) PANELBOARDS

- A. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- B. Main Overcurrent Devices: Thermal-magnetic circuit breaker.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.
- D. Bus: Copper phase and neutral buses.
- E. Surge Protective Device: Factory installed, integrally mounted, plug-in-style, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules.
 - 1. UL 1449 3rd Edition Type 2, 5kA nominal (L-N) rating.

2. Minimum Single-Impulse Current Ratings per Phase:
 - a. Line to Neutral: 80,000 A.
 - b. Line to Ground: 80,000 A.
 - c. Neutral to Ground: 40,000 A.
 3. Protection modes shall be as follows:
 - a. Line to neutral.
 - b. Line to ground.
 - c. Neutral to ground.
 4. EMI/RFI Noise Attenuation per UL 1283: -50 dB at 100 kHz.
 5. Maximum UL 1449 Listed Voltage Protection Ratings (VPR's) shall not exceed the following:
 - a. 1200 V, line to neutral and line to ground on 277/480 V systems.
 - b. 700 V, line to neutral and line to ground on 120/208 V systems
 - c. 1800 V, line to line on 277/480 V systems.
 - d. 1200 V, line to line on 120/208 V systems.
- F. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) shall not exceed the following:
1. 15%, allowable system voltage fluctuation on 277/480 V systems.
 2. 25%, allowable system voltage fluctuation on 120/208 V systems.
 3. 320 V, MCOV on 277/480 V systems.
 4. 150 V, MCOV on 120/208 V systems.
- G. Accessories:
1. Audible alarm activated on failure of any surge diversion module.

2.8 MOTOR CONTROL PANELBOARDS

- A. Fusible switches for main and branch overcurrent protection devices.
- B. Motor controllers shall meet specification of Division 26 Section "Enclosed Controllers."
- C. Square D Type QMB or approved equal.

2.9 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. GFCI Circuit Breakers: Single- and two-pole configurations with 5 or 30-mA trip sensitivity as indicated on Drawings.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 5. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- D. Fuses are specified in Division 26 Section "Fuses."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim **74 inches (1880 mm)** above finished floor, unless otherwise indicated.
- C. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- D. Install overcurrent protective devices and controllers.
- E. Install filler plates in unused spaces.
- F. For panelboards mounted flush in walls, stub four **1-inch (27-GRC)** empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

- A. Identify field-installed conductors and panelboards as specified in Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Directories shall reflect room numbers as assigned by the Owner, which may not match room numbers indicated on contract document drawings.
- C. Panelboard Nameplates: Label each panelboard as specified in Division 26 Section "Identification for Electrical Systems."

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- B. Perform the following field tests and inspections and prepare test reports:
 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 1. Measure as directed during period of normal system loading.
 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Snap switches.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 3. Leviton Mfg. Company Inc. (Leviton).
 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5361 (single), 5352 (duplex).
 - b. Hubbell; HBL5361 (single), 5362 (duplex).
 - c. Leviton; 5361 (single), 5362 (duplex).
 - d. Pass & Seymour; 5361 (single), 5362 (duplex).
 2. Standard receptacles in guest rooms shall be rated for 15amps, tamper-resistant and of the same series listed above.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; VGF20.
 - b. Hubbell GF20L.
 - c. Leviton 7899.
 - d. Pass & Seymour 2095.
- C. GFCI receptacles in guestrooms shall be rated 15amps, tamper-resistant and of the same series

2.4 DUPLEX RECEPTACLE / USB CHARGER

- A. Convenience Receptacles, 125 V, 15 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-15R, and UL 498. Tamper-Resistant decorator duplex receptacle.

- B. Two USB ports 3Amp, 5V DC, type A, class 2.0.
- C. Hubbell Model USB15X2 or approved equal by Copper, Leviton, or Pass & Seymour.

2.5 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches - Public Spaces, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; CSB120 (single pole), CSB220 (two pole), CSB320 (three way), CSB420 (four way).
 - b. Hubbell; CSB120 (single pole), CSB220 (two pole), CSB320 (three way), CSB420 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; CSB20AC1 (single pole), CSB20AC2 (two pole), CSB20AC3 (three way), CSB20AC4 (four way).
- C. Switches - Guest Rooms, 120V, 15 A:
 - 1. Specification grade, decorator switch with cushioned thermoplastic paddle to assure smooth, quiet long term operation. Pass & Seymour 2601 or approved equal by Cooper, Hubbell, or Leviton.

2.6 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material: Smooth, high-impact thermoplastic.

2.7 FINISHES

- A. Color: Wiring device catalog numbers in Section text do not designate device color.
 - 1. Wiring Devices: Almond, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- H. Adjust locations of service poles to suit arrangement of partitions and furnishings.

3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 114 to 126 V.
 - 2. Percent Voltage Drop under 15-A Load: A value over 5 percent is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Cartridge fuses rated 600 V and less for use in switches, switchboards, and controllers.

1.3 SUBMITTALS

- A. Product Data: Include the following for each fuse type indicated:
 - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA FU 1.
- D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than **40 deg F (5 deg C)** or more than **100 deg F (38 deg C)**, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: Quantity equal to one percent of each fuse type and size, but no fewer than three of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Bussman, Inc.
 2. Littelfuse, Inc.
 3. Mersen (formerly Ferraz Shawmut, Inc.)

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Service Entrance: Class L time delay or Class J time delay.

- B. Feeders: Class L time delay or Class J time delay.
- C. Motor Branch Circuits: Class J time delay.
- D. Other Branch Circuits: Class J time delay

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Motor-rated toggle switches
2. Fusible switches.
3. Nonfusible switches.
4. Molded-case circuit breakers.
5. Enclosures.
6. Elevator Power Switches

1.3 DEFINITIONS

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. HD: Heavy duty.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current rating.
 - 4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

- B. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 2. Altitude: Not exceeding 6600 feet (2010 m).

1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MOTOR-RATED TOGGLE SWITCHES

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electric Co.; Electrical Distribution & Control Division.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D/Group Schneider.
- B. Manual Switches: Standard toggle switches in surface mounted metallic NEMA enclosure, minimum amperage rating of 20 amps, 1 or 2-pole as required for application.
 - 1. Square D KG series or equal.
- C. Optional Feature: Provide with optional features such as keyed switch operation and pilot light where indicated on Drawings.
- D. Boilers: Toggle switches used as local disconnecting means for boilers shall be capable of being locked in the 'off' position. Provide with handle guard/ lock off option or mount switch in a lockable enclosure and label cover 'BOILER DISCONNECT'.

2.3 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electric Co.; Electrical Distribution & Control Division.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D/Group Schneider.
- B. Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Nonfusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- D. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2.4 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electric Co.; Electrical Distribution & Control Division.

3. Siemens Energy & Automation, Inc.
 4. Square D/Group Schneider.
- B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. GFCI Circuit Breakers: Single- and two-pole configurations with 5 or 30-mA trip sensitivity as indicated on drawings.
- C. Molded-Case Circuit-Breaker Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 4. Ground-Fault Protection: integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

2.5 ELEVATOR POWER SWITCH

- A. Manufacturers:
1. Cooper Bussmann. (PS series)
 2. Littelfuse (LPS series)
 3. Mersen (formerly Ferraz Shawmut) (ES series)
- B. Factory assembled fusible shunt trip switch in NEMA enclosure with all necessary relays, control transformer and options as listed below, as shown on Drawings, and as required to meet functional requirements of local elevator and building codes. Coordinate requirements with elevator equipment supplier and with fire alarm system supplier. Ampere rating shall be per elevator manufacturer requirements and utilize Class J fuses. Features shall include, but not be limited to, the following:
1. Horsepower rated fusible switch with shunt trip capabilities.
 2. 100VA control power transformer with primary and secondary fuses (primary voltage per Drawings, 120 volt secondary).
 3. Fire safety interface relay - 3PDT, 10A, 120V. Coil of isolation relay shall be 120VAC.
 4. Fire Alarm System Interface -Isolation relay to activate shunt trip solenoid. Fire alarm system shall control this relay.
 5. Options:
 - a. Key to test switch.
 - b. Green 'ON' pilot light.

- c. Mechanically interlocked auxiliary contact for hydraulic elevators with automatic recall – 1-pole, NC, 5 amp 120VAC rated.
- 6. Three-pole fire alarm voltage monitor relay (monitors shunt trip voltage).

2.6 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

3.3 IDENTIFICATION

- A. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance testing as follows:
 - 1. Inspect mechanical and electrical connections.
 - 2. Verify switch and relay type and labeling verification.
 - 3. Verify rating of installed fuses.

3.5 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 262816

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

- B. Related Sections include the following:

1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
3. Division 26 Section "Theatrical Lighting" for theatrical lighting fixtures and their controls.

1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CRI: Color-rendering index.
- C. CU: Coefficient of utilization.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.
- G. RCR: Room cavity ratio.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.
 - 2. Emergency lighting units including battery and charger.
 - 3. Ballasts.
 - 4. Energy-efficiency data.
 - 5. Lamps: include life, output, CRI and color temperature for each type.
 - 6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project. Upon request, provide electronic photometric data in IESNA format.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Battery and Charger Data: One for each emergency lighting unit.

4. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fixtures: Refer to the Interior Light Fixture Schedule on drawings for allowable fixture manufacturers. Fixtures must meet requirements noted on drawings and specified below.
- B. Ballasts: Subject to compliance with requirements, provide products by one of the following:
 1. Advance Transformer Company.
 2. K-Tronic N.A., Inc.
 3. Lutron Electronics, Inc.
 4. Osram Sylvania.
 5. Universal Lighting Technologies.
- C. Lamps: Subject to compliance with requirements, provide products by one of the following:
 1. General Electric.
 2. Philips.
 3. Osram Sylvania.
 4. Venture Lightng International, Inc.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to

prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

I. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least **0.125 inch (3.175 mm)** minimum unless different thickness is indicated.
 - b. UV stabilized.
 2. Glass: Annealed crystal glass, unless otherwise indicated.
- J. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. Electronic Ballasts: Comply with ANSI C82.11; instant-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer control is indicated.
1. Sound Rating: A.
 2. Total Harmonic Distortion Rating: Less than 20 percent.
 3. Transient Voltage Protection: IEEE C62.41, Category A or better.
 4. Operating Frequency: 20 kHz or higher.
 5. Lamp Current Crest Factor: 1.7 or less.
 6. BF: between 0.85 and 1.05.
 7. Power Factor: 0.95 or higher.
 8. Input Power (ANSI Watts): Maximum input power for 32-watt T8 lamps are as follows:
 - a. One Lamp: 35 watts.
 - b. Two Lamps: 65 watts.
 - c. Three Lamps: 95 watts.
 - d. Four Lamps: 115 watts.
- B. Electronic Programmed-Start Ballasts for T5 and T5HO Lamps: Comply with ANSI C82.11 and the following:
1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.

2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: A.
 4. Total Harmonic Distortion Rating: Less than 10 percent.
 5. Transient Voltage Protection: IEEE C62.41, Category A or better.
 6. Operating Frequency: 40 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. BF: 0.95 or higher, unless otherwise indicated.
 9. Power Factor: 0.95 or higher.
 10. Input Power (ANSI Watts): Maximum input power for 32watt T8 lamps are as follows:
 - a. One Lamp: 65 watts.
 - b. Two Lamps: 120 watts.
 - c. Three Lamps: 185 watts.
 - d. Four Lamps: 240 watts.
- C. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.
- D. Ballasts for Low-Temperature Environments:
1. Temperatures **0 Deg F (Minus 17 Deg C)** and Higher: Electronic type rated for **0 deg F (minus 17 deg C)** starting and operating temperature with indicated lamp types.
- E. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.
- F. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
1. Dimming Range: 100 to **[10]** **[1]** percent of rated lamp lumens.
 2. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
 3. Total Harmonic Distortion Rating: Less than 10 percent at full output
 4. Transient Voltage Protection: IEEE C62.41, Category A or better.
 5. Operating Frequency: 40 kHz or higher.
 6. Lamp Current Crest Factor: 1.7 or less.
 7. BF: between 0.85 and 1.05.
 8. Power Factor: 0.95 or higher at full output.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Lamp end-of-life detection and shutdown circuit.
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: A.

4. Total Harmonic Distortion Rating: Less than 20 percent.
 5. Transient Voltage Protection: IEEE C62.41, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. BF: 0.95 or higher, unless otherwise indicated.
 9. Power Factor: 0.95 or higher.
 10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 11. Ballast Case Temperature: 75 deg C, maximum.
- B. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
1. Dimming Range: 100 to 5 percent of rated lamp lumens.
 2. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

2.5 EMERGENCY FLUORESCENT POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
1. Emergency Connection: Operate one or more fluorescent lamp(s) continuously at a total output of 1000 lumens minimum. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
 2. Night-Light Connection: Operate one fluorescent lamp continuously.
 3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 4. Battery: Sealed, maintenance-free, nickel-cadmium type.
 5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

2.6 BALLASTS FOR HID LAMPS

- A. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
1. Lamp end-of-life detection and shutdown circuit.
 2. Sound Rating: A.
 3. Total Harmonic Distortion Rating: Less than 15 percent.
 4. Transient Voltage Protection: IEEE C62.41, Category A or better.
 5. Lamp Current Crest Factor: 1.5 or less.
 6. Power Factor: 0.90 or higher.

7. Protection: Class P thermal cutout.
- B. Auxiliary Instant-On Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent light output.

2.7 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.8 EMERGENCY LIGHTING UNITS

- A. Description: Self-contained units complying with UL 924.
1. Battery type as scheduled.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures. Provide this option where indicated on drawings.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage. Provide this option where indicated on drawings.
8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.9 FLUORESCENT LAMPS

- A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
- B. T8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of **48 inches (1220 mm)**, 2800 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life 20,000 hours, unless otherwise indicated.
- C. T8 rapid-start low-mercury lamps, rated 17 W maximum, nominal length of **24 inches (610 mm)**, 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life of 20,000 hours, unless otherwise indicated.
- D. T5 rapid-start low-mercury lamps, rated 28 W maximum, nominal length of **45.2 inches (1150 mm)**, 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life of 20,000 hours, unless otherwise indicated.
- E. T5HO rapid-start, high-output low-mercury lamps, rated 54 W maximum, nominal length of **45.2 inches (1150 mm)**, 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life of 20,000 hours, unless otherwise indicated.
- F. Compact Fluorescent Lamps: 4-Pin, low mercury, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at 3 hours operation per start, and suitable for use with dimming ballasts, unless otherwise indicated.
 1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
 5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
 6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).

2.10 HID LAMPS

- A. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65, and color temperature 4000 K.
- B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.
- C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.

2.11 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Suspended fluorescent direct/indirect and direct fixtures in finished space: Suspend fixtures with manufacturer's standard aircraft cable system unless noted otherwise. Feed fixtures with manufacturer's standard SO cable.
- C. Suspended industrial troffers in unfinished spaces: Suspend fixtures with chains unless noted otherwise.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, **12 gage (2.68 mm)**.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, **12 gage (2.68 mm)**.
- F. Rod Hangers: **3/16-inch (5-mm)** minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Do not use grid as a support element.
 1. Install ceiling support system wires at a minimum of 2 wires connected directly to each fixture, located not more than 6 inches (150 mm) from opposite fixture corners. Provide additional supports if required by local code or the local authority having jurisdiction.
 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two **3/4-inch (20-mm)** metal channels spanning and secured to ceiling tees.
- C. Suspended Lighting Fixture Support:
 1. Pendants and Rods: Where longer than **48 inches (1200 mm)**, brace to limit swinging.
 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

- D. Adjust aimable lighting fixtures to provide required light intensities.
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

END OF SECTION 265100

SECTION 283111 – FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Fire-alarm control panel.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Firefighters' two-way telephone communication service.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.

- B. The existing fire alarm system shall be removed in its entirety.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

- A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 SUBMITTALS

- A. General Submittal Requirements:
 1. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified fire-alarm technician, Level III minimum.

- B. Product Data: For each type of product indicated.
- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 - 2. Include voltage drop calculations for notification appliance circuits.
 - 3. Include battery-size calculations.
 - 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 - 6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 - 7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
- D. Qualification Data: For qualified Installer.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 - 3. Record copy of site-specific software.
 - 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
 - 5. Manufacturer's required maintenance related to system warranty requirements.
 - 6. Abbreviated operating instructions for mounting at fire-alarm control panel.
 - 7. Copy of NFPA 25.
- G. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittal Procedure" make an identical submittal to the authorities having jurisdiction. To facilitate review, include copies of annotated Contract

Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. Upon receipt of comments from authorities having jurisdiction, submit a copy of comments and approval to the Engineer for review.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
- C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for one year.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within one year from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide two weeks notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
 - 2. Smoke Detectors: Quantity equal to 5 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 3. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 4. Keys and Tools: One extra set for access to locked and tamperproofed components.
 - 5. Audible and Visual Notification Appliances: One of each type installed.
 - 6. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide systems approved by Marriott and on the following list. Systems listed below, not approved by Marriott are not acceptable:
 - 1. Edwards Systems Technology; a division of GE Infrastructure
 - 2. Gamewell / FCI, a Honeywell company.
 - 3. NOTIFIER; a Honeywell company.
 - 4. Siemens Building Technologies, Inc.; Fire Safety Division.
 - 5. SimplexGrinnell LP; a Tyco International company.
- B. Manufacturers: Subject to compliance with requirements, provide notification devices by one of the following:
 - 1. One of the system manufacturers listed above.
 - 2. Gentex Corporation
 - 3. Whealock Inc
- C. Manufacturers: Subject to compliance with requirements, provide digital alarm communicator transmitters by one of the following:
 - 1. One of the systems manufacturers listed above.
 - 2. Silent Knight.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors in other than guest rooms and suites.
 - 4. Duct smoke detectors.
 - 5. Automatic sprinkler system water flow.
 - 6. Heat detectors in elevator shaft and pit.
 - 7. Fire-extinguishing system operation.
- B. Smoke detectors in guest rooms shall initiate the following:
 - 1. Audible signal via the sounder base. For guest room and suites equipped with more than one smoke detector, all sounder base shall activate if one detector senses smoke.
 - 2. Visual signal via strobes in rooms and suites equipped with strobes.
 - 3. Trouble signal at the fire alarm control panel and annunciator. If the trouble signal is not acknowledged within a time period acceptable to the authority having jurisdiction, a general fire-alarm signal shall be initiated.
- C. Fire-alarm signal shall initiate the following actions:
 - 1. Continuously operate alarm notification appliances, including devices within suites. Note sounder bases within suites shall annunciate upon general fire-alarm signal.
 - 2. Identify alarm at fire-alarm control panel and the remote annunciator.

3. Transmit an alarm signal to the remote alarm receiving station.
 4. Unlock electric door locks in designated egress paths.
 5. Release fire and smoke doors held open by magnetic door holders.
 6. Activate voice/alarm communication system for the level containing the device initiating the alarm and levels below and above the level containing the device initiating the alarm.
 7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 8. Recall elevators to primary or alternate recall floors.
 9. Record events in the system memory.
- D. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. Elevator shunt-trip supervision.
- E. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of primary power at fire-alarm control panel.
 4. Ground or a single break in fire-alarm control panel internal circuits.
 5. Abnormal ac voltage at fire-alarm control panel.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at fire-alarm control panel or annunciator.
 9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
- F. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control panel and remote annunciator.

2.3 FIRE-ALARM CONTROL PANEL

- A. General Requirements for Fire-Alarm Control Panel:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
 - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control panel and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 1. Announcer and Display: Liquid-crystal type, 2 line(s) of 80 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- C. Circuits:
 1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
 - a. Initiating Device Circuits: Style B.
 - b. Notification Appliance Circuits: Style Y.
 - c. Signaling Line Circuits: Style 4.
 - d. Install no more than 50 addressable devices on each signaling line circuit.
 2. Serial Interfaces: Two RS-232 ports for printers.
- D. Smoke-Alarm Verification:
 1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control panel.
 2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control panel and detector.
 3. Record events by the system printer.
 4. Sound general alarm if the alarm is verified.
 5. Cancel fire-alarm control panel indication and system reset if the alarm is not verified.
- E. Notification Appliance Circuit: Operation shall play digitally recorded messages that are acceptable to the authority having jurisdiction..
- F. Elevator Recall:
 1. Smoke detectors at the following locations shall initiate automatic elevator recall.
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
 - c. Smoke detectors in elevator hoistway.
 2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
 3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.

- a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.
- H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- I. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided in a separate cabinet located in the fire command center.
 - 1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
 - a. Allow the application of an evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
 - d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control panel.
 - 2. Status Announcer: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
 - 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- J. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals and digital alarm communicator transmitters shall be powered by 24-V dc source.
 - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- K. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 - 1. Batteries: Sealed lead calcium or sealed, valve-regulated, recombinant lead acid.
- L. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control panel.
 2. Station Reset: Key- or wrench-operated switch.

2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
4. Guest room and suite smoke detectors shall be system detectors equipped with audible sounder bases.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

- B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control panel and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control panel, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

- C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control panel and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control panel, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.

- c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
- 3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
 - 4. Each sensor shall have multiple levels of detection sensitivity.
 - 5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
 - 6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control panel.

2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
 - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
 - 1. Rated Light Output:
 - a. As required by NFPA 72 to provide coverage of the space served.
 - 2. Mounting: Wall mounted unless otherwise indicated.
 - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - 4. Flashing shall be in a temporal pattern, synchronized with other units.
 - 5. Strobe Leads: Factory connected to screw terminals.
 - 6. Mounting Faceplate: Factory finished, white.
- C. Voice/Tone Notification Appliances:

1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
2. High-Range Units: Rated 2 to 15 W.
3. Low-Range Units: Rated 1 to 2 W.
4. Mounting: Semi-recessed.
5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.8 FIREFIGHTERS' TWO-WAY TELEPHONE COMMUNICATION SERVICE

- A. Dedicated, two-way, supervised, telephone voice communication links between fire-alarm control panel in the fire command center and remote firefighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module. Provide the following:
1. Common-talk type for firefighter use only.
 2. Selective-talk type for use by firefighters and fire wardens.
 3. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously.
 4. Audible Pulse and Tone Generator, and High-Intensity Lamp: When a remote telephone is activated, it causes audible signal to sound and high-intensity lamp to flash.
 5. Selector panel controls shall provide for simultaneous operation of up to six telephones in selected zones. Indicate ground faults and open or shorted telephone lines on the panel front by individual LEDs.
 6. Display: Liquid-crystal digital to indicate location of caller.
 7. Remote Telephone Cabinet: Flush- or surface-mounted cabinet as indicated, factory-standard red finish, with handset.
 - a. Install one-piece handset to cabinet with vandal-resistant armored cord. Silk-screened or engraved label on cabinet door, designating "Fire Emergency Phone."
 - b. With "break-glass" type door access lock.
 8. Remote Telephone Jack Stations: Single-gang, stainless-steel-plate mounted plug, engraved "Fire Emergency Phone."
 9. Handsets: push-to-talk-type sets with noise-canceling microphone stored in a cabinet adjacent to fire-alarm control panel in the fire command center.

2.9 MAGNETIC DOOR HOLDERS

- A. Magnetic door hold open devices are furnished with door hardware under division 8. Coordinate voltage with division 8 door hardware supplier.

2.10 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control panel for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control panel, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.
 - B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control panel. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.
- 2.11 ADDRESSABLE INTERFACE DEVICE
- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
 - B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.
- 2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER
- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
 - B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control panel and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
 - C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 1. Verification that both telephone lines are available.
 2. Programming device.
 3. LED display.
 4. Manual test report function and manual transmission clear indication.
 5. Communications failure with the central station or fire-alarm control panel.
 - D. Digital data transmission shall include the following:
 1. Address of the alarm-initiating device.
 2. Address of the supervisory signal.
 3. Address of the trouble-initiating device.
 4. Loss of ac supply or loss of power.
 5. Low battery.
 6. Abnormal test signal.
 7. Communication bus failure.
 - E. Secondary Power: Integral rechargeable battery and automatic charger.

- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.
- 1.

2.13 WIRE AND CABLE

- A. Wire and cable fire fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits traveling from the FACP through a zone or zones other than the zone served: Twisted, shielded pair, NFPA 70 Article 760, Classification CI, for power-limited fire alarm signal service. UL listed as Type FPL or FPLP, and complying with requirements in UL 1424 and UL 2196 for a 2-hour rating.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 1. Low-Voltage Circuits: No. 16 AWG, minimum
 2. Line-Voltage Circuits: No. 12 AWG, minimum.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways meeting the requirements for branch circuit wiring as specified in Division 26 Section "Raceways and Boxes for Electrical Systems:" in all locations except as follows:
 1. Cable is not required to be installed in raceway where concealed in an accessible space above finished ceilings. Install plenum cable in environmental air spaces, including plenum ceilings. Provide sleeves as specified in Division 26 Section "Common Work Results for Electrical Systems" where cable passes through walls. See Open-Cable Installation below.
- B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF RACEWAYS

- A. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- B. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.

B. General Requirements:

1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Splices allowed only where extending existing cable.
3. Secure and support cables at intervals not exceeding 60 inches (1520 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.

C. Open-Cable Installation.

1. Utilize cable tray where available.
2. Suspend cable not in a cable tray or pathway a minimum of 6 inches (200 mm) above ceiling by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
4. Route cable parallel or perpendicular to building structure.

3.4 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control panel on finished floor with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
- C. Smoke- or Heat-Detector Spacing:
 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 3. Smooth ceiling spacing shall not exceed 30 feet maximum or less as recommended by the system manufacturer.
 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.
 5. HVAC: Locate detectors not closer than 3feet from air-supply diffuser or return-air opening.
 6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

- D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- E. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- F. Guest room and suite smoke Detectors: Where more than one smoke alarm is installed within a guest room or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- G. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- H. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install speakers on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.
- J. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- K. Fire-Alarm Control Panel: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
- L. Annunciator: Install such that center of display is approximately 54-inches AFF.

3.5 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 2. Alarm-initiating connection to elevator recall system and components.
 - 3. Supervisory connections at valve supervisory switches.
 - 4. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
 - 5. Supervisory connections at fire-pump engine control panel.

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control panel.

3.7 GROUNDING

- A. Ground fire-alarm control panel and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control panel.

3.8 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by the authority having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

- G. Prepare test and inspection reports.
- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

SECTION 316323 - MICROPILES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This specification, along with the drawings, encompasses the furnishing of all designs, materials, products, accessories, tools, equipment, services, transportation, and labor and supervision, required for testing and installing of micropiles and pile-top attachments. The micropile contractor shall be responsible for installation means and methods. The micropile load capacities shall be verified by verification and proof load testing and must meet the acceptance criteria specified herein.

1.3 UNIT PRICES

- A. Comply with requirements of Section 012200 "Unit Prices."
- B. Basis of Bids: Bids shall be a lump sum based on number of piles, design length from top elevation to estimated rock elevation shown on Drawings plus the required rock embedment depth which shall be determined by the specialty contractor based on the loading conditions.
- C. Basis for Payment: Payment for micropiles will be made on net length of micropiles in place and accepted. The actual length may vary to coincide with elevations where satisfactory bearing strata are encountered, and with actual bearing value of bearing strata determined by testing services, and with stability characteristics of soil strata. Adjustments will be made on net variation of total length, based on elevations provided on Drawings.
- D. There will be no additional compensation for excavation, concrete fill, reinforcing, casing, or other costs due to unauthorized over excavation. No payment will be made for rejected micropiles.
- E. Prices quoted include full compensation for labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casing, dewatering, reinforcement, concrete, and other items for complete installation.
- F. Unit Prices: Provide unit prices for the following items in accordance with the requirements of Section 012200 "Unit Prices," will apply in event additions to or deductions from Work are required and authorized by written order from Architect to Contractor.
 1. Uncased Micropiles: Uncased micropile (per linear foot) including all materials and excavation.

2. Cased Micropiles: Cased micropile (per linear foot) including all materials and excavation.
3. Pile Load Tests: Additional Pile Load Tests (per pile).

1.4 SUBMITTALS

- A. The Contractor shall prepare and submit shop drawings for review and approval for the micropile system or systems intended for use at least 14 calendar days prior to planned start of construction.
- B. Detailed description of the construction procedures proposed for use. This shall include a schedule of major equipment resources. If the Contractor uses a post-grouting system, all relevant details including grouting pressure, volume, location and mix design, shall be submitted.
- C. Calibration reports for each test jack, pressure gauge, and master pressure gauge to be used. The calibration tests shall have been performed by an independent testing laboratory and tests shall have been performed within one year of the date submitted.
- D. The Contractor shall submit certified mill test reports, properly marked, for the reinforcing steel, to the Owner for record purposes. The ultimate strength, yield strength, elongation, and material properties composition shall be included. For steel pipe used as permanent casing, or core steel, the Contractor shall submit a minimum of two representative coupon tests or mill certifications (if available).
- E. Shop Drawings: For micropiles. Show fabrication and installation details for piles, including splices and top details.
 1. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 2. Indicate locations, sizes, type, and arrangement of reinforcement.
 3. Include arrangement of static pile reaction frame, test and anchor piles, equipment, and instrumentation. Submit structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 4. Plans indicating micropile number, location, pattern, design load, minimum total bond length, total length, grouting volumes and maximum pressures, micropile attachment and cut-off elevation
- F. Material Certificates: For the following, from manufacturer:
 1. Cementitious materials.
 2. Admixtures.
 3. Steel reinforcement and accessories.
 4. Steel casing and accessories.
- G. Material Test Reports: For concrete materials
- H. Static Pile Test Reports: Submit within three days of completing each test.
- I. Qualification Data: For qualified installer, professional engineer and testing agency.

J. Other Informational Submittals:

1. Record drawings showing the location of the piles, their depth and inclination, and details of their composition.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: The micropile contractor shall be fully experienced in all aspects of micropile design and construction, and shall furnish all necessary plant, materials, skilled labor, and supervision to carry out the contract. The contractor will have successfully completed at least five projects in the previous five years of similar scope and size.
- B. Testing Agency Qualifications: Qualified According to ASTM C 1077, ASTM D 3740, and ASTM E 329 for testing indicated.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/AWSD1.1M, Structural Welding Code – Steel.
 2. AWS D1.4, Structural Welding Code – Reinforcing Steel.

1.6 DEFINITIONS

- A. Admixture: Substance added to the grout to either control bleed and/or shrinkage, improve flowability, reduce water content, retard setting time, or resist washout.
- B. Alignment Load (AL): A nominal load applied to a micropile during testing to keep the testing equipment correctly positioned.
- C. Apparent Free Micropile Length: The length of pile which is apparently not bonded to the surrounding ground, as calculated from the elastic load extension data during testing.
- D. Bond Breaker: A sleeve or coating placed over the steel reinforcement to prevent load transfer.
- E. Bonded Length: The length of the micropile that is bonded to the ground and which is conceptually used to transfer the applied axial loads to the surrounding soil or rock. Also known as the load transfer length.
- F. Casing: Steel pipe introduced during the drilling process to temporarily stabilize the drill hole. Depending on the details of the micropile construction and composition, this casing may be fully extracted during or after grouting, or may remain partially or completely in place, as part of the final pile configuration or as required by drawings or engineering direction.
- G. Centralizer: A device to centrally locate the reinforcing element(s) within the borehole.
- H. Contractor: The person/firm responsible for performing the micropile work.
- I. Coupler: The means by which the load can be transmitted from one partial length of reinforcement to another.

- J. Creep Movement: The movement that occurs during the creep test of a micropile under a constant load.
- K. Design Load (DL): Anticipated final maximum service load in the micropile.
- L. Elastic Movement: The recoverable movement measured during a micropile test.
- M. Free (Unbonded) Length: The designed length of the micropile that is not bonded to the surrounding ground or grout during testing.
- N. Micropile: A small diameter, bored, cast-in-place pile, in which most of the applied load is resisted by the steel reinforcement.
- O. Overburden: Non-lithified material, natural or placed, which normally requires cased drilling methods to provide an open borehole to underlying strata.
- P. Post Grouting: The injection of additional grout into the load transfer length of a micropile after the Primary grout has set. Also known as regROUTing or secondary grouting.
- Q. Primary Grout: Portland cement based grout that is injected into the micropile hole prior to or after the installation of the reinforcement to provide the load transfer to the surrounding ground along the micropile and affords a degree of corrosion protection in compression.
- R. Proof Test: Incremental loading of a micropile, recording the total movement at each increment.
- S. Reinforcement: The steel component of the micropile which accepts and/or resists applied loadings.
- T. Safety Factor: The ratio of the ultimate capacity to the working load used for the design of any component or interface.
- U. Test Load (TL): The maximum load to which the micropile is subjected during testing.
- V. Tremie Grouting: The placing of grout in a borehole via a grout pipe introduced to the bottom of the hole. During grouting, the exit of the pipe is kept at least 10 feet below the level of the grout in the hole.
- W. Type A-D: Classification of micropiles based on method and pressure of grouting (see FHWA, 1997).
- X. Working Load: Equivalent term for Design Load.

1.7 ALLOWABLE TOLERANCES

- A. Centerline of piling shall not be more than 3 inches from indicated plan location.
- B. Plumbness of micropile shall be within 2% of the total length off vertical in any direction.
- C. Top of pile elevation shall be within +1/2 inch to -1/2 inch of the design vertical datum.
- D. Centerline of core reinforcement shall not be more than 3/4 inch from centerline of piling.

1.8 DESIGN CRITERIA

- A. The micropiles shall be designed to meet the specified loading and movement conditions as shown on the Drawings. The calculations and drawings required from the Contractor shall be submitted to the Owner for review and acceptance in accordance with "Submittals".
- B. The micropile top attachment shall effectively distribute the design load (DL) to the concrete footing, such that the concrete bearing stress does not exceed those in the ACI Building Code and the bending stress in the steel plates does not exceed AISC Allowable stresses for steel members.

1.9 GROUND CONDITIONS

- A. The test borings as shown on the boring location plan and logs of borings as described in the Geotechnical Report are believed to be representative of the conditions likely to be encountered on the site, and are to be used as the basis for micropile design in conjunction with the appropriate levels of engineering judgment and experience.
- B. Survey Work: Engage a qualified land surveyor to perform surveys, layouts, and measurements for micropiles. Before excavating, lay out each micropile to lines and levels required. Record actual measurements of each micropile's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data. Record and maintain information pertinent to each micropile and cooperate with the owners testing and inspecting agency to provide data for required reports.

1.10 REFERENCED CODES AND STANDARDS

A. Publications:

1. The following publications form a part of this specification to the extent indicated by the specific citations in other paragraphs of this Specification. In case of conflict, the particular requirements of this specification shall prevail. The latest publication as of the issue of this specification shall govern, unless indicated otherwise.
 - a. American Society for Testing and Materials (ASTM)
 - b. American Association of State Highway and Transportation Officials (AASHTO)

ASTM	AASHTO	SPECIFICATION
A36	M183, M223	Structural Steel
A82	M55	Cold-Drawn Steel Wire for Concrete Reinforcement
A252	---	Welded and Seamless Steel Pipe Piles
A615	M31	Deformed and Plain Billet Steel Bars for Concrete Reinforcement
A722	M275	Uncoated High-Strength Steel Bar for Prestressing Concrete
A775	M282	Electrostatic Epoxy Coating
C33	M80	Concrete Aggregates
C109	T106	Compressive Strength of Hydraulic Cement Mortar
C188	T133	Density of Hydraulic Cement
D3966	---	Standard Test Method for Piles Under Lateral Load

D1784	---	Polyvinyl Chloride (PVC) Pipe (Class 13464-B)
C144	M45	Aggregates for Masonry Mortar
C150	M85	Portland Cement
C494	M194	Chemical Admixtures for Concrete
D1143	---	Method of Testing Piles Under Static Axial Compressive Load
D3350	M252	Polyethylene Corrugated Tubing
D3689	---	Method of Testing Individual Piles Under Static Axial Tensile Load
---	T26	Quality of Water to be Used in Concrete

c. American Welding Society (AWS):

D1.1	Structural Welding Code – Steel
D1.2	Structural Welding Code – Reinforcing Steel

PART 2 - PRODUCTS

2.1 WATER

- A. Water for mixing grout shall be potable, clean and free from substances which may be in any way deleterious to grout or steel.

2.2 ADMIXTURES

- A. Admixtures shall conform to the requirements of ASTM C494. Admixtures which control bleed, improve flowability, reduce water content, and retard set may be used in the grout. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations. Admixtures with chlorides shall not be permitted.

2.3 CEMENT

- A. All cement shall be Portland cement conforming to ASTM C150 Type I, Type II, or Type III, and shall be the product of one manufacturer. If the brand or type of cement is changed during a project, additional grout mix tests shall be conducted to ensure consistency of quality and performance in situ.

2.4 FILLERS

- A. Inert fillers such as sand may be used in the grout.

2.5 BAR REINFORCEMENT

- A. Reinforcing steel shall be deformed bars in accordance with ASTM A615 Grade 60 or Grade 75 or ASTM A722 Grade 150.

- B. For cases of tensile loading, bar couplers, if required, shall develop the ultimate tensile stress of the bar, without any evidence of failure. For compressive loading, the coupler shall be compatible with efficient load transfer and overall reinforcement performance requirements.

2.6 PIPE/CASING

- A. If the casing is to be relied upon to carry loads, the permanent steel casing/pipe/Round HSS:
1. Shall meet the requirements of ASTM A500, Grade B (or better) or ASTM A53, Grade B (or better) and meet the structural design requirements outlined in the design submittal.

2.7 PLATES AND SHAPES

- A. Structural steel plates and shapes for pile top attachments shall conform to ASTM A36 or ASTM A 572 Grade 50.

2.8 CENTRALIZERS

- A. Centralizers shall be fabricated from plastic, steel, or material that is non-detrimental to the reinforcing steel. Wood shall not be used.

2.9 CONCRETE MIXES

- A. Prepare concrete design mixes according to ACI 301, determined by either laboratory trial batch or field test data basis.
1. Use a qualified testing agency for preparing and reporting proposed mix designs determined by laboratory trial batch.
- B. Proportion mixes according to ACI 301 to provide a stable, homogenous neat cement grout or a sand cement grout suitable for micropiles with the following properties:
1. Compressive Strength (28 Days): 4000 psi.
- C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- E. Concrete-mix design adjustments may be considered if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant. Resubmit and obtain approval from Architect of proposed changes to concrete-mix proportions.

PART 3 - EXECUTION

3.1 PREPERATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by micropile operations.

3.2 EXCAVATION

- A. Unclassified Excavation: Excavate to bearing elevations regardless of character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.
 - 1. Obstructions: Unclassified excavated materials may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. Payment for removing obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work will be according to Contract provisions for changes in the Work.
- B. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.
- C. Excavate shafts for micropiles to indicated elevations. Remove loose material from bottom of excavation.
 - 1. Excavate bottom of micropiles to level plane within 1:12 tolerance.
 - 2. Remove water from excavated shafts before grouting.
 - 3. Excavate rock sockets to design dimensions as designed by specialty contractor.
- D. Notify and allow testing and inspecting agency to test and inspect excavation. If unsuitable bearing stratum is encountered, make adjustments to micropiles as required.
 - 1. Payment for additional authorized excavation will be according to Contract provisions for changes in the Work.

3.3 INSTALLATION

- A. The micropile installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project. The micropile contractor shall select the drilling method and the grouting procedures used for the installation of the micropiles.
- B. The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered. The borehole must be open to the defined nominal diameter, full length, prior to placing grout and reinforcement.
- C. All installation techniques shall be determined and scheduled such that there will be no interconnection or damage to piles in which grout has not achieved final set.

- D. Centralizers shall be provided at 10 feet maximum vertical spacing to ensure the central reinforcement is located in the center of the pile for the entire length. The uppermost centralizer shall be located a maximum of 5 feet from the top of the micropile. Centralizers shall permit the free flow of grout without misalignment of reinforcement.
- E. The central reinforcement steel with centralizers shall be lowered into the stabilized drill holes to the desired depth without difficulty. Partially inserted reinforcing bars shall not be driven or forced into the hole such that there will be no interconnection or damage to piles in which the grout has not achieved final set.
- F. The Contractor shall check pile top elevations and adjust all installed micropiles to the planned elevations.

3.4 GROUTING

- A. The Contractor shall provide systems and equipment to measure the grout quality, quantity during the grouting operations.
- B. The Contractor shall provide a stable, homogenous, neat cement grout or a sand cement grout with a minimum 28-day unconfined compressive strength of 4000 psi. The grout shall not contain lumps or any other evidence of poor or incomplete mixing. Admixtures, if used, shall be mixed in accordance with manufacturer's recommendations. The pump shall be equipped with a pressure gauge to monitor grout pressures. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The grout should be kept in constant agitation prior to pumping.
 - 1. The grout shall be injected from the lowest point of the drill hole (by tremie methods) until clean, pure grout flows from the top of the micropile. The tremie grout may be pumped through grout tubes, hollow stem augers, or drill rods. Subsequent to tremie grouting, all grouting operations associated with, for example, extraction of drill casing and pressure grouting, must ensure complete continuity of the grout column.
 - 2. Grout within the micropiles shall be allowed to attain the minimum design strength prior to being loaded.

3.5 PILE SPLICES

- A. Pile splices shall be constructed to develop the theoretical design strength of the pile section.
- B. Lengths of casing and reinforcing steel to be spliced shall be secured in proper alignments and in such a manner that no eccentricity between the axes of the two lengths spliced or angle between them results.

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 - 1. Micropile installation.
 - 2. Excavation.

3. Grouting.
 4. Steel reinforcement placement.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Micropile Tests and Inspections: Observe drilling operations and maintain complete and accurate records for each element.
- D. Grout Tests and Inspections:
1. Test results for the proposed grout mix completed within one year of the start of work may be submitted for initial verification of the required compressive strengths for installation of preproduction verification test piles and initial production piles. During production, micropile grout shall be tested for compressive strength in accordance with AASHTO T106/ASTM C109 at a frequency of no less than one set of three 50-mm grout cubes from each grout plant each day of operation or per every 10 piles, whichever occurs more frequently. The compressive strength shall be the average of the 2 cubes tested. Grout consistency as measured by grout density shall be determined per ASTM C 188/AASHTO T 133 or API RP-13B-1 at a frequency of at least one test per pile, conducted just prior to start of pile grouting. The Baroid Mud Balance used in accordance with API RP-13B-1 is an approved device for determining the grout density of neat cement grout. Grout samples shall be taken directly from the grout plant.
 2. Tests two cubes each at 3, 7, and 28 days after grouting.
 3. Strength of each grout mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi. The minimum compressive strength shall be as specified in the structural design calculations submitted by the Contractor for the micropiles.
 4. Report test results in writing to owner, concrete manufacturer, and Contractor within 48 hours of testing. List Project identification name and number, date of grout placement, name of grout testing and inspecting agency, location of grout batch in Work, design compressive strength at 3, 7, and 28 days, grout mixture proportions and materials and compressive breaking strength.
 5. Additional Tests: Testing and inspecting agency will make additional tests of concrete if test results indicate that consistency, compressive strengths, or other requirements have not been met.
 6. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
 7. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. An excavation, grout, or a micropile will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports for each micropile as follows:
1. Actual top and bottom elevations.
 2. Actual pile diameter at top and bottom.
 3. Micropile designation.
 4. Description, location, and dimensions of any obstructions.
 5. Cased or uncased.
 6. Top of rock elevation.

7. Final top centerline location and deviations from requirements.
8. Variation of shaft from plumb.
9. Shaft excavation method.
10. Depth of rock socket.
11. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
12. Date and time of starting and completing excavation.
13. Condition of reinforcing steel and splices.
14. Position of reinforcing steel.
15. Grout placing method and delays.
16. Grout volume.
17. Grout testing results.
18. Remarks, unusual conditions encountered, and deviations from requirements.

3.7 PILE LOAD TESTS

A. Pre-Production Pile Tests:

1. Pile load tests shall be performed to verify the adequacy of the design of the pile system, and the proposed construction procedures prior to installation of production piles. One sacrificial test piles with dead weight, reaction piles, or ground anchors shall be constructed immediately prior to the commencement of the installation of the production micropiles. The Owner shall determine the number of piles, their location, acceptable load and movement criteria, and the type(s) of loading direction.
2. The Contractor shall submit for review and acceptance the proposed micropile load testing procedure. The testing program shall be provided two weeks prior to starting the load testing. This micropile verification load testing proposal shall be in general conformance with ASTM D-1143 +/or D-3689.
3. If the micropile load test fails to meet the design requirements, the cause(s) shall be established, and the Contractor shall modify the micropile design and/or installation methods as appropriate. Additional testing shall be performed as deemed appropriate by the engineer of record for the micropiles.
4. These micropile load test results shall verify the suitability of the Contractor's design and installation methods.
5. The drilling and grouting methods, casing and other reinforcement details, and depth of embedment for the test pile shall be identical to the production piles, except where approved otherwise by the Owner.
6. The tested micropiles shall be loaded to 200% of the compression (200% of the tension) design load (DL) (i.e., 2.0 DL). Piles shall be tested under compression loads prior to testing under tension loads. An Alignment Load (AL if required) shall be applied to the pile prior to setting the movement recording devices. This Alignment Load shall be no more than 10% on Design Load (i.e., 0.1 DL): dial gauges shall be zeroed at the first setting of AL.
7. Contractor shall submit a proposed axial pile load test sequence (load increments and hold times) for Owner review.
8. Measurement of pile movement shall be obtained at each increment. The load hold period shall start as soon as the test load is applied and the pile movement, with respect to a fixed reference, shall be measured and recorded at 1 minute, 2, 3, 4, and 5, and 10 minutes (load cycle maxima only).
9. The acceptance criteria for micropile verification load tests are:

- a. The pile shall sustain the compression and tension design capacities (1.0 DL) with no more than 0.5 in. plus the elastic compression of the pile in total vertical movement at the top of the pile as measured relative to the top of the pile prior to the start of testing.
 - b. Test piles shall have a creep rate at the end of the 150% DL increment which is not greater than 0.040 in./log cycle time from 1 to 10 minutes or 0.080 in./log cycle time from 6 to 60 minutes and has a linear or decreasing creep rate.
 - c. Failure does not occur at the 2.0 DL maximum compression and tension loads. Failure is defined as a slope of the load versus deflection (at end of increment) curve exceeding 0.025 inches/kip.
10. The Contractor will provide the Owner a written report confirming micropile geometry and construction details within 7 working days after the completion of the pre-production tests. This written confirmation will either confirm the bond lengths as shown in the drawings for micropiles or propose modifications based upon the results of the verification tests.
 11. When a micropile fails to meet the acceptance criteria, modifications shall be made to the design, the construction procedures, or both. These modifications include, but are not limited to, installing replacement micropiles, modifying the installation methods, increasing the bond length, regROUTing via pre-placed re-grout tubes, or changing the micropile type. Any modification which requires changes to the structure shall have prior review and acceptance of the Owner and engineer of record for the micropiles.

3.8 PRODUCTION PILE TESTING

- A. The Contractor shall proof test additional production micropiles if requested by the Owner. At the Contractor's suggestion, but with the Owner's concurrence, tension tests may be performed based to maximum DL in compression or tension for friction piles with sufficient structural tension capacity.
- B. The test sequence shall be the same as was approved for pre-production test piles.
- C. The acceptance criteria for micropile proof load tests are:
 1. The pile shall sustain the compression and tension design capacities (1.0 DL) with no more than 0.5 in. plus the elastic compression of the pile in total vertical movement at the top of the pile as measured relative to the pile prior to the start of testing.
 2. Test piles shall have a creep rate at the end of the 130% DL increment which is not greater than 0.040 in./log cycle time from 1 to 10 minutes or 0.080 in./log cycle time from 6 to 60 minutes and has a linear or decreasing creep rate.
- D. If a micropile that is proof tested fails to meet the acceptance criteria, the contractor shall be directed to proof test another micropile in the vicinity. For failed piles and further construction of other piles, the Contractor shall modify the design, the construction procedure, or both. These modifications include, but are not limited to, installing replacement micropiles, incorporating piles of reduced load capacities, modifying the installation methods, increasing the bond length, or changing the micropile type. Any modification which requires changes to the structure shall have prior review and acceptance of the Owner. Any modifications of design or construction procedures shall be at the Contractor's expense.

AQUA WAIKIKI WAVE
BUILDING PACKAGE

34-14102-00
FOR REVIEW - NOT FOR CONSTRUCTION

END OF SECTION 316319