

BATTERY PARK CITY AUTHORITY
SPECIFICATIONS FOR POLICE MEMORIAL - SUPERSTORM SANDY

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5/17/2013

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SECTION 02201
EARTHWORK

PART 1 - GENERAL**1.01 DESCRIPTION OF WORK**

- A. Remove all items designated to be removed and excavate for new construction, fill and backfill as required, prepare subgrades and place aggregate bases for pavements. Protect existing vegetation and all adjoining properties and existing structures from damage.

1.02 RELATED SECTIONS

- A. Asphaltic Concrete Paving.....Section 02511

1.03 REFERENCES

References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

- A. American Society of Testing and Materials (ASTM) standards, latest editions.
- B. United States Department of Labor (USDOL), Occupational Safety and Health Administration (OSHA):

29 CFR 1910, Occupational Safety and Health Standards
- G. All Applicable New York City Department of Environmental Protection (NYCDEP) Rules and Regulations
- H. All applicable New York City Department of Transportation (NYCDOT), Department of Sanitation (NYCDOS), Department of Buildings (NYCDOB), and Transit Authority (NYCTA) Rules and Regulations

1.04 DEFINITIONS**A. Excavation**

Excavation is considered unclassified and consists of removal of material encountered to contract level, stockpiling, testing, loading, handling, transporting and subsequent legal disposal of such.

B. Improvements

Man-produced items such as concrete, brick, asphalt, piping, etc. Those items not naturally occurring.

C. Non-Hazardous Excavated Material

Material that may include or contain mixtures of the following: soil (including, but not limited to, natural undisturbed material), debris, concrete and concrete products (including steel or fiberglass reinforcing rods that are embedded in the concrete), asphalt pavement, brick, glass, rock, municipal solid waste, refuse, and incidental ash. This material includes material defined in Title 6 New York Code of Rules and Regulations 360-7.1(b)(1)(i) and will exceed 6 NYCRR 375-6 Unrestricted Use and Restricted Use Soil Cleanup Objectives and NYSDEC CP-51: Soil Cleanup Guidance Supplemental Soil Cleanup Objectives.

All material excavated from the site is assumed to meet the definition of non-hazardous excavated material.

D. Environmentally Clean Fill and Backfill

1. For fill and backfill proposed for use below cover material (as defined in the previous paragraph) and underneath areas with no potential for public contact (e.g., pavement), environmentally clean fill is defined as soil that has been tested utilizing methods which yield laboratory reporting limits that are below the regulatory comparison criteria and found to contain:

a. No detectable concentrations of volatile organic compounds;

- b. No other organic compounds or inorganic analytes at concentrations above the lower of DER-10 Technical Guidance for Site Investigation and Remediation, Appendix 5, "Allowable Constituent Levels for Imported Fill or Soil" Restricted Residential Use and Ecological Resources Soil Cleanup Objectives; and,
- c. No other organic compounds or inorganic analytes at concentrations above the lower of the NYSDEC CP-51: Soil Cleanup Guidance Residential Use, Protection of Ecological Resources, and Protection of Groundwater Supplemental Soil Cleanup Objectives.
- d. For sites with no ecological resources (as described in CP-51, Section V.C.) the Soil Cleanup Objectives for Ecological Resources shall not apply. The determination regarding whether ecological resources are present shall be made by the IEH Division of the Authority.

1.05 SUBMITTALS**A. Product Data**

Provide manufacturer's information on the compaction equipment to be used on each type of material for review.

B. Shop Drawings

Submit shop drawings and associated calculations for sheeting, shoring, and bracing. Shop drawings and calculations shall be signed and sealed by a New York State licensed professional

D. Quality Control Submittals**1. Design Data:**

Provide the following information:

- a. Gradation analysis for fill materials.
- b. Gradation analysis for aggregate bases.

- c. Gradation analysis for crushed stone.
- d. Material composition analysis of recycled concrete material.

2. Contractor Qualifications

Provide proof of Contractor qualifications specified under "Quality Assurance".

1.06 QUALITY ASSURANCE

A. Qualifications

- 1. Company specializing in performing the Work of this Section shall have a minimum of 3 years experience and shall have worked on 3 projects of similar size.

B. Regulatory Requirements

- 1. Work of this Section shall conform to all requirements of and all applicable regulations and guidelines of all governmental authorities having jurisdiction, including, but not limited to, safety, health, and anti-pollution regulations. Where more stringent requirements than those contained in the Building Code or other applicable regulations are given in this Section, the requirements of this Section shall govern.
- 2. Conform to requirements of "Safety and Health Standards, Subpart P - Excavations, Trenching and Shoring" - OSHA.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Stockpile material in such a manner as to prevent erosion and dust. Provide silt curbs if necessary.
- B. Testing and certification of all imported environmentally clean fill and aggregate are the responsibilities of the Contractor.

1.08 PROJECT/SITE CONDITIONS

- A. Obtain all available on the site affecting or being affected by the project construction.
- B. Prior to clearing and removal or abandonment of improvements, ascertain the exact locations of all existing underground utilities. Protect these during subsequent operations.
 - 1. Demolish and remove underground utilities designated to be removed. Coordinate with utility companies for shut-off of services if lines are active.
 - 2. Consult immediately with the owner for directions should uncharted or incorrectly charted piping or other utilities be encountered during excavation. cooperate with the owner in keeping their respective services and facilities in operation. Repair damaged utilities to the satisfaction of the Utility Owner.
 - 3. Do not interrupt existing utilities serving facilities occupied others during occupied hours, except when permitted in writing by the owner, and only after acceptable temporary utility service has been provided. Do not proceed with interruption of services without providing a minimum of 48 -hours notice to the affected parties and receiving their written approval.
- C. Coordination

Examine drawings to determine sequence of operations, and relation to work of other trades. Start of work will signify acceptance of field conditions and will acknowledge coordination with other trades.

1.09 SEQUENCING AND SCHEDULING

- A. Perform work in such a manner to ensure a minimum interference with roads, walks, adjacent properties, and facilities to remain open. Do not close or obstruct these items without obtaining permission of the owner.

PART 2 - PRODUCTS**2.01 MATERIALS**

A. Restricted Excavated Material

Remove all debris not explicitly designated to be salvaged (to remain) from improvements and soil excavated during construction from premises and legally dispose of away from premises as part of the base bid. Any environmentally clean fill (as defined in Paragraph 1.04F of this Section and tested to meet such requirement) meeting the gradation requirements of Paragraph B below may be reused on the site pending credit to the Authority.

B. Fill and Backfill

Only environmentally clean fill (as defined in Paragraph 1.04F of this Section) shall be used as fill and backfill. Composition shall consist of angular sands and gravels. Flat structured material such as mica (the main component of "mole" rock) falling into the acceptable gradation or other material affecting the permeability and structural characteristics of the sand material shall be no more than .4% of the total material. Material shall not contain salts or foreign materials of any kind and the material shall show a percentage of wear by the Los Angeles wear test (ASTM C131) of not more than 35%. These fill materials shall contain no particles exceeding 4" in the largest dimension. No more than 30% of the material by weight shall be retained on a ¾" sieve. Of the material passing the No. 4 sieve, no more than 10% shall pass the No. 200 sieve by weight. The Contractor shall provide the Authority with laboratory data on material proposed for use as fill/backfill. Samples shall be collected from imported material and material proposed for reuse on-site. The Contractor shall collect and analyze one representative sample of each material for every 500 cubic yards of imported fill/backfill brought to the site or material proposed for reuse on site for the complete list of 6 NYCRR Part 375 and NYSDEC CP-51 Supplemental Soil Cleanup Objectives Parameters as defined in Paragraph 1.04F.

C. Aggregate Base

1. Aggregate base course, to be used under pavements shall be composed of crushed ledge rock (blue stone) or talus, roughly cubical or pyramidal in shape, and sand meeting the gradation and soundness requirements of New York State DOT, Item 3.04.02, Type 2. Material shall be uniform in quality and free of wood, loam, clay, dirt, roots, bark, and any other extraneous material. Material shall not contain salts or foreign materials of any kind. The aggregate shall be produced from material showing a percentage of wear by the Los Angeles wear test (ASTM C131) of not more than 35%.
2. Stone shall have the following gradation:

Sieve	Percent Passing by Weight
2"	100
1/4"	25-60
No. 40	5-40
No. 200	0-10

2.02 EQUIPMENT

- A. Provide proper compaction equipment to properly compact subgrade, fill and backfill, aggregate base, crushed stone and broken stone base.

2.03 SOURCE QUALITY CONTROL

1. Contractor's Responsibility

Inspections and testing performed by the Authority's agent(s) shall not relieve the Contractor of responsibility for performing all other testing and inspection specified herein or otherwise necessary to meet the quality control and quality assurance requirements of this Section.

PART 3 - EXECUTION**3.01 EXAMINATION**

- A. Verification of Conditions

Verify existing site conditions match those of the Drawings and pre-bid inspections. Notify the Authority

in writing prior to commencement of Work of any discrepancies.

B. Preparation

1. Before starting any excavation work for new construction, ascertain the exact locations of all existing underground drain lines, piping, and conduits. Consult with the Mechanical Trades.
2. At location where any of the above services interfere with the excavation work, notify the Authority and Mechanical Trade under whose jurisdiction such work falls before continuing with any more excavation.

3.02 PREPARATION AND PROTECTION

A. General

1. Provide adequate protection measures to protect workmen and pedestrians at the site.
2. Prevent damage to existing improvements designated to remain. If they are damaged during construction, restore improvements to their original condition.
3. Prevent damage to improvements on the site. Restore damaged improvements to their original condition to the satisfaction of the owner. Restore grades and vegetation to their original condition or better.
4. Salvable Improvements
 - a. Carefully remove and protect all items to be saved and reused. Replace any items which are damaged by removal at own cost.
 - b. Notify the Authority in writing of any item which is damaged prior to removal so that they may ascertain the item's condition.

B. Condition Survey

1. General: The Contractor shall perform a condition survey of the adjoining structures prior to beginning excavation. Note damage to existing structures.

C. Shoring, Sheet piling, and Bracing**1. General**

- a. Inspect site, examine existing conditions and make all necessary preparations for the safe and proper sequence of work.
- b. Properly guard and protect excavations so as to prevent them from becoming dangerous to person or property.
- c. Brace, shore, and protect existing structures when excavations are made adjacent to the existing structures or within a distance that they will be affected by the excavation.
- d. Maintain sides and slope of excavation in safe condition until backfilling or other work is complete. Maintain shoring and bracing in place till completion of work.
- e. Provide materials for work in good serviceable order.
- f. All shoring, bracing, etc. is to be removed upon completion of the work where they are installed.

C. Workability of Excavation Subgrade

1. Take all steps necessary to prepare or improve existing conditions for proposed work, including general excavation throughout the project site.
2. Properly grade site and perform operations to avoid disturbing the existing subgrade and any intermediate subgrade.

3. If subgrade conditions are disturbed that prevent earthwork operations or safe operation of installation equipment, the Contractor shall take steps to improve subgrade conditions at own expense.

3.03 EXCAVATION - GENERAL

- A. No additional compensation will be allowed for excavation or foundation work carried below the levels shown on Drawings unless same has been authorized in writing by the Authority. Contractor is responsible for all remedial work due to unauthorized excavation.
- B. For pavements, excavate to depths required for installation of aggregate base or pavement as specified herein or shown on Drawings.
- C. Remove all excavated material from the site and legally dispose of away from the premises, in accordance with the requirements specified in this section. Burning of material on the site is not permitted.

3.04 FILLING AND GRADING

- A. Placement and Compaction of Aggregate Bases
 1. Provide aggregate base under all exterior pavements and wherever else indicated on the Drawings or specified herein. Provide crushed stone under all interior slabs. Provide 6" minimum unless specified otherwise elsewhere.
- B. Inspection
 1. Contractor's Responsibility: The Contractor shall notify the Authority at least 48 hours prior to filling operations, pouring of footings, and installation of excavation support to allow for the Authority to have the appropriate personnel at the site.
 2. Contractor's Inspections: Inspections and testing performed by the Authority shall not relieve the Contractor of responsibility for performing all

other testing and inspection specified herein or otherwise necessary to meet the quality control and quality assurance requirements of this Section.

C. Responsibility

1. All required testing and/or analysis not specifically defined as being provided by the Authority shall be provided by the Contractor as part of the included Work and costs of this Project.
2. No testing and/or analysis by the Authority shall relieve the Contractor of the responsibility of conforming to the requirements of these specifications.
3. Time for conducting the tests and/or inspections defined in these specifications shall be considered as part of the Work of this Project and neither extension of time nor additional costs shall be accepted as a result.

3.04 PROTECTION

- A. Protect graded and compacted areas from traffic and erosion. Keep free of trash and debris.
- B. When completed compacted areas are disturbed by subsequent construction or weather, scarify surface, re-shape, and compact to required density prior to further construction.
- C. Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION

LIST OF SUBMITTALS

<u>SUBMITTAL</u>	<u>DATE SUBMITTED</u>	<u>DATE APPROVED</u>
Samples:	_____	_____
1. Fill and backfill		
2. Aggregate base		
3. Crushed stone		
Design Data:	_____	_____
1. Aggregate base		
Qualifications:	_____	_____
1. Contractor		

* * *

Template 1A

Specification Section 02201
Environmentally Clean Fill/Backfill Criteria
Template for Summarizing Results of Analyses
Sites with No Ecological Resources

	Specification Section 02200 Criteria for Cover Material	Specification Section 02200 Criteria for Non-Contact Material	Insert Sample ID No. Insert Date of Sample Collection Insert Laboratory ID No. Insert Laboratory Name and ELAP No.
METALS	(mg/kg)	(mg/kg)	
Arsenic	13	16	
Barium	350	400	
Beryllium	7.2	47	
Cadmium	2.5	4.3	
Chromium, hexavalent	1	19	
Chromium, trivalent	30	180	
Cobalt	30	30	
Copper	50	270	
Cyanide (total)	27	27	
Iron	2,000	2,000	
Lead	63	400	
Manganese	1,600	2,000	
Mercury (total)	0.18	0.73	
Nickel	30	130	
Selenium	3.9	4	
Silver	2	8.3	
Vanadium	100	100	
Zinc	109	2,480	

	Specification Section 02200 Criteria for Cover Material (mg/kg)	Specification Section 02200 Criteria for Non-Contact Material (mg/kg)	Insert Sample ID No. Insert Date of Sample Collection Insert Laboratory ID No. Insert Laboratory Name and ELAP No.
PESTICIDES			
2,4,5-T	1.9	1.9	
2,4,5-TP Acid (SILVEX)	3.8	3.8	
2,4-D (2,4-Dichloro-phenoxyacetic acid)	0.5	0.5	
4,4'-DDD	0.0033	13	
4,4'-DDE	0.0033	8.9	
4,4'-DDT	0.0033	7.9	
Aldrin	0.005	0.097	
alpha-BHC	0.02	0.02	
alpha-Chlordane	0.094	2.9	
beta-BHC	0.036	0.09	
delta-BHC	0.04	0.25	
Dibenzofuran	6.2	59	
Dieldrin	0.005	0.1	
Endosulfan I ¹	2.4	24	
Endosulfan II ¹	2.4	24	
Endosulfan sulfate ¹	2.4	24	
Endrin	0.014	0.06	
gamma-BHC (Lindane)	0.1	0.1	
gamma-Chlordane	0.54	0.54	
Heptachlor	0.042	0.38	
Heptachlor epoxide	0.02	0.02	
Methoxychlor	100	100	
Parathion	1.2	1.2	
POLYCHLORINATED BIPHENYLS (PCBS)			
Aroclor-1016	0.1	1	
Aroclor-1221			
Aroclor-1232			
Aroclor-1242			
Aroclor-1248			
Aroclor-1254			
Aroclor-1260			
Aroclor-1262			
Aroclor-1268			

¹ The SCO is the sum of endosulfan I, endosulfan II and endosulfan sulfate.

	Specification Section 02200 Criteria for Cover Material	Specification Section 02200 Criteria for Non-Contact Material	Insert Sample ID No. Insert Date of Sample Collection Insert Laboratory ID No. Insert Laboratory Name and ELAP No.
SEMIVOLATILE ORGANIC COMPOUNDS	(mg/kg)	(mg/kg)	
2,4,5-Trichlorophenol	0.1	0.1	
2,4-Dichlorophenol	0.40	0.40	
2,4-Dinitrophenol	0.2	0.2	
2,6-Dinitrotoluene	1.0	1.0	
2-Chlorophenol	100	100	
2-Methylnaphthalene	0.41	0.41	
2-Nitroaniline	0.4	0.4	
2-Nitrophenol	0.3	0.3	
3-Nitroaniline	0.5	0.5	
4-Chloroaniline	0.22	0.22	
4-Methyl-2-pentanone	1.0	1.0	
4-Nitrophenol	0.1	0.1	
Acenaphthene	20	98	
Acenaphthylene	100	100	
Aniline	0.33	0.33	
Anthracene	100	100	
Benzo(a)anthracene	1	1	
Benzo(a)pyrene	1	1	
Benzo(b)fluoranthene	1	1	
Benzo(g,h,i)perylene	100	100	
Benzo(k)fluoranthene	0.8	1.7	
Benzoic Acid	2.7	2.7	
Bis(2-ethylhexyl)phthalate	50	50	
Butylbenzyl-phthalate	100	100	
Chloroethane	1.9	1.9	
Chrysene	1	1	
Dibenz(a,h)anthracene	0.33	0.33	
Diethylphthalate	7.1	7.1	
Dimethylphthalate	27	27	
Di-n-butylphthalate	8.1	8.1	
Di-n-octylphthalate	100	100	
Fluoranthene	100	100	
Fluorene	30	100	
Hexachlorobenzene	0.41	0.41	
Indeno(1,2,3-cd)pyrene	0.5	0.5	
Isophorone	4.4	4.4	
m-Cresol (3-Methylphenol)	0.33	0.33	
Naphthalene	12	12	
Nitrobenzene	0.17	0.17	
o-Cresol (2-Methylphenol)	0.33	0.33	
p-Cresol (4-Methylphenol)	0.33	0.33	
Pentachlorophenol	0.8	0.8	
Phenanthrene	100	100	
Phenol	0.33	0.33	
Pyrene	100	100	

	Specification Section 02200 Maximum Reporting Limit (mg/kg)	Insert Sample ID No. Insert Date of Sample Collection Insert Laboratory ID No. Insert Laboratory Name and ELAP No.
VOLATILE ORGANIC COMPOUNDS		
1,1,1-Trichloroethane	0.68	
1,1,2,2-Tetrachloroethane	0.6	
1,1-Dichloroethane	0.27	
1,1-Dichloroethene	0.33	
1,2,3-Trichloropropane	0.34	
1,2,4-Trichlorobenzene	3.4	
1,2,4-Trimethylbenzene	3.6	
1,2-Dichlorobenzene	1.1	
1,2-Dichloroethane	0.02	
1,3,5-Trimethylbenzene	8.4	
1,3-Dichlorobenzene	2.4	
1,3-Dichloropropane	0.3	
1,4-Dichlorobenzene	1.8	
1,4-Dioxane	0.1	
2,6-Dinitrotoluene	0.17	
4-Methyl-2-Pentanone	1.0	
Acetone	0.05	
Benzene	0.06	
Carbon Disulfide	2.7	
Carbon Tetrachloride	0.76	
Chlorobenzene	1.1	
Chloroform	0.37	
cis-1,2-Dichloroethene	0.25	
Ethylbenzene	1	
Freon 113 (1,1,2-TFE)	6	
Hexachlorobenzene	0.33	
Isopropylbenzene	2.3	
Methyl ethyl ketone (2-Butanone)	0.12	
Methyl tert-butyl ether (MTBE)	0.93	
Methylene chloride	0.05	
n-Butylbenzene	12	
n-Propylbenzene	3.9	
p-Isopropyltoluene	10	
sec-Butylbenzene	11	
tert-Butylbenzene	5.9	
Tetrachloroethene	1.3	
Toluene	0.7	
trans-1,2-Dichloroethene	0.19	
Trichloroethene	0.47	
Vinyl Chloride	0.02	
Xylene (mixed)	0.26	

Template 1B

Specification Section 02201
 Environmentally Clean Fill/Backfill Criteria
 Template for Summarizing Results of Analyses
 Sites with Ecological Resources

	Specification Section 02200 Criteria for Cover Material (mg/kg)	Specification Section 02200 Criteria for Non-Contact Material (mg/kg)	Insert Sample ID No. Insert Date of Sample Collection Insert Laboratory ID No. Insert Laboratory Name and ELAP No.
METALS			
Aluminum	10,000	10,000	
Antimony	12	12	
Arsenic	13	13	
Barium	350	400	
Beryllium	7.2	10	
Boron	0.5	0.5	
Cadmium	2.5	4	
Calcium	10,000	10,000	
Chromium, hexavalent	1	1	
Chromium, trivalent	30	41	
Cobalt	20	20	
Copper	50	50	
Cyanide (total)	27	27	
Iron	2,000	2,000	
Lead	63	63	
Lithium	2	2	
Manganese	1,600	1,600	
Mercury (total)	0.18	0.18	
Molybdenum	2	2	
Nickel	30	30	
Selenium	3.9	3.9	
Silver	2	2	
Technetium	0.2	0.2	
Thallium	5	5	
Tin	50	50	
Uranium	5	5	
Vanadium	39	39	
Zinc	109	109	

	Specification Section 02200 Criteria for Cover Material	Specification Section 02200 Criteria for Non-Contact Material	Insert Sample ID No. Insert Date of Sample Collection Insert Laboratory ID No. Insert Laboratory Name and ELAP No.
PESTICIDES	(mg/kg)	(mg/kg)	
2,3,7,8-TCDD	0.000001	0.000001	
2,3,7,8-TCDF	0.000001	0.000001	
2,4,5-T	1.9	1.9	
2,4,5-TP Acid (SILVEX)	3.8	3.8	
2,4-D (2,4-Dichloro-phenoxyacetic acid)	0.5	0.5	
4,4'-DDD	0.0033	0.0033	
4,4'-DDE	0.0033	0.0033	
4,4'-DDT	0.0033	0.0033	
Aldrin	0.005	0.097	
alpha-BHC	0.02	0.02	
alpha-Chlordane	0.094	1.3	
beta-BHC	0.036	0.09	
Biphenyl	60	60	
Chlordecone (Kepone)	0.06	0.06	
delta-BHC	0.04	0.04	
Dibenzofuran	6.2	59	
Dieldrin	0.005	0.006	
Endosulfan I ¹	2.4	24	
Endosulfan II ¹	2.4	24	
Endosulfan sulfate ¹	2.4	24	
Endrin	0.014	0.014	
Furan	600	600	
gamma-BHC (Lindane)	0.1	0.1	
gamma-Chlordane	0.54	0.54	
Heptachlor	0.042	0.14	
Heptachlor epoxide	0.02	0.02	
Methoxychlor	1.2	1.2	
Parathion	1.2	1.2	
POLYCHLORINATED BIPHENYLS (PCBS)			
Aroclor-1016	0.1	1	
Aroclor-1221			
Aroclor-1232			
Aroclor-1242			
Aroclor-1248			
Aroclor-1254			
Aroclor-1260			
Aroclor-1262			
Aroclor-1268			
¹ The SCO is the sum of endosulfan I, endosulfan II and endosulfan sulfate.			

	Specification Section 02200 Criteria for Cover Material (mg/kg)	Specification Section 02200 Criteria for Non-Contact Material (mg/kg)	Insert Sample ID No. Insert Date of Sample Collection Insert Laboratory ID No. Insert Laboratory Name and ELAP No.
SEMIVOLATILE ORGANIC COMPOUNDS			
1,2,3,6,7,8-HCDF	0.00021	0.00021	
2,3,4,5-Tetrachlorophenol	20	20	
2,3,5,6-Tetrachloroaniline	20	20	
2,4,5-Trichloroaniline	20	20	
2,4,5-Trichlorophenol	0.1	0.1	
2,4,6-Trichlorophenol	10	10	
2,4-Dichlorophenol	0.40	0.40	
2,4-Dinitrophenol	0.2	0.2	
2,6-Dinitrotoluene	1.0	1.0	
2-Chlorophenol	0.8	0.8	
2-Methylnaphthalene	0.41	0.41	
2-Nitroaniline	0.4	0.4	
2-Nitrophenol	0.3	0.3	
3,4-Dichlorophenol	20	20	
3-Chloroaniline	20	20	
3-Chlorophenol	7	7	
3-Nitroaniline	0.5	0.5	
4-Chloroaniline	0.22	0.22	
4-Methyl-2-pentanone	1.0	1.0	
4-Nitrophenol	0.1	0.1	
Acenaphthene	20	20	
Acenaphthylene	100	100	
Aniline	0.33	0.33	
Anthracene	100	100	
Benzo(a)anthracene	1	1	
Benzo(a)pyrene	1	1	
Benzo(b)fluoranthene	1	1	
Benzo(g,h,i)perylene	100	100	
Benzo(k)fluoranthene	0.8	1.7	
Benzoic Acid	2.7	2.7	
Bis(2-ethylhexyl)phthalate	50	50	
Butylbenzyl-phthalate	100	100	
Chloroethane	1.9	1.9	
Chrysene	1	1	
Dibenz(a,h)anthracene	0.33	0.33	
Diethylphthalate	7.1	7.1	
Dimethylphthalate	27	27	
Di-n-butylphthalate	0.014	0.014	
Di-n-hexyl-phthalate	0.91	0.91	
Di-n-octylphthalate	100	100	
Fluoranthene	100	100	
Fluorene	30	100	
Hexachlorobenzene	0.41	0.41	
Indeno(1,2,3-cd)pyrene	0.5	0.5	
Isophorone	4.4	4.4	
m-Cresol (3-Methylphenol)	0.33	0.33	
Naphthalene	12	12	
Nitrobenzene	0.17	0.17	
o-Cresol (2-Methylphenol)	0.33	0.33	
p-Cresol (4-Methylphenol)	0.33	0.33	
Pentachloroaniline	100	100	
Pentachlorophenol	0.8	0.8	
Phenanthrene	100	100	
Phenol	0.33	0.33	
Pyrene	100	100	

	Specification Section 02200 Maximum Reporting Limit (mg/kg)	Insert Sample ID No. Insert Date of Sample Collection Insert Laboratory ID No. Insert Laboratory Name and ELAP No.
VOLATILE ORGANIC COMPOUNDS		
1,1,1-Trichloroethane	0.68	
1,1,2,2-Tetrachloroethane	0.6	
1,1-Dichloroethane	0.27	
1,1-Dichloroethene	0.33	
1,2,3,4-Tetrachlorobenzene	10	
1,2,3-Trichlorobenzene	20	
1,2,3-Trichloropropane	0.34	
1,2,4-Trichlorobenzene	3.4	
1,2,4-Trimethylbenzene	3.6	
1,2-Dichlorobenzene	1.1	
1,2-Dichloroethane	0.02	
1,2-Dichloropropane	700	
1,3,5-Trimethylbenzene	8.4	
1,3-Dichlorobenzene	2.4	
1,3-Dichloropropane	0.3	
1,4-Dichlorobenzene	1.8	
1,4-Dioxane	0.1	
2,4-Dichloroaniline	100	
2,6-Dinitrotoluene	0.17	
3,4-Dichloroaniline	20	
4-Methyl-2-Pentanone	1.0	
Acetone	0.05	
Benzene	0.06	
Carbon Disulfide	2.7	
Carbon Tetrachloride	0.76	
Chloroacetamide	2	
Chlorobenzene	1.1	
Chloroform	0.37	
cis-1,2-Dichloroethene	0.25	
Dibromochloromethane	10	
Ethylacetate	48	
Ethylbenzene	1	
Freon 113 (1,1,2-TFE)	6	
Hexachlorobenzene	0.33	
Hexachlorocyclopentadiene	10	
Isopropylbenzene	2.3	
Methanol	6.5	
Methyl ethyl ketone (2-Butanone)	0.12	
Methyl tert-butyl ether (MTBE)	0.93	
Methylene chloride	0.05	
n-Butylbenzene	12	
n-Nitrosodiphenylamine	20	
n-Propylbenzene	3.9	
Pentachlorobenzene	20	
Pentachloronitrobenzene	10	
p-Isopropyltoluene	10	
sec-Butylbenzene	11	
Styrene	300	
tert-Butylbenzene	5.9	
Tetrachloroethene	1.3	
Toluene	0.7	
trans-1,2-Dichloroethene	0.19	
Trichloroethene	0.47	
Vinyl Chloride	0.02	
Xylene (mixed)	0.26	

Template 2

Excavated Materials Disposal Plan (EMDP) for Larger Earthwork Projects
(Insert School/Site Name and Address)
(Date)

General notes regarding this template:

1. The EMDP **must** be signed by a Certified Hazardous Materials Manager approved by the Institute of Hazardous Materials Management in Rockville, Maryland, or Qualified Environmental Professional, approved by the Institute of Professional Environmental Practice, Pittsburgh, Pennsylvania, or similar board-certified profession.
2. Directions to EMDP preparers are provided within this template as ***bold and italicized*** text. In general, bold ***and italicized*** text indicates where information unique to the Site is to be inserted by the writer.

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Appendix B – Waste Transporter Permits
Appendix C – Disposal Facility Permits and Supporting Documentation (including a copy of the NYSDEC Part 360 Permit or equivalent out of state regulatory agency permit)

Introduction

This Excavated Materials Disposal Plan (EMDP) describes the procedures to be followed for the characterization, excavation, management, transportation and disposal of material excavated at _____ (*insert Site name and location*) in accordance with SCA Specification Section 02201, (*insert Design # and date*). This work will be performed by _____ (*insert name of excavation contractor*) under contract with _____ (*insert name of general contractor, if applicable*).

Project activities associated with this EMDP include the characterization, excavation, management, transportation, and disposal of approximately _____ (*insert amount*) cubic yards of non-hazardous excavated material (*change to appropriate category if the EMDP is being prepared for non-hazardous industrial waste, petroleum contaminated material, and/or hazardous waste*) for the construction of the _____ (*insert project type – new school, addition, flood elimination project, etc.*).

All material excavated from the Site is assumed to meet the definition of non-hazardous excavated material (*change to appropriate category if the EMDP is being prepared for non-hazardous industrial waste, petroleum contaminated material and/or hazardous waste*). According to Specification Section 02201, Section 1.0, the following definitions apply to this project: (*conform below with the project specifications*)

Non-Hazardous Excavated Material

Material that may include or contain mixtures of the following: soil (including, but not limited to, natural undisturbed material), debris, concrete and concrete products (including steel or fiberglass reinforcing rods that are embedded in the concrete), asphalt pavement, brick, glass, rock, municipal solid waste, refuse, and incidental ash. This material includes material defined in Title 6 New York Code of Rules and Regulations 360-7.1(b)(1)(i) and will exceed 6 NYCRR 375-6 Unrestricted Use and Restricted Use Soil Cleanup Objectives and NYSDEC CP-51: Soil Cleanup Guidance Supplemental Soil Cleanup Objectives.

All material excavated from the site is assumed to meet the definition of non-hazardous excavated material.

Petroleum-Contaminated Material

Material (soil, concrete, sediment, UST contents, fill, debris, etc.) that meets the NYSDEC STARS Memo #1 definition of petroleum-contaminated material from known source areas. Petroleum-contaminated material shall be evidenced by the following observations **and** be from a known source area: producing higher than background responses on a portable vapor meter such as a photo ionization detector or flame ionization detector, petroleum-like odor, visual impacts (e.g., staining or discoloration), proximity to known releases from existing or historic petroleum storage tanks or systems, and exceed the soil cleanup levels for gasoline and/or fuel oil contaminated soil provided in the NYSDEC CP-51: Soil Cleanup Guidance. The determination as to whether the excavated material is petroleum-contaminated or is non-petroleum contaminated material will be made by analytical testing of representative material samples. All sampling shall be performed under the supervision of the Authority's IEH Division or its representative. The Contractor shall provide the IEH Division with qualitative and quantitative information, and the IEH Division shall make the final determination as to whether or not the material is petroleum-contaminated and the appropriate disposal.

Hazardous Waste

Material meeting the definition of a Resource Conservation and Recovery Act hazardous waste as defined in 40 CFR Part 261, New York State ECL Section 27-09 or 6 NYCRR Part 371.

Environmentally Clean Fill and Backfill

Refer to Section 02201 for definition and requirements associated with fill and backfill.

A. PRE-EXCAVATION UTILITY SURVEYS

- 1. Describe how buried utilities (e.g. electric, gas, water, sewers, telephone, etc.) will be located and marked out.*
- 2. Describe how utility mark-out information will be provided to the Authority.*
- 3. Confirm appropriate contact will be made with underground facilities protective organizations in accordance with applicable laws and regulations.*

B. WASTE CHARACTERIZATION SAMPLING

Waste characterization samples will be collected and analyzed in accordance with the proposed disposal facility(ies) requirements, outlined in Section D.

(Describe the type of soil sampling – i.e., will the sampling be performed in-situ [with a Geoprobe] or will samples be collected from excavated stockpiles.)

Describe the soil sampling frequency and analyte list. For example, use text such as...

A total of ____(*insert number*) soil samples will be collected for analysis. This number of soil samples equates to one sample for every 500 cubic yards (*change as required based on disposal facility requirements*) of excavated material. Each sample will be analyzed for the following parameters:

- Volatile organic compounds (VOCs) by USEPA Method 8260
- Semi-volatile organic compounds (SVOCs) by USEPA Method 8270
- Polychlorinated biphenyls (PCBs) by USEPA Method 8082
- Pesticides via USEPA Method 8081
- Herbicides via USEPA Method 8151
- RCRA Metals via USEPA Method 6010
- Mercury via USEPA Method 7471

In addition, a total of ____(*insert number*) samples, one soil sample for every 5,000 cubic yards (*change as required based on disposal facility requirements*), will be collected and analyzed for the following parameters:

- RCRA Characteristics
- Full TCLP

Introduce and provide a to-scale site plan (Figure 1). Figure 1 shall show the site, an outline of the proposed new construction, proposed excavation areas, and quantities of excavated materials.

Introduce and provide a to-scale sampling plan (Figure 2). Figure 2 shall show the Site, the locations on the Site where soil samples shall be collected, and which discrete soil samples shall make up composite sample(s), as applicable. Note that the Figure should show sampling grids with estimated average depths of excavation in each grid.

Discrete grab samples will be collected for VOCs. A five-point (*change as required based on disposal facility requirements*) composite sample will be collected for all other analytes listed above. Samples will be analyzed by _____ (*insert name and address of laboratory*), a New York State Department of Health Environmental Laboratory Approval Program (ELAP) -certified laboratory.

After sample collection, the soil samples will be shipped to the NYSDOH ELAP certified

laboratory in chilled coolers, and accompanied by appropriate chain of custody records. Analytical results will be provided to the proposed disposal facilities for their review and approval. In addition, the results will be submitted to the BPCA's IEH Division. A letter on _____(*insert excavation contractor name*) letterhead will be provided to the BPCA that states that all available analytical data has been provided to the disposal facility. The disposal facility(ies) will provide an original signed letter indicating that the soil meets the acceptance criteria for their facility(ies) and the excavated material is accepted for disposal. This letter will be forwarded to the BPCA upon receipt.

C. MANAGEMENT OF EXCAVATED SOIL

(Describe the procedures for excavation work – for instance, number and types of excavators? Is there any hand excavation work anticipated?)

On-site personnel involved in excavation activities shall comply with applicable Occupational Safety and Health Administration (OSHA) rules and regulations, New York City Department of Buildings (NYCDOB) requirements, and the Health and Safety Plan (HASP) presented as Appendix A to this EMDP.

Excavated soil, if not directly loaded into trucks for transportation and disposal, will be stockpiled on-site. Stockpiles will be placed on and covered with heavy duty tarps secured by sand bags.

Dust suppression will be performed during work activities where the potential for elevated dust conditions exists. Water will be used to spray/mist excavation areas in these instances. There will be no visible dust emissions from the work areas. Other dust suppression techniques which may be utilized include speed limits for trucks in unpaved areas, maintenance of Site paving as long as practical, and minimization of excavation activities during periods of high winds. *(Note – if a community air monitoring program [CAMP] is required by the specifications, briefly describe the CAMP requirements and implementation.)*

D. DISPOSAL FACILITIES AND WASTE HAULERS

Excavated material transportation will be performed by licensed transporters with valid NYSDEC 6 NYCRR 364 Waste Transporter Permits. All proposed disposal facilities shall be listed on the waste transporter permits. Loaded vehicles leaving the Site will be appropriately cleaned, lined, and covered in accordance with applicable laws and regulations. The proposed licensed transporters with valid 6 NYCRR 364 Permits for this project are as follows:

- *Transporter 1 Name and Address*
NYSDEC Part 364 Waste Transporter Permit # and Date of Expiration –
Disposal Facilities permitted for transport to -
- *Transporter 2 Name and Address*
NYSDEC Part 364 Waste Transporter Permit # and Date of Expiration –
Disposal Facilities permitted for transport to -
- *Transporter 3 Name and Address*
NYSDEC Part 364 Waste Transporter Permit # and Date of Expiration –
Disposal Facilities permitted for transport to -
- *Add additional haulers as necessary*

Please refer to Appendix B for copies of the waste transporter permits.

Non-hazardous excavated material shall be transported to an off-site disposal facility meeting the requirements of 6 NYCRR Part 360 or equivalent out-of-state facility approved by the appropriate regulatory agency of that State with a permit to receive non-hazardous excavated material. (*Note - change to appropriate category if the EMDP is being prepared for non hazardous industrial waste, hazardous waste and/or petroleum contaminated material*).

The proposed disposal facilities meeting the criteria described above for this project are as follows:

- *Disposal Facility 1 Name and Name of Owner*
Address and Phone Number -
Type of Permit (i.e., Part 360?, NJDEP?, etc.)
- *Disposal Facility 2 Name and Name of Owner*
Address and Phone Number -
Type of Permit (i.e., Part 360?, NJDEP?, etc.)
- *Disposal Facility 3 Name and Name of Owner*
Address and Phone Number -
Type of Permit (i.e., Part 360?, NJDEP?, etc.)
- *Add additional disposal facilities as necessary*

Please refer to Appendix C for copies of the disposal facility permits and soil testing requirements, and acceptance criteria for each proposed disposal facility.

Waste characterization data will be provided to the proposed disposal facilities for their review and approval. An original signed approval letter from each disposal facility will be submitted to

the BPCA IEH Division at least 48 hours prior to transportation and off-site disposal.

If the excavated material is rejected by the above proposed disposal facilities for any reason, an alternate disposal facility (including required documentation) meeting the requirements of the Specification Section 02201 will be proposed for BPCA IEH Division's consideration.

E. QUALITY ASSURANCE/ QUALITY CONTROL

A qualified person will coordinate and manage the sampling and analysis program, management, transportation, and disposal of excavated materials from the Site. _____ (*insert name of the qualified person and the excavation firm responsible for these activities*) will direct these activities.

Laboratories used will be NYSDOH ELAP certified laboratories. The laboratories will communicate directly with the samplers regarding the analytical results and reporting and will be responsible for providing all labels, sample containers, trip blanks, shipping coolers, and laboratory documentation.

Periodic quality assurance/quality control (QA/QC) audits of the EMDP will be performed by the Contractor, and may also be performed by the BPCA, or the BPCA's auditors. Any items noted to be in non-compliance will be documented and audit findings will be presented to _____ (*insert name of excavation firm*) for resolution (with a copy to the BPCA IEH Division). Verification of resolution(s) will be determined through re-inspecting or re-auditing the non-compliant item.

All records regarding the removal and disposal of excavated materials shall be maintained by _____ (*insert name of excavation firm*) at the project site. These records will be made available to the BPCA or their designated representatives at their request. Shipping manifests and/or bills of lading for excavated material will be provided to the BPCA on a daily basis.

F. SIGNATURE OF CERTIFIED PREPARER

_____ (*insert name, certification*) has prepared this EMDP for the
_____ (*insert site name, address, and type of work being
performed*) in accordance with the requirements of Specification Section 02201. Additionally,
_____ (*insert name*) hereby certifies that (*he/she*) is a currently
licensed/certified _____ (*insert correct certification - Certified
Hazardous Materials Manager approved by the Institute of Hazardous Materials Management in
Rockville, Maryland, or Qualified Environmental Professional, approved by the Institute of
Professional Environmental Practice, Pittsburgh, Pennsylvania, or similar board-certified
profession*).

PREPARED BY: _____

Name

Certification and Certification Number

FIGURES

APPENDIX A
HEALTH AND SAFETY PLAN

APPENDIX B
WASTE TRANSPORTER PERMITS

APPENDIX C

**DISPOSAL FACILITY PERMITS AND SUPPORTING
DOCUMENTATION**

(including a copy of the NYSDEC Part 360 Permit or equivalent out of state regulatory agency
permit)

Template 2

Excavated Materials Disposal Plan (EMDP) for Smaller Earthwork Projects
(Insert School/Site Name and Address)
(Date)

General notes regarding this template:

1. This template should be used if the net cut is expected to be 100 cubic yards or less.
2. Directions to EMDP preparers are provided within this template as ***bold and italicized*** text. In general, bold ***and italicized*** text indicates where information unique to the Site is to be inserted by the writer

Introduction

This Excavated Materials Disposal Plan (EMDP) describes the procedures to be followed for the characterization, excavation, management, transportation and disposal of material excavated at _____ (*insert Site name and location*) in accordance with SCA Specification Section 02201, (*insert Design # and date*). This work will be performed by _____ (*insert name of excavation contractor*) under contract with _____ (*insert name of general contractor, if applicable*).

Project activities associated with this EMDP include the characterization, excavation, management, transportation, and disposal of approximately _____ (*insert amount*) cubic yards of non-hazardous excavated material for the construction of the _____ (*insert project type – new school, addition, flood elimination project, etc.*).

All material excavated from the Site is assumed to meet the definition of non-hazardous excavated material. According to Specification Section 02201, Section 1.0, the following definition applies to this project: (*conform below with the project specifications*)

Non-Hazardous Excavated Material

Material that may include or contain mixtures of the following: soil (including, but not limited to, natural undisturbed material), debris, concrete and concrete products (including steel or fiberglass reinforcing rods that are embedded in the concrete), asphalt pavement, brick, glass, rock, municipal solid waste, refuse, and incidental ash. This material includes material defined in Title 6 New York Code of Rules and Regulations 360-7.1(b)(1)(i) and will exceed 6 NYCRR 375-6 Unrestricted Use and Restricted Use Soil Cleanup Objectives and NYSDEC CP-51: Soil Cleanup Guidance Supplemental Soil Cleanup Objectives.

Excavation Procedures

Prior to excavation a pre-excavation utility survey will be performed. *Describe how buried utilities (e.g. electric, gas, water, sewers, telephone, etc.) will be located and marked out.*

On-site personnel involved in excavation activities shall comply with applicable Occupational Safety and Health Administration (OSHA) rules and regulations, and New York City Department of Buildings (NYCDOB) requirements.

Excavated soil, if not directly loaded into trucks for transportation and disposal, will be stockpiled on-site. Stockpiles will be placed on and covered with heavy duty tarps secured by sand bags.

Dust suppression will be performed during work activities where the potential for elevated dust conditions exists. Water will be used to spray/mist excavation areas in these instances. There will be no visible dust emissions from the work areas. Other dust suppression techniques which may be utilized include speed limits for trucks in unpaved areas, maintenance of Site paving as long as practical, and minimization of excavation activities during periods of high winds.

Proposed Waste Transporters and Disposal Facilities

Excavated material transportation will be performed by licensed transporters with valid NYSDEC 6 NYCRR 364 Waste Transporter Permits. All proposed disposal facilities shall be listed on the waste transporter permits. Loaded vehicles leaving the Site will be appropriately

cleaned, lined, and covered in accordance with applicable laws and regulations. The proposed licensed transporters with valid 6 NYCRR 364 Permits for this project are as follows:

- *Transporter 1 Name and Address*
NYSDEC Part 364 Waste Transporter Permit # and Date of Expiration –
Disposal Facilities permitted for transport to -
- *Transporter 2 Name and Address*
NYSDEC Part 364 Waste Transporter Permit # and Date of Expiration –
Disposal Facilities permitted for transport to -
- *Add additional haulers as necessary*

Non-hazardous excavated material shall be transported to an off-site disposal facility meeting the requirements of 6 NYCRR Part 360 or equivalent out-of-state facility approved by the appropriate regulatory agency of that State with a permit to receive non-hazardous excavated material.

The proposed disposal facilities meeting the criteria described above for this project are as follows:

- *Disposal Facility 1 Name and Name of Owner*
Address and Phone Number -
Type of Permit (i.e., Part 360?, NJDEP?, etc.)
- *Disposal Facility 2 Name and Name of Owner*
Address and Phone Number -
Type of Permit (i.e., Part 360?, NJDEP?, etc.)
- *Add additional disposal facilities as necessary*

Waste characterization samples will be collected and analyzed in accordance with the proposed disposal facility(ies) requirements. Waste characterization data will be provided to the proposed disposal facilities for their review and approval. An original signed approval letter from each disposal facility will be submitted to the BPCA IEH Division at least 48 hours prior to transportation and off-site disposal.

If the excavated material is rejected by the above proposed disposal facilities for any reason, an alternate disposal facility (including required documentation) meeting the requirements of the Specification Section 02201 will be proposed for BPCA IEH Division's consideration.

Please refer to Appendix A for copies of the waste transporter permits, disposal facility permits and soil testing requirements, and acceptance criteria for each proposed disposal facility.

APPENDIX A

**WASTE TRANSPORTER AND DISPOSAL FACILITY PERMITS AND
SUPPORTING DOCUMENTATION**

SECTION 03733
CONCRETE REPAIR WORK

PART 1 - GENERAL**1.01 DESCRIPTION OF WORK**

- A. Provide labor, materials, equipment, and services to provide for the structural repair of concrete members with manufactured structural repair concrete/mortar as shown on Drawings and as specified herein. Work includes removing spalled concrete and cleaning and coating of exposed steel reinforcement.

1.02 RELATED SECTIONS
(NOT USED)**1.03 REFERENCE STANDARDS**

References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

- A. American Society of Testing and Materials (ASTM)
- B. International Concrete Restoration Institute (ICRI)

1.04 SUBMITTALS

- A. Product Data

Provide manufacturer's information on the anti-corrosion coating and structural repair concrete/mortar, including application instructions and specifications.

- B. Quality Control Submittals

- 1. Certificates:

- a. Furnish manufacturer's certification that materials meet or exceed Specification requirements.

- 2. Repair Procedure: Furnish written description of repair procedures and operations sequencing prior to commencing the Work.

4. Contractor Qualifications

Provide proof of Installer and Manufacturer qualifications specified under "Quality Assurance".

1.05 QUALITY ASSURANCE**A. Qualifications**

1. Installer: Company specializing in the Work of this Section shall have a minimum of three years experience and at least two projects with similar quantity of materials. Contractor shall be trained by the repair mortar manufacturer and shall have a certificate of training on file from the manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Materials specified shall be delivered to the site in sealed, properly labeled containers. Containers shall indicate manufacturer's name, trade name of product, lot number, shelf life of product, and mix ratio (if applicable).
- B. Keep containers tightly closed when not in use. Comply with manufacturer's printed instructions for storing and protecting materials.
- C. Do not store liquid material in hot sun. Keep material from freezing.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply if the temperature is below 50°F or above 85°F unless the material manufacturer is consulted for recommendations.
- B. Do not use frozen materials or materials coated with ice or frost.
- C. Do not apply when there is expectation of rain within 24 hours.

PART 2 - PRODUCTS**2.01 MANUFACTURERS**

- A. Sto Concrete Restoration Div., Atlanta, GA 30331
- B. Sika Corp, Lyndhurst, NJ 07071
- C. Strongwall Industries, Ridgewood, NJ 07451

2.02 MATERIALS**A. Structural Repair Concrete/Mortar - Horizontal Application**

1. Shall have non-shrink characteristics and be of high compressive and bond strength. Material shall be capable of being poured or troweled in place for horizontal applications and for formed applications of sufficient dimensions to allow for proper placement of material and conform to the following properties:
 - a. Compressive strength of 5000 psi in 28 days when tested in accordance with ASTM C109.
 - b. Bond strength of 2000 psi in 28 days when tested in accordance with ASTM C882 modified). Results of tests showing failure of base material is acceptable alternative.
 - c. Flexural strength of 1600 psi in 28 days when tested in accordance with ASTM C78 or ASTM C293.
 - d. Maximum linear length change shall be maximum of 0.08% at 28 days when tested in accordance with ASTM C157.
 - e. Modulus of elasticity shall be between 3.0 and 3.5×10^6 when tested in accordance with ASTM C469.
2. Repair concrete/mortar shall be "CR701 Sto Trowel-Grade Mortar" as manufactured by Sto Concrete Restoration Division, "Sikatop 122 Plus" as manufactured by Sika Corporation, or "SW-81/SW-81F" as manufactured by Strongwall Industries.

B. Anti-corrosion Coating

1. Corrosion-inhibiting, epoxy/acrylic resin, protective coating for steel reinforcing bars that will not form a vapor barrier or bond break with the repair mortar with the following properties:
 - a. Bond strength of 1800 psi in 2 hours when tested in accordance with ASTM C882.
 - b. Flexural strength of 2000 psi in 28 days when tested in accordance with ASTM C78.
 - c. Tensile strength of 800 psi in 28 days when tested in accordance with ASTM C190.

2. Anti-corrosion coating shall be "CR246 Sto Bonding and Anti-corrosion Agent" by Sto Concrete Restoration Division or "Armotec 110" as manufactured by Sika Corporation.

E. Miscellaneous Materials

1. Water: Potable water, ASTM C94
2. J hooks: 1/4" diameter threaded rod, Type 316 stainless steel
3. Epoxy paste adhesive: ASTM C882
4. Coarse aggregate: Clean, washed crushed stone, 3/8" maximum size, conforming to ASTM C33.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine all adjoining work on which this Work is in anyway dependent for proper installation and workmanship. Report to the Authority any conditions that prevent the performance of this Work.
- B. The Contractor shall determine the most suitable material indicated in Part 2 of this Specification to be used for each application to achieve the most structural sound repair with appropriate finish, unless specifically indicated on the Drawings. As an example, the Contractor may decide to form an application on a vertical surface in lieu of using the overhead repair mortar. The contractor shall include in the repair work procedure what materials will be used where and how the repair will be achieved for both the structural integrity of the patch and the correct finish.

3.02 PREPARATION AND PROTECTION

A. Protection

Protect adjacent surfaces not to be restored. Protect sills, ledges, and projections from material droppings.

B. Surface Preparation

1. Remove spalled and weak concrete and remove all loose and foreign material. Chip substrate by bush hammering or other mechanical means acceptable to the repair concrete/mortar manufacturer to obtain a minimum aggregate-fractured surface profile of 1/8±" conforming to an ICRI CSP 7 or greater surface preparation.

Minimum depth of repair shall be 1/2", with the perimeter of the repair having a minimum of 1/8" in depth. Feather edging is not permitted.

2. If steel reinforcing is exposed, chip out behind the reinforcing steel. Chip a minimum of 1/2" behind the bar and 3" past the point where the bar is exposed. Concrete behind bars shall be removed enough to allow for the entire circumference of the bar to be cleaned. Remove concrete to the point past where sound material begins.
3. Exposed steel reinforcement and steel beams shall be free of all rust, scale, oil, paint, grease, loose mill scale, and all other foreign matter that will prevent bonding with the repair concrete. Use power chipping or power driven brushes and clean to an SSPC-SP2 or SP3 surface preparation.

4. Where additional reinforcement is not shown to be anchored in and for patches greater than 1 1/2" in depth and overhead patches, install stainless steel threaded J hooks set in epoxy paste adhesive. Anchor is to be 3/4" clear minimum from finished face of repair. Hooks are to be embedded a minimum of 3" into concrete, installed diagonally to plane of concrete surface. Holes are to be drilled 1/8" larger than rod diameter and shall be cleaned thoroughly. Space hooks at 16" o.c.

3.03 ANTI-CORROSION COATING APPLICATION

- A. Mix anti-corrosion coating in accordance with manufacturer's instructions. Apply to dry reinforcing steel using a stiff bristle brush. Brush in well to ensure continuous coverage. Apply in two coats of approximately 10 mils each or as per manufacturer's latest recommendations.
- B. Protect coated steel from weather and allow to dry a minimum of 30-45 minutes between coats or repair concrete/mortar application. However, apply repair material within 24 hours after last coating. If 24 hour period elapses, reapply bonding agent and allow to dry as above.

3.04 REPAIR CONCRETE/MORTAR APPLICATION

- A. Mix structural repair concrete in accordance with manufacturer's instruction. Follow time limits set by manufacturer to prevent hardening of material prior to placement. For material requiring extension with aggregate due to depth of repair, provide 3/8"

aggregate of proportions specified by the repair mortar manufacturer.

- B. Prior to application of material, thoroughly saturate surface with water. Remove any standing water prior to patching.
- C. Apply a scrub coat of the repair material of proportions determined by manufacturer (indicate in written repair procedure). While still damp, apply repair concrete/mortar.
- D. Apply material behind and around rebars first to completely fill void.
- E. Overhead/Vertical Repairs - Apply repair concrete/mortar, non-formed/overhead application, on vertical and overhead members with a trowel or other such device, all in accordance with the manufacturer's recommendations. Apply in lifts of up to 2" or as determined by material manufacturer at a consistency that the material will not slump. Follow manufacturer's instructions for scoring, curing, priming, and approximate time between layers. Do not leave voids. Trowel exposed surface smooth and to same shape and finish as the adjacent existing surface.
- F. Horizontal Repairs - Pour or trowel repair concrete/mortar, horizontal application, into hole until it is to the same level and at the same pitch as the surrounding slab. For deep repairs, extend mortar with clean aggregate by the amount recommended by the manufacturer. Provide finish as follows:
 - 1. Surfaces to receive bonded applied cementitious applications such as full-set terrazzo and vitreous ceramic tile: Darby and float surface and follow with a rough broom finish.
 - 2. Surfaces to receive floor coverings such as resilient flooring, thin-set terrazzo and vitreous ceramic tile, carpeting, wood floors, or surfaces which are intended as walking surfaces such as exposed or painted (cement finish), unless specified otherwise: Steel trowel surface to a smooth plane finish, free of score marks, grooves, depressions and ripples with a tolerance no greater than $\pm 1/8"$ in ten feet.
 - 3. Surfaces intended to receive roofing, waterproofing membranes: Darby and float surface. Leave surface free from depressions, bulges, rough spots, and other defects.

4. Ramps, Exterior Concrete Steps: Level surface with wood float and follow with a broom finish perpendicular to direction of traffic.

G. Formed Repairs

1. Apply repair concrete, horizontal application, on vertical members where formwork can be utilized to confine the concrete and the width of repair permits its proper installation.
2. Apply flowable repair mortar for repairs to be formed, especially for thin repairs.
3. Place so as not to leave voids. Vibrate forms with pencil vibrator to removed air bubbles. Remove formwork as soon as possible and trowel exposed surface smooth and to same shape and finish as the adjacent existing surface.

3.05 CURING

- A. As soon as surface of patch has hardened, cure patch a minimum of 48 hours by applying water-based acrylic curing compounds conforming to ASTM C309 or C1315, misting, wet burlap, etc. For patches to be covered with other material, only use curing compounds acceptable to the finish material manufacturer, unless the compound is removed prior to placing the finish material in a manner acceptable to the finish manufacturer.
- B. Follow manufacturer's latest recommendations for any other recommendations. The curing provision of A above shall not be waved unless manufacturer does not permit it.

3.06 PROTECTION AND CLEANING

- A. Clean all adjacent areas of excess material and clean all floors and walls of powder and droppings. Remove misplaced materials from surfaces immediately.
- B. Protect material from freezing and from rainfall prior to final set.

3.07 FIELD QUALITY CONTROL

- A. The Authority will inspect surfaces and reject any that contain cracks or other defects. The repair will be tested for soundness and structural integrity. Any defective areas shall be fixed at Contractor's expense. Notify the Authority's representative in advance of the concrete repairs. The Authority's representative will

review the mixing, surface preparation and proper application of all materials.

- B. Engage the services of the material manufacturer's representative to inspect the surface preparation, instruct in the proper usage of the material and to inspect the work throughout the project. Pay for all required fees.

END OF SECTION

LIST OF SUBMITTALS

<u>SUBMITTAL</u>	<u>DATE SUBMITTED</u>	<u>DATE APPROVED</u>
Product Data:	_____	_____
1. Anti-corrosion coating		
2. Repair concrete/mortar		
Certificates:	_____	_____
1. Material certification		
2. Training certificate		
Procedure:	_____	_____
1. Detailed written repair procedure		
Reports:	_____	_____
1. Manufacturer's written field reports.		
Qualifications	_____	_____
1. Installer		
2. Manufacturer		

* * *

SECTION 04420
EXTERIOR CUT STONE

PART 1 - GENERAL**1.01 DESCRIPTION OF WORK**

- A. Provide all cut stone Work as indicated on the Drawings and as specified herein.

1.02 REFERENCES

- A. References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.
- B. Indiana Limestone Institute of America (ILI).
- C. National Building Granite Quarries Association, Inc. (NBGQA).
- D. Brick Institute of America (BIA).
- E. American Society for Testing and Materials (ASTM).

1.03 SUBMITTALS

- A. Product Data

Suppliers' catalog sheets and specifications and standard test report for stone. Catalog sheets, specifications and installation instructions for accessories, anchors, mortar mixes, etc.

- B. Shop Drawings

- 1. Shop Drawings shall be submitted with details at scale not less than 3/4" = 1'-0".
- 2. Shop Drawings shall show sizes, dimensions of stone, jointing, bonding, anchoring, flashing and other necessary details; relation of contiguous work, including masonry concrete, windows, doors and built in items. Show also the supporting of stone by lintels, shelf angles, and other means.

C. Samples

1. Submit samples for approval in triplicate of each kind of stone.
2. Size of samples shall be 12" x 12".
3. Samples shall have same finish as required for the completed work.
4. Indicate extreme variation in color and texture of materials proposed to be used; materials incorporated in the finished work must be within the ranges or will be rejected.
5. Any material falling below the general character, as shown by the approved samples, will be rejected and must be replaced with approved material.
6. Accessories: One of each item and type specified.
7. Mortar Samples: Each color and type proposed. Submit samples installed in joints between actual specimens of the proposed stone.

D. Quality Control Submittals

1. Schedule: By mortar types.
2. Certificates
 - a. Statements that stone supplier and installer have the specified qualifications.
 - b. Statements that each kind and type of stone provided for this project meets the specified requirements.
3. Test Results:

Modulus of Rupture ASTM C99
Flexural Strength ASTM C880
Compressive Strength ASTM C170
Absorption ASTM C97
Petrographic Analysis
Accelerated Weathering G-90-98
Anchor Tests C1354-96, C1242-02a
4. Mock-up: Provide mock-ups as indicated under Quality Assurance.

1.04 QUALITY ASSURANCE**A. Qualifications**

1. Stone Supplier: Firm with 10 years of experience specializing in supplying, fabricating and finishing the required kind and type of stone.
2. Installer: Firm with 5 years of experience specializing in installing cut stone.

B. Regulatory Requirements

1. Building Code: Work of this Section shall conform to all requirements of the NYC Building Code and all applicable regulations of governmental authorities having jurisdiction, including safety, health, noise, and anti-pollution regulations. Where more severe requirements than those contained in the Building Code are given in this Section, the requirements of this Section shall govern.
2. NYC Board of Standards and Appeals (BSA) approvals, NYC Materials and Equipment Acceptance (MEA) approvals or Office of Technical Certification and Research (OTCR)

C. Certifications

Masonry construction shall conform to the material acceptance, certification and inspection requirements of Section BC 1701 of the 2008 NYC Building Code.

D. Source Quality Control

Stone of a given color range and grain shall come from a single quarry.

E. Defects

1. Do not use stone units with chipped arises, cracks, voids, stains, or other defects which will be visible in the finished Work.
2. Do not patch or hide defects. Remove defective stone units from the site.

F. Mockups

1. Construct sample panels to conform to appearance and workmanship as indicated in the Drawings and Specifications.
2. Use approved sample panels for a standard of comparison for the Project. All Work shall conform in workmanship and appearance to that of the approved samples.
3. If not approved, remove panel and install new panel (or panels), repeating the process until panel is approved.
4. Do not proceed with Work until panels are approved in writing by the Project Architect/Engineer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Cut stone shall be carefully packed for transportation and all precautions shall be taken against damage to the stone in transit.

Where necessary to ensure against damage, the stone shall be crated. All stone shall be delivered in the proper sequence required for expediting the work of setting.

- B. All stone shall be prepared in shops that are well protected from the weather and it shall be delivered to the job in a dry condition and without moisture or other stains.

All stone that is wet or discolored by moisture or other stains when delivered to the site, will be rejected and shall be removed from the premises at once. After delivery to the site, the stone shall be placed on plank platforms raised far enough above the ground or floor to prevent wet contacts or earth contacts and shall be kept properly covered with suitable material that will protect it from wetting soiling, staining and discoloration, and other damage.

- C. Handle stone in a manner that will prevent chipping, staining, and other damage. Use suitable lifting devices. Protect stone with suitable wood or other rigid cushioning materials.
- D. Patching of stone is prohibited.

1.06 ENVIRONMENTAL AND PROTECTION REQUIREMENTS**A. Cold Weather Construction Requirements**

Salt or other chemicals for lowering the freezing temperature of the mortar shall not be used.

Masonry units, mortar, and grout shall be preconditioned and masonry protected for the following cold weather conditions **per Section 2104.3 of the 2008 NYC Building Code:**

1. Air temperature 40°F to 32°F:
 - a. Heat mixing water or sand to minimum of 70°F and to maximum of **140°F**.
 - b. **Mortar and grout temperature shall be between 40°F and 120°F at the time of mixing.**
2. Air temperature 32°F to 25°F:
 - a. Heat mixing water and sand to minimum of 70°F and to maximum of **140°F**.
 - b. **Mortar and grout temperature shall be between 70°F and 120°F at the time of mixing. Grout temperature shall be maintained above 70°F at the time of grout placement.**
 - c. Provide heat source to maintain a minimum air temperature 32°F on each side of masonry construction.
3. Air temperature 25°F to 20°F:
 - a. Heat mixing water and sand to minimum of 70°F and to maximum of **120°F**.
 - b. Provide heat source to maintain a minimum air temperature of 32° on each side of masonry construction.
 - c. Provide wind breaks for wind in excess of 15 miles per hour.
 - d. **Keep temperature of masonry units a minimum of 40°F when laid and prior to grout placement.**

4. Air temperature 20°F and Below:
 - a. Heat mixing water and sand to a minimum of 70°F and to maximum of 120°F.
 - b. Provide enclosures and heat source to maintain a minimum air temperature of 32°F on each side of masonry construction during construction.
 - c. Keep temperature of masonry units a minimum of 40°F when laid **and prior to grout placement.**

B. Cold Weather Protection Requirements

1. Mean Daily Air Temperature of 40°F to 32°F:
 - a. Protect masonry **with weather resistive membrane** from rain or snow for 24 hours.
2. Mean Daily Air Temperature of 32°F and Below:
 - a. **Protect masonry with weather resistive membrane from rain or snow for 24 hours.**
 - b. An air temperature of at least 32°F shall be maintained on each side of masonry for a period of at least 48 hours if Type M or S mortar is used and at least 72 hours if Type N or O mortar is used.

C. Hot Weather Construction

Follow the requirements of BC 2104.4. When temperatures exceed 100°F, or 90°F with a wind speed of 8 mph, provide necessary conditions and equipment to produce mortar having a temperature below 120°F and to maintain the mortar and grout below 120°F.

1.07 EXISTING CONDITIONS

- A. Take necessary field measurements of existing structures.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All stone shall be well seasoned and free from quarry sap or any material producing stains after weathering. Stone shall contain no seams or defects which would impair its strength. All exposed surfaces shall be

free from spots, spalls, chips, stains, discolorations or other defects which would affect the appearance of the Work.

Stone shall be obtained from quarries or shops capable of furnishing quantity, sizes and character of the stone required. Cutting must be done by firms properly equipped to produce the finished material without causing delay in the progress of the Work. The Contractor will be held responsible for any delay in the completion of the Work due to his failure to supply satisfactory stone in ample quantities and proper sequence.

Submit an affidavit to the Authority from the quarry attesting that all stone of each type required for the particular project has been quarried and obtained from one quarry.

2.02 LIMESTONE

A. Where applicable, match the existing limestone in type, color, grade, and finish.

B. Type

Indiana Oolitic Limestone; ASTM C568, Class II. (Medium density, 4000 PSI).

C. Color

Gray.

D. Grade

Meet Indiana Limestone Institute of America (ILI) grade description.

1. Select.

E. Finish

Smooth; machine-planed with tool marks removed by hand.

F. Thickness: As shown or as otherwise necessary to meet the specified performance requirements.

2.03 GRANITE

A. Type: Granite Building Stone Standard ASTM C615. Color: As selected by Project Architect.

Where applicable, match the existing granite in grade, color, grain, and finish.

B. Grade

Standard; free of cracks, seams, and starts which may impair structural integrity or function, non-absorbent.

C. Finish

1. Wearing surfaces (Steps, Platforms, Paving): Thermal

2. Risers: Wire sawn

D. Thickness: As shown or as otherwise necessary to meet the specified performance requirements.

2.04 STEPPING STONES TO FLAGPOLE

A. "National Split" (Quarry Cleft) exposed surfaces; 2" thick.

1. Color: Slight variations in gray and rust.

2. Edges: Sawn or hand-cut.

2.05 CORNERSTONE, & DATESTONE (LIMESTONE)

A. Setting of stone shall be at time as directed by the Authority for the ceremony of the building dedication.

B. Cornerstone shall have a pocket cut in center to receive copper box specified in Section 07600.

C. Pocket size shall be 1" larger than box dimensions.

D. Cornerstone recess shall be approximately 1'-7" wide x 9" high.

E. Datestone material shall be as indicated on the Drawings.

F. Inscriptions

1. Lettering shall be incised, lettering type as indicated on the Drawings.

2. Text: as indicated on the Drawings.

3. Submit Drawings for approval at scale of 1-1/2" = 1'-0", showing full inscription with spacing and sizes of letters clearly dimensioned and a full size detail of two (2) typical letters showing style, depth of carving, and other pertinent information.

2.06 COPINGS AND CORNICES (LIMESTONE)

- A. Sections of uniform lengths, not less than 4'-0", and as indicated on the Drawings.
- B. Projection beyond face of wall shall have drip groove cut along the underside.
- C. Drip groove shall not contact face of building.
- D. Full return heads.
- E. Top beds cut with a minimum 1" wash, washing in the direction of the roof.

2.07 STEPS AND PLATFORMS (GRANITE)

- A. Solid stone cut full thickness of rise.
- B. 4" minimum bearing when supported on walls.
- C. Pitch of 3/16" per foot, unless otherwise detailed.
- D. Outer edges of steps, platforms and cheeks shall be slightly rounded.

2.08 REGLETS (LIMESTONE)

- A. Provide in stone to receive flashing where indicated on the Drawings.
- B. Reglet: 3/4" deep; Width: 3/4" at top and both sides shall slope to form an undercut, so that reglet is 1" wide at bottom.

2.09 SILLS (LIMESTONE)

- A. Unless otherwise shown, window and door sills shall have lugs and shall be cut with wash as detailed. Where the face of sill projects beyond the face of wall, a drip groove shall be cut along the underside.
- B. Stone sills beneath window sills, and louver openings shall extend under sill, and shall be provided with reglet to receive weather bar. See Details.

2.10 WEEP HOLES

- A. Rigid plastic tubing having inner diameter of 1/4" shall be used as weep holes for exterior stonework.

2.11 MORTAR**A. Base Materials**

1. Portland Cement ASTM C150
Type I
2. Sand for Mortar Mix ASTM C144
Sand shall be natural sand with
100% passing the No. 8 sieve.
3. Hydrated Lime ASTM C207
Type "S"
4. Water: **Shall be clean potable water free of
injurious foreign matter conforming to the
requirements of Section BC 1903.4 of the 2008 NYC
Building Code.**
5. Mortar Coloring: Provide pure mineral pigments,
natural and synthetic iron oxides, and chromium
oxides compounded for use in mortar mixes.
Material shall conform to ASTM C979. Coloring
shall not contain alkalyde salts. No liquid
colorants shall be permitted. SGS mortar Colors,
Solomon Grind-Chem Services, Inc. or "True Tone
Mortar Colors", Davis Colors (Rockwood
Industries).
6. Mortar additive for use in setting of exterior
brick granite steps and other such elements with
horizontal surfaces exposed to de-icing salts.
 - a. Additive shall be non-toxic, non-flammable,
and non-hazardous during storage, mixing,
application, and when cured.
 - b. Finished mortar shall be resistant to urine,
dilute acid, dilute alkali, sugar, brine, and
calcium chlorides and other salts used in de-
icing salts.
7. Premixed sand and lime for mortar mixes is not
permitted. The use of batched material by Spec-
Mix and factory-packaged cement-lime-pigment by
major mortar manufacturers is permitted, subject
to approval of the Authority.
8. No air-entraining admixtures or material
containing such shall be permitted in the mortar.
Also, no anti-freeze compounds, calcium chloride,
or other compounds shall be permitted in the
mortar, unless expressly permitted otherwise.

B. Mortar Mixes

Shall conform to ASTM C270 and BIA M1-88. Provide Type I Portland cement. Masonry cement shall not be used as a substitute. The maximum strength of each mortar type shall not exceed the minimum strength of the next higher strength mortar type.

1. Mix for Limestone

- a. Setting Mortar: (Type "N") 1 part cement, 1 part lime, 6 parts dry sand.
- b. Pointing Mortar: (Type "N") One (1) part cement, 1 part lime, 6 dry parts sand.

2. Mix for Granite

- a. Setting Mortar: (Type "N") 1 part cement, 1/2 part lime, 4-1/2 parts dry sand.
- b. Pointing Mortar: (Type "N") 1 part cement, 1/2 part lime, 4-1/2 parts dry sand.

3. Measure mortar ingredients by volume or equivalent weight. In measuring by volume, use a container to measure ingredients. Do not measure by shovel.
4. Mix ingredients in a clean mechanical mixer, with the minimum amount of water to produce a workable consistency.
5. **Proportion mortar coloring with other mortar mix ingredients to obtain desired color, as approved by the Project Architect. Provide white cement instead of gray cement where required to meet the desired color. Do not exceed 1 part pigment to 10 parts cement, by weight. If consistent color cannot be obtained, provide as a minimum premixed Portland cement and coloring from major cement manufacturer.**

2.12 ANCHORS AND DOWELS

- A. Provide all anchors, dowels and accessories shown on the Drawings and as required for securing stone, as manufactured by Hohmann Barnard; stainless steel ASTM A167, 18-8, **Type 304**.
- B. Anchors shall be provided for all stones that extend less than 8" into wall, and for all stones, that

project more than 1-1/4" beyond the wall face immediately below.

- C. Anchors shall have ends turned 1" into cut stone and 2" into the masonry. Lengths specified are exclusive of bent ends. When anchors are required, provide 2 anchors for each stone 18" or more in length and one anchor for smaller stones.
- D. Anchors for bonding stone to masonry shall be 1/4" x 1 1/4" flat stainless steel (**Type 304**) bars extending beyond stone at least 4" into masonry.
- E. Anchors for securing cut stone to concrete shall be #303 Corrugated Dovetail Tie, 1" wide x 2 1/2" long, 14 gage, **Type 304** stainless steel, with #205 Series Dovetail Anchor Slots. Every stone shall be anchored with at least two (2) anchors.
- F. Cramps

Type 304 stainless steel bars, 1/8" x 1", unless indicated otherwise on the Drawings.
- G. Dowels

Type 304 stainless steel rods, 3/8" minimum diameter, unless indicated otherwise on the Drawings.
- H. Anchor Bolts, Washers, and Nuts

Type 304 stainless steel.
- I. Wire Ties

10 gage stainless steel wire.
- J. Setting buttons/Pads

Lead or stainless steel.
- K. Stone Cleaner

Non-staining cleaning solution which will not harm stone and mortar.

2.13 **FABRICATION**

- A. Cut stone to the required dimensions and profiles, with surfaces finished to true planes.

1. Cut or drill to form chases, openings, reveals, reglets, and similar spaces and features shown and as required for contiguous Work.
2. Cut or drill holes and sinkages for anchors, supports, fasteners, and necessary lifting devices. If possible, do not locate holes, sinkages within 2" of exposed surfaces. Holes must be sized to allow for expansion and contraction of anchors.
3. Unless otherwise shown, cut stone for a uniform joint width of 1/4".
4. Cut all external corners and interior angles of molded or projecting courses with solid returns. Unless otherwise approved or required by the Design, return on external angles shall be not less than 8" and returns on interior angles shall be as required to provide solid returns of molded or projecting members.
5. All projecting stone such as cornices, coping, belt courses, sills, and other units with top exposed surfaces shall be cut with wash on top and shall have grooved drips cut on the underside. Where Work is to be built on such stone the top surface shall be cut with raised seats and lugs to form level beds for the above. Projecting courses shall have not less than four-sevenths of their cubic contents inside the face of the wall unless other approved special arrangements are provide for anchoring them to the structure.

B. Tolerances

Stone shall be cut within the indicated tolerances for the specified finish. In the case of optional tolerance specifications, comply with the most stringent tolerances unless otherwise indicated.

1. Limestone: Fabrication tolerances in the "ILI Handbook" by the Indiana Limestone Institute of America, Inc.
2. Granite: Fabrication tolerances in the "Specifications For Building Granite" by the National Building Granite Quarries Association, Inc.

2.14 POINTING SEALANTS

- A. Type 1B Sealant "For Vertical Joints" (one-part polyurethane) as specified in Section 07900 - JOINT SEALERS. Provide joint primer/sealer as recommended by Sealant Manufacturer; backer rod: compressible rod stock of expanded extruded polyethylene.

2.05 SOURCE QUALITY CONTROL

- A. The Authority will assign a Special Inspector who will inspect the masonry construction under the requirements of Section BC 1704.5 of the 2008 NYC Building Code.

- B. Preconstruction Testing

- 1. Preconstruction testing of mortar properties will be done in accordance with ASTM C780. The Contractor shall assist the Authority's laboratory by any means necessary and shall provide the mock-up prior to beginning the installation work to allow for adjustments of the mix if necessary. Do not proceed with masonry work until the preconstruction testing is completed. Contractor shall mix mortar as it intends for the actual construction.
 - 2. Compressive strength tests of field mixed mortar are to be done during construction of the mock-up, or earlier if desired by the Contractor, to provide a benchmark for the strength based on actual field conditions and proportioning of the mortar. If mortar strengths are too high, proportions may be required to be modified if directed by the Architect or Engineer of Record.

PART 3 - EXECUTION**3.01 EXAMINATION**

- A. Examine surfaces to receive cut stone for defects that will adversely affect the execution and quality of the Work. Do not proceed until unsatisfactory conditions are corrected.
 - 1. Verify that required built-in anchorage items are install in designed locations.
 - 2. Verify that any required bituminous dampproofing or waterproofing has been applied (if indicated on the Drawings or if specified).

3.02 PREPARATION

- A. Just prior to setting stone, clean surfaces that support the Work of this Section.
- B. Clean stone before setting by scrubbing with fiber brushes, followed by a thorough drenching with clear water. Use only mild cleaning solutions that contain no harsh or caustic abrasive or fillers.
- C. If stone is not wet at time of setting, drench or sponge stone with clean water, except do not wet expansion joint or control joint surfaces that require sealant.

3.03 PROTECTION

- A. Protect face materials against staining. Remove misplaced mortar immediately.
- B. Protect newly laid masonry from exposure to precipitation, excessive drying, freezing, soiling, backfill, and other harmful elements.
- C. Do not use frozen materials or lay masonry on frozen materials; remove frozen materials from wall. Refer to Part 1 of this Section, "Environmental Requirements" for temperature restrictions.
- D. Cover top of walls with not-staining, waterproof, temporary covering when work is not in progress. Protective covering shall overhang each side of wall a minimum of 2' and be securely anchored.
- E. Protect sills, ledges, off-sets, and similar features from drippings and other damage during construction.

3.03 MIXING PROCEDURE FOR MORTAR

- A. Measure material by volume or equivalent weight. In measuring by volume, use a container to measure ingredients. Do not measure by shovel.
- B. Setting Mortar
 - 1. Mix ingredients in a clean mechanical mixer for a minimum of 3 minutes, maximum of 5, with the minimum amount of water to produce a workable consistency.
 - 2. Mortar that has stiffened because of evaporation of water from the mortar may be retempered only once, and only during the first hour of placement

to restore the required consistency. Use mortar within 2¹/₂ hours of its initial mixing; tempering is permitted only once and during the first hour only. Limit amount of mortar batched at one time to stay within these requirements.

C. Pointing Mortar

1. Add sufficient water to dry mix to produce a damp mix that will retain its shape when pressed into a ball by hand. Mix from 3 to 7 min. in a mechanical mixer.
2. Let mortar stand for not less than 1 hour nor more than 1-1/2 hours for prehydration. Add sufficient water to bring mortar to proper consistency for tuck-pointing, somewhat drier than mortar used for laying units.
3. Use mortar within 2-1/2 hours of its initial mixing; tempering is permitted only once after bringing mortar to proper consistency. Limit amount of mortar batched at one time to stay within these requirements.

- D. For prepackaged masonry repair mortar, mix with water or manufacturer's polymer in proportions defined by manufacturer to provide the required consistency.**

3.04 INSTALLATION

- A. Install stone plumb and true to line in level courses, unless otherwise shown. Set stone in full mortar setting bed and completely fill joints, accessory sinkages, and lifting holes with mortar, except keep expansion joints, control joints, and other required cavities free of mortar.
1. Set lugged sills with ends only embedded in setting mortar. Point open joint 1" deep with pointing mortar.
- B. Solidly build-in accessories, supports, and contiguous items of other trades unless otherwise shown or directed.
- C. Set stone with 1/4" wide joints and beds, unless otherwise shown.
1. Tolerance: Maximum variation of + 1/4 of specified width.
- D. After mortar has set "thumb-print" hard, rake out exposed joints 3/4" deep. Brush face of joints clean.

E. Weep Holes

Provide at the following locations unless indicated otherwise:

1. 1" above grade on all vertical joints.
2. In horizontal joints where an angle is located, at 24" on center.
3. At the bottom of each vertical stone joint above a window or door unit.
4. Care shall be taken in placing weep holes in joints so that stone underneath will not be stained as a result of the weep holes.

F. Anchorage

Anchor stone to concrete and masonry backing and stones to each other as indicated on the Project Drawings and the approved Shop Drawings and in accordance with Stone Institute or Association Reference recommendations. On the Shop Drawings, show all required anchorage types and locations based on the References.

3.05 POINTING

- A. Except where joints are to be sealed with sealant, wet the raked joints and point full with pointing mortar. Cut joints flush and neatly tool surface of joints slightly concave. Finish joints that abut other masonry to match the joint finish of the adjacent masonry.
- B. Sealing with Sealant (provided under Section 07900): Rake out joints to depth of 3/4"; prime ends of stones. Insert proper size backer rod and gun apply sealant with a neat uniform finish.

3.06 FIELD QUALITY CONTROL

- A. The Authority will assign under the requirements of **Section 1704.5 of the 2008 NYC Building Code** a **Special Inspector** who will inspect the masonry construction. If the masonry work is not designated for Controlled Inspection, the masonry work will be subject to Quality Control Inspection, with testing and inspection similar to that listed below for **Special Inspection**. Inspections performed by the Authority do not relieve the Contractor of its obligation to conform to all requirements specified in this Section.

- B. The **Special Inspector** will make inspections and any testing deemed necessary. Mortar suspected or tested to be too strong or too weak will be subject to petrographic analysis or other methods deemed necessary by the Engineer of Record and **Special Inspector**. The Contractor shall pay for all tests if they verify improper work. Inspections **will** include, but not be limited to, the following:
1. Proper installation of reinforcement and placement of stone on angles.
 2. Proper installation of mortar, including proportioning and mixing. Those mortar properties listed in the Appendix of ASTM C780 are to be tested at the discretion of the **Special Inspector** or the Architect/Engineer of Record. Mortar strengths, when tested, will be determined in accordance with ASTM C780 using **cylinders**.
 3. Proper installation of weeps, flashing, **drip edges**, etc.
 4. **At solid masonry construction, all bed, head, and collar joints are filled completely. For cavity wall construction, all bed and head joints are filled completely.**
- C. The Architect or Engineer of Record will analyze any results not found to be in conformance with the applicable ASTM standard, industry practice, and the Specifications and determine if the work in question is to be removed and redone.
- D. Cooperate with the **Special Inspector** and the Testing Laboratory performing **Special** Inspection testing.

3.07 CLEANING

- A. Clean the stone after completion of setting, pointing, and other Work liable to soil the stone.
1. Carefully remove excess mortar and other encrusted matter.
 2. Scrub soiled surfaces of stone with mild detergent or stone cleaner and water. Use non-metallic tools. Do not use any acid bearing cleaner on limestone. **Perform a mock-up of the cleaning procedure.**

3. Remove any remaining stains by rubbing with a carborundum stone and restore the specified surface finish.
4. Flush stone with clean water to remove any remaining residue of cleaning agent and dirt.

END OF SECTION

LIST OF SUBMITTALS

<u>SUBMITTAL</u>	<u>DATE SUBMITTED</u>	<u>DATE APPROVED</u>
Product Data:	_____	_____
1. Catalog sheets		
2. Specifications		
3. Installation instructions		
4. Test reports		
Shop Drawings:	_____	_____
Samples:	_____	_____
1. 3 samples each kind of stone (12"x 12")		
2. One sample of each item & type accessory specified		
3. Mortar joints		
Quality Control Submittals:	_____	_____
1. Schedule by mortar type		
2. Certification of stone supplier qualifications		
3. Certification of stone installer qualifications		
4. Certification that stone complies with Specs		
5. Test results		
Calculations:	_____	_____
Mock Up:	_____	_____

* * *

SECTION 04435
CAST STONE

PART 1 - GENERAL**1.01 DESCRIPTION OF WORK**

- A. The Work of this Section includes all labor, materials, equipment and services necessary to:

Provide cast stone copings, bandings, window sills, windows surrounds and all other cast stone features and accessories as indicated on Drawings, specified herein, and as needed for a complete and proper installation.

4

1.02 SUSTAINABILITY REQUIREMENTS

- A. The Contractor shall implement practices and procedures to meet the Project's sustainable requirements. The Contractor shall ensure that the requirements related to these goals, as defined in Specification Section S01352, Sustainability Requirements, and as specified in this Section, are implemented to the fullest extent. Substitutions or other changes to the work shall not be proposed by the Contractor or their sub-contractors if such changes compromise the stated Sustainable Design Performance Criteria.

- B. Sustainability requirements included in the Section are as follows:

1. Documentation of Regional materials.

1.03 REFERENCES

- A. References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.
- B. American Concrete Institute (ACI).
- C. Concrete Reinforcing Steel Institute (CRSI).
- D. Precast Concrete Institute (PCI).
- E. American Society for Testing and Materials (ASTM).

1.04 SUBMITTALS

A. Submit the following product information

1. Materials list of items proposed to be provided under this Section.
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
3. Laboratory tests reports, by a qualified independent testing laboratory, as specified in Article titled "Source Quality Control"; or Precast Concrete Institute (PCI) or Cast Stone Institute (CSI) certification.
 - a. Source Quality Control testing will be waived if the casting plant is PCI or CSI certified. Submit documentation of PCI or CSI Plant Certification Program in order to obtain a written waiver from the Authority, and include copies of material test reports for completed projects indicating compliance of cast stone with ASTM C1364.
4. Qualification Data: For manufacturer, installer and test laboratory as 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.
5. Shop Drawings showing complete information for fabrication and erection of the Work of this Section, including, but not limited to:
 - a. Show fabrication and installation details for cast stone. Include dimensions and cross sections; details, locations, size, and type of reinforcement and anchorages, including special reinforcement and lifting devices necessary for handling and erection. Indicate finished faces.

Include plans and building elevations showing layout of units and locations of joints and anchors.

- b. Erection procedures, sequence of erection, and required handling equipment.
 - c. Layout, dimensions, and identification of each precast unit corresponding to the sequence and procedure of installation.
 - d. Details of inserts, connections, and joints, including accessories.
 - e. Location and details of anchorage devices that are to be embedded in other construction.
6. Product Certification: Air-entraining admixture certified by the manufacturer to be compatible with other admixtures used.

B. Samples

- 1. Cast Stone: Submit 3 cast stone samples approximately 12" x 12" x 4", showing quality, texture, and color of the proposed finish.
- 2. Samples for Initial Selection of Mortar Color: Submit the full range of colors available. Where mortar color is to match existing, provide proposed colors.
- 3. Samples for Verification of Mortar Color: For each mortar color required, submit the full range expected in the finished construction. Make samples using the same ingredients to be used on Project. Label samples to indicate type and amount of colorant used.
- 4. Submit 3 samples each of anchorages and other attachments and accessories.
- 5. Full Size Cast Stone Samples: Prior to start of installation, and after the review of finish Samples, submit one full size Sample of each shape of required cast stone unit, delivered to the job site. Acceptable full size samples may be incorporated in the construction.
- 6. Review of samples by the Authority will be for color, texture, and general condition only. Compliance with all other requirements is the exclusive responsibility of the Contractor.
- 7. Field quality control test samples, if required.

4

C. Sustainable Submittals:

1. Submit Contractor's Sustainable Materials Form with complete information on regional content for cast stone provided under the work of this section in accordance with Section G01352, Sustainability Requirements. Include cost of all cast stone materials and distance in miles to point of materials extraction and manufacture.
2. Submit documentation of regional materials - product data, mix design information, or manufacturer's statement.

1.05 QUALITY ASSURANCE

A. Installers Qualifications

A firm with at least 3 years experience in installing cast stone units of a type and quantity similar to those indicated for this Project.

Use adequate numbers of skilled workman 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 of this Section.

B. Manufacturer Qualifications

A supplier experienced in manufacturing cast stone units similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to manufacture required units.

C. Testing Laboratory Qualifications: An independent testing laboratory qualified according to ASTM E329 to conduct the testing specified, as documented according to ASTM E548.

D. Source Limitations for Cast Stone: Obtain cast stone units through one source from a single manufacturer.

E. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver the Work of this Section to the job site in such quantities and at such times as to assure the continuity of construction; carefully pack or crate to prevent damage.
- B. Store units at the job site in a manner to prevent cracking, distortion, warping, staining, and other physical damage, and in a manner to keep markings visible.
- C. Lift and support the units only at designated lifting points or supporting points as shown on the approved Shop Drawings.
- D. Any units damaged before final acceptance shall be replaced.
- E. Patching of units will not be acceptable.
- F. Pack, handle, and ship cast stone units in suitable packs or pallets.
 - 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units, if required, using dollies with wood supports.
 - 2. Store cast stone units on wood skids or pallets with non-staining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.
- G. Store installation materials on elevated platforms, under cover, and in a dry location.
- H. Store mortar aggregates where grading and other required characteristics can be maintained and contamination avoided.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Cold Weather Construction Requirements

Salt or other chemicals for lowering the freezing temperature of the mortar shall not be used.

Masonry units, mortar, and grout shall be preconditioned and masonry protected for the following cold weather

conditions per Section 2104.3 of the 2008 NYC Building Code:

1. Air temperature 40°F to 32°F:
 - a. Heat mixing water or sand to minimum of 70°F and to maximum of 140°F.
 - b. Mortar and grout temperature shall be between 40°F and 120°F at the time of mixing.
2. Air temperature 32°F to 25°F:
 - a. Heat mixing water and sand to minimum of 70°F and to maximum of 140°F.
 - b. Mortar and grout temperature shall be between 70°F and 120°F at the time of mixing. Grout temperature shall be maintained above 70°F at the time of grout placement.
 - c. Provide heat source to maintain a minimum air temperature 32°F on each side of masonry construction.
3. Air temperature 25°F to 20°F:
 - a. Heat mixing water and sand to minimum of 70°F and to maximum of 120°F.
 - b. Provide heat source to maintain a minimum air temperature of 32°F on each side of masonry construction.
 - c. Provide wind breaks for wind in excess of 15 miles per hour.
 - d. Keep temperature of masonry units a minimum of 40°F when laid and prior to grout placement.
4. Air temperature 20°F and Below:
 - a. Heat mixing water and sand to a minimum of 70°F and to maximum of 120°F.
 - b. Provide enclosures and heat source to maintain a minimum air temperature of 32°F on each side of masonry construction during construction.
 - c. Keep temperature of masonry units a minimum of 40°F when laid and prior to grout placement.

B. Cold Weather Protection Requirements

1. Mean Daily Air Temperature of 40°F to 32°F:
 - a. Protect masonry with weather resistive membrane from rain or snow for 24 hours.
2. Mean Daily Air Temperature of 32°F and Below:
 - a. Protect masonry with weather resistive membrane from rain or snow for 24 hours.
 - b. An air temperature of at least 32°F shall be maintained on each side of masonry for a period of at least 48 hours if Type M or S mortar is used and at least 72 hours if Type N or O mortar is used.

C. Hot Weather Construction

Follow the requirements of BC 2104.4. When temperatures exceed 100°F, or 90°F with a wind speed of 8 mph, provide necessary conditions and equipment to produce mortar having a temperature below 120°F and to maintain the mortar and grout below 120°F.

PART 2 - PRODUCT**2.01 MATERIALS****A. Cast Stone**

1. Portland Cement: ASTM C150, Type I, white, containing not more than 0.60 percent total alkali when tested according to ASTM C114.
2. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C33; gradation as needed to produce required textures. Used for wet mix process.
3. Fine Aggregates: Manufactured or natural sands complying with ASTM C33, gradation as needed to produce required textures.
4. Coloring Admixture for Cast Stone: ASTM C979, synthetic mineral-oxide pigments or colored water-reducing admixtures, temperature stable, non-fading, and alkali resistant.
5. Water: Shall be clean potable water free of injurious foreign matter conforming to the

requirements of Section BC 1903.4 of the 2008 NYC Building Code.

6. Air-Entraining Admixture: ASTM C260, certified by the manufacturer to be compatible with other admixtures used.
 - a. Add to wet-cast process mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 5 to 7 percent. For dry-cast process mixes, it is required if needed to meet the freeze-thaw resistance criteria.
7. Other Admixtures: ASTM C494.
8. Reinforcement: Deformed steel bars complying with ASTM A615/A615M.
 - a. Epoxy Coating: ASTM A775/A775M.
9. Inserts: Fabricated from stainless steel complying with ASTM A276 or ASTM A666, Type 304.

6

B. Anchors:

1. Eye rods: Type 304 stainless steel complying with ASTM A276.
2. Pins/Dowels: Round stainless-steel bars complying with ASTM A276, Type 304, 1/2-inch diameter.
3. Strap Anchors for building with back-up wall or welding to existing steel: 1/8" thick minimum stainless steel, Type 304 conforming to ASTM A240. See Drawings for sizes and shapes.
4. Rod Anchors for attaching into masonry are to be Type 304 stainless steel adhesive type with screen:
 - a. Hilti HY 20 for hollow back up and HY 150 for solid back-up.
 - b. ITW/Ramset Epcon 6
 - c. Powers Fasteners AC100+Gold
4. Electrode for Welding to Stainless Steel to carbon steel: E309-16. Keep electrode dry. Oven dry electrode after exposing it for more than 6 hours.

2

C. Mortar

1. Portland Cement: ASTM C150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color, white, or a blend to produce mortar color indicated.
2. Hydrated Lime: ASTM C207, Type S.
3. Mortar Aggregate: ASTM C144.
 - a. White-Mortar Aggregates: Natural, white sand or ground, white stone.
- 3

4. Mortar Coloring: Provide pure mineral pigments, natural and synthetic iron oxides, and chromium oxides compounded for use in mortar mixes. Material shall conform to ASTM C979. Coloring shall not contain alkalyde salts. No liquid colorants shall be permitted. Use only pigments with record of satisfactory performance in masonry mortars.
5. Water: Shall be clean potable water free of injurious foreign matter conforming to the requirements of Section BC 1903.4 of the 2008 NYC Building Code.

D. ACCESSORIES

1. Job-Mixed Detergent Solution: Solution of 1/2 cup (125 mL) of dry-measure tetrasodium polyphosphate and 1/2 cup (125 mL) of dry-measure laundry detergent dissolved in 1 gal. (4 L) of water.
2. Sealant
 - a. Sealant as specified in Section 07900 - Joint Sealers, as applicable for vertical joints and for horizontal joints.
 - b. Bond breaker tape as specified in Section 07900 - Joint Sealers.

2.02 CAST STONE UNIT FABRICATION

- A. Provide cast stone units complying with ASTM C1364.
 1. Compressive Strength: At 28 days after manufacture, not less than 6500 psi, when tested in accordance with Test Method ASTM C1194.

2. Absorption, Cold Water: At 28 days after manufacture, not greater than 6%, when tested in accordance with Method A, Cold Water of Test Method ASTM C1195.
3. Absorption, Hot Water: At 28 days after manufacture, not greater than 10%, when tested in accordance with Method B, Boiling Water Test of Test Method ASTM C1195.
4. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C666, Procedure A, as modified by ASTM C1364.

B. Colors and Textures

1

1. _____.

2. Color shall be uniform for each unit and consistent for all units.

C. Fabrication

1. General

- a. Fabricate the Work of this Section to the sizes and shapes indicated, and of texture matching the approved Samples.
- b. Provide finished units that are straight, true to size and shape, and within the specified casting tolerances.
- c. Make exposed edges sharp, straight, and square, unless indicated otherwise. Make flat surfaces into a true plane.
- d. Warped, cracked, broken, spalled, stained, **surface crazed**, and otherwise defective units will not be acceptable.
- e. Place and secure in the forms all anchors, clips, stud bolts, inserts, lifting devices, shear ties, and other devices required for handling and installing the precast units and for attachment of subsequent items as indicated or specified.

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- f. Field measure existing units and produce molds from existing units to replicate work. Based

on these, create shop drawings and molds. Joint widths are to be 1/4" minimum if existing is less than 1/4" and 3/8" maximum if joints are equal to or greater than 3/8".

- g. Reinforce units as indicated and as required by ASTM C1364. Use epoxy-coated reinforcement.
2. Fabricate units with sharp arris and details accurately reproduced with indicated texture on all exposed surfaces, unless otherwise indicated. Match existing units in texture, color and shape where units are being replaced. Take all molds as necessary.
- a. Slope exposed horizontal surfaces at least 1:12, unless otherwise indicated.
 - b. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
 - c. Provide drips on projecting elements, unless otherwise indicated.
3. Casting tolerances
- Maintain casting, bowing, warping, and dimension tolerance below the following maximums:
- a. Overall dimension for height and width of units:
Plus zero, and minus 1/16" of unit length.
 - b. Make thickness of units plus or minus 1/8" maximum.
 - c. Bowing or warping: Do not exceed 1/360 of the length.
 - d. Insert locations: Place within plus or minus 1/4" in each direction.
4. Cure and finish units as follows:
- a. Cure units in totally enclosed curing room under dense fog and water spray at 95 percent relative humidity for a minimum of 24 hours. Follow PCI recommendations.

- b. Yard cure units until the sum of the mean daily temperatures for each day equals or exceeds 350°F.
- c. Acid etch units to remove cement film from surfaces indicated to be finished.

2.03 MORTAR MIXES

A. Setting Mortar

- 1. Shall conform to ASTM C270 and BIA M1-88. Provide Type I Portland cement. Masonry cement shall not be used as a substitute. Preconstruction testing with the proportions carefully monitored is to be used to establish the upper end of the strength range, which should generally be near the minimum strength of the next higher strength mortar.
 - a. **Mortar shall be Type S: 1 part white cement, 1/2 part lime, 4¹/₂ parts dry sand. Minimum compressive strength shall be 1800 psi at 28 days.**

3

- 2. Mortar Color: Proportion mortar coloring with other mortar mix ingredients to obtain desired color, as approved by the Project Architect. Do not exceed 1 part pigment to 10 parts cement, by weight. If consistent color cannot be obtained, provide as a minimum premixed Portland cement and coloring from major cement manufacturer.

2.04 SOURCE QUALITY CONTROL

5

- A. The Authority will assign a Special Inspector who will inspect the masonry construction under the requirements of Section BC 1704.5 of the 2008 NYC Building Code.
- B. Employ an independent testing agency to sample and test cast stone according to ASTM C1364 and the specific test methods specified in Article titled "Cast Stone Units".

Include testing for:

- 1. Compressive Strength in accordance with Test Method ASTM C1194. Test units from each 500 ft³ of cast stone.
- 2. Absorption, Cold Water and Hot Water, in accordance with Test Method ASTM C1195. Test units from each 500 ft³ of cast stone.

3. Resistance to Freezing and Thawing in accordance with Test Method ASTM C666, Procedure A. Test one unit from each cast stone mixture design.
- C. If test specimens fail, the specimens and the entire 500 ft³ lot they came from shall be rejected and shall not be used in the project.
- D. The requirements for Source Quality Control testing will be waived by the Authority if the casting plant is PCI or CSI Certified. See Article titled "Submittals" for certification and other submittals required.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of cast stone.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PROTECTION

- A. Cover top of masonry wall with waterproof plastic membrane at the end of the work period, when work is not in progress, and at other times when Work needs to be protected from rain and other precipitation. Extend cover down sides as needed to thoroughly protect the Work.
- B. During cold weather, do not use wet masonry units and frozen masonry units.
- C. Do not use frozen materials or lay masonry on frozen materials; remove frozen materials from wall. Refer to Part 1 of this Section, "Environmental Requirements" for temperature restrictions.
- D. Remove excess mortar from walls as soon after laying units as practicable to prevent staining and to facilitate cleaning of wall.
- E. Brace walls as needed until sufficiently set, or until intersecting walls provide lateral support.
- F. Prevent masonry cleaners from coming in contact with adjacent glass, metal, and other masonry surfaces such as

cast stone. Protect adjoining glass and metal surfaces and all other adjacent materials and property from masonry operations.

3.03 MIXING PROCEDURES FOR MORTAR

- A. Measure material by volume or equivalent weight. In measuring by volume, measure ingredients by container. Do not measure by shovel.
- B. Mix ingredients in a clean mechanical mixer for a minimum of 3 minutes, maximum of 5, with the minimum amount of water to produce a workable consistency.
- C. Mortar that has stiffened because of evaporation of water from the mortar may be retempered only once, and only during the first hour of placement to restore the required consistency. Mortar shall be used within 2¹/₂ hours after initial mixing. Limit amount of mortar batched at one time to stay within these requirements.

3.04 INSTALLATION

- A. Coordinate as required with other trades to assure proper and adequate accommodation with the Work of this Section.
- B. Set cast stone as indicated on Drawings. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
- C. Drench units with clear water just before setting.
- D. Set units in full bed of mortar with full head joints, unless otherwise indicated. Build anchors and ties into mortar joints as units are set. Anchors to be set in substrate with non-shrink grout.
 - 1. Coping Stone: Set 3/8" of mortar prior to installation of flashing providing full bed. Rake joint 3/8" to allow for bondbreaker tape and sealant installation. Seal flashing penetrations with sealant. Install another 3/8" mortar on top of flashing and place stone. Provide full bed of mortar and tool joint. After stones are set and mortar cured, install bond breaker tape and sealant under the flashing.
 - 2. Fill dowel holes and anchor slots with mortar.

3. Fill collar joint solid as units are set.
4. Build concealed flashing into mortar joints as units are set.
- E. After units are set in or on the wall they shall have all top surfaces covered and protected from the elements at the close of each day's work and shall be kept covered and protected until all the Work is completed.
- F. Lead, Plastic or hard rubber buttons shall be used in setting large units to sustain the weight until mortar has set.
- G. All joints between units shall be raked out 3/8" deep and shall be filled with joint sealer, (after bond breaker tape) as specified in Article titled "Accessories".
- H. Expansion Joints

Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.

Provide expansion joints at a maximum spacing of approximately 40 feet on center. Match joint spacing with parapet expansion joints.

Provide filler seal, bond breaker tape, and joint sealers at expansion joints where indicated on the Drawings and where required for proper installation. (See Section 07900 Joint Sealers).

Keep joints free of mortar and other rigid materials.
- I. Discrepancies
 1. Immediately notify Authority's Representative.
 2. Do not proceed until fully corrected.

3.05 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m) or more.
- B. Variation from Level: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (9 mm) maximum.

- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches (3 mm in 900 mm) or one-fourth of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not exceed 1/16-inch (1.5-mm) difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

3.06 FIELD QUALITY CONTROL

5

- A. The Authority will assign under the requirements of Section 1704.5 of the 2008 NYC Building Code a Special Inspector who will inspect the masonry construction. If the masonry work is not designated for Controlled Inspection, the masonry work will be subject to Quality Control Inspection, with testing and inspection similar to that listed below for Special Inspection. Inspections performed by the Authority do not relieve the Contractor of its obligation to conform to all requirements specified in this Section.
- B. The Special Inspector will make inspections and any testing deemed necessary. Mortar suspected or tested to be too strong or too weak will be subject to petrographic analysis or other methods deemed necessary by the Engineer of Record and Special Inspector. The Contractor shall pay for all tests if they verify improper work. Inspections will include, but not be limited to, the following:
 - 1. Proper installation of reinforcement and placement of stone on angles.
 - 2. Proper installation of mortar, including proportioning and mixing. Those mortar properties listed in the Appendix of ASTM C780 are to be tested at the discretion of the Special Inspector or the Architect/Engineer of Record Mortar strengths, when tested, will be determined in accordance with ASTM C780 using cylinders.
 - 3. Proper installation of weeps, flashing, drip edges, etc.
 - 4. At solid masonry construction, all bed, head, and collar joints are filled completely For cavity wall construction, all bed and head joints are filled completely.
- C. The Architect or Engineer of Record will analyze any results not found to be in conformance with the applicable ASTM standard, industry practice, and the Specifications

and determine if the work in question is to be removed and redone.

- D. Cooperate with the Special Inspector and the Testing Laboratory performing Special Inspection testing.
- E. If there is evidence that the strength of cast stone units may be deficient or may not comply with the specified requirements, the Authority will employ an independent testing laboratory to obtain, prepare, and test cores drilled from hardened cast stone units to determine the compressive strength according to ASTM C 42. Include in the bid, a minimum of 3 units to be field tested and destroyed. If the units are found to be defective, other units will be tested and replaced at no cost to the Authority.
 - 1. Allow the Authority's testing laboratory access to material storage areas. Cooperate with the Authority's testing laboratory and provide samples of materials and concrete mixes as may be requested for testing and evaluation.
 - 2. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by the Authority.
 - 3. Cores will be tested in an air-dry condition.
 - 4. The strength of the cast stone for each series of 3 cores will be considered satisfactory if the average compressive strength is equal to at least 85 percent of the 28-day design compressive strength and no single core is less than 75 percent of the 28-day design compressive strength.
 - a. Test results will be made in writing on the same day that tests are performed, with copies to Authority, Contractor, and cast stone fabricator. Test reports will include the following:
 - b. Project identification name and number.
 - c. Date when tests were performed.
 - d. Name of cast stone fabricator.
 - e. Name of testing laboratory.
 - f. Identification letter, name, and type of cast stone unit or units represented by core tests;

design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of cast stone as placed.

- F. Defective Work: Cast Stone units that do not comply with the specified requirements, including compressive strength, manufacturing tolerances, and finishes, are unacceptable. The Contractor shall remove and replace defective Work with cast stone units that comply with the specified requirements at no cost to the Authority.
- G. Additional testing, at Contractor's expense, will be performed by the Authority's testing laboratory to determine compliance of corrected Work with specified requirements.

3.07 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses. Remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, and after completion of other work liable to damage or soil cast stone units, clean exposed cast stone as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
 - 3. Clean in conjunction with the cleaning of all other masonry work. Do not clean in temperature below 50 degrees F. Clean by scrubbing with soap powder and water, applied vigorously with stiff fiber brushes, adding clean, sharp, fine, white sand to the soap and water mixture where necessary. After scrubbing, drench all surfaces of the cast stone units

thoroughly with clean water. The use of sand blast, wire brushes; or acids of any kind will not be permitted under any circumstances for the cleaning of cast stone Work. Start the cleaning operation at the top of the structure and proceed downward. Perform a mock-up of the cleaning procedure.

END OF SECTION

HB:AG:GR:MF:mf

Notes to Specifier (Delete from Specifications)

1. Specify type of finish. Choose one of the finishes listed below or modify as required and include in Art. 2.02, Par. B.

"1. Provide multiple colors and textures as required to match existing units."

"1. As selected by Project Architect from manufacturer's full range for colors and textures."

"1. Provide units with fine-grained texture and buff color resembling Indiana limestone."
2. If colored cast stone is used, specify colored mortar.
3. Delete if pigmented mortar is not required.
4. Omit for projects where compliance with NYC Green Schools Rating System is not required (Typical of CIP projects). Verify for referenced project.
5. The designer should verify whether Special Inspection is required for the stone work on the Project. If not, specify Quality Control Inspection.
6. Edit anchorage to suit depending on whether for new construction or for existing construction. The designer is to determine beforehand whether Type 316 is required due to corrosive conditions and make revisions. For each project, one of the manufacturers should be asked during the design to determine the appropriate anchor based on pull tests.
7. Delete note if new construction.

* * *

LIST OF SUBMITTALS

<u>SUBMITTAL</u>	<u>DATE SUBMITTED</u>	<u>DATE APPROVED</u>
Product Data:		
1. Materials list.	_____	_____
2. Manufacturer's specifications & material data.	_____	_____
3. Source Quality Control laboratory test reports; or PCI/CSI Certification.	_____	_____
4. Qualification Data for manufacturer, installer, test lab.	_____	_____
5. Shop Drawings.	_____	_____
6. Product Certification	_____	_____
Samples:		
1. Cast stone samples, size 12"x 12" x 4".	_____	_____
2. Mortar colors for initial selection.	_____	_____
3. Mortar colors for verification.	_____	_____
4. Anchors, attachments, accessories.	_____	_____
5. Full size samples.	_____	_____
Field Quality Control Testing (if required):		
1. Test samples.	_____	_____
Sustainability:	_____	_____
1. Contractor's Sustainable Materials Form (see Section S01352).		

2. Mfr's printed literature
or statement on regionally
extracted and manufactured
material content.

*** * ***

SECTION 04510
MASONRY CLEANING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Provide all masonry cleaning Work as indicated on the Drawings and as specified herein, including, but not limited to the following:

1. Brick
2. Terra Cotta
3. Granite
4. Sandstone
5. Limestone
6. Marble
7. Cast Stone
8. Architectural Precast Concrete

B. The work of this section shall not take place until all paint (as designated by the Authority) has been removed in accordance with Section 02085 - Exterior Paint Removal

1.02 REFERENCES

A. References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

1. American Society for Testing and Materials (ASTM)

1.03 SUBMITTALS

A. Product Data:

Cleaning materials manufacturers' catalog sheets, specifications, and application instructions.

B. Quality Control Submittals:**1. Cleaning Subcontractor's Qualifications Data:**

- a. Firm name, address, and telephone number.
- b. Period of time firm has performed masonry cleaning work, and names and addresses of the required number of similar projects completed by the firm.

2. Cleaners Qualifications Data:

- a. Name of each person who will be performing the Work of this Section.
- b. Employer's name, address, and telephone number.
- c. Names and addresses of the required number of similar projects that each person has worked on which meet the experience criteria.

3. Cleaning Procedure: Proposed cleaning procedure for cleaning masonry including each step in the cleaning process, type of scaffolding, and type, size and location of equipment.

C. Submit a schedule of cleaning activities for each type of masonry to be cleaned. (Include location and a description of the cleaning sequence, all products, equipment and scaffolding, etc. to be used.

D. Submit a description of Protection Procedures for each condition and surface which requires protection.

1.04 QUALITY ASSURANCE**A. Cleaning Contractor's Qualifications:**

The firm performing the Work of this Section shall have been regularly engaged in masonry cleaning work for a minimum of five years, and shall have completed 5 similar projects using the cleaning method specified.

B. Cleaners' Qualifications:

The persons cleaning the masonry and their supervisors shall be personally experienced in the required method of

masonry cleaning, and shall have worked on 5 similar projects within the last 3 years.

C. Field Examples:

1. Before the building cleaning operations are started, clean a sample panel of approximately 100 square feet of each type of masonry required to be cleaned at a location on the building directed by the Authority's Representative. If the sample panel is not satisfactory, as determined by the Authority's Representative, modify the cleaning procedure and clean another sample panel. Continue cleaning sample panels until satisfactory results are obtained and approved by the Authority's Representative. When a final approval is obtained, go back and re-clean all previously rejected panels.
 - a. For cleaning procedures other than specified, but which generally follow the method(s) specified, submit proposed procedure for approval and clean additional sample panels adjacent to the above sample panels for comparison of results.
2. Approved panels and procedures will become the cleaning standard for the Work of this Section.
3. Cover the approved sample panels with six mil polyethylene plastic mounted on wood frames of adequate size and strength to protect the panels until the completion of Work. The cover shall be easily removable for comparison with completed Work.

D. If unusual types of soiling agents are encountered, consult with the Authority's Representative before proceeding with the Work.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver cleaning materials in manufacturer's packaging, with instructions for use.
- B. Store, protect, and handle cleaning materials in accordance with manufacturer's instructions.

1.06 PROJECT CONDITIONS**A. Environmental Requirements:**

1. Make necessary provisions for the diversion and disposal of cleaning water and solutions, including the furnishing of pumps if required. Take precautions as required to prevent damage and contamination resulting from run off of cleaning solution.
2. Do not wet or wash down masonry surfaces when the temperature is below 40°F or may drop below 40°F within 24 hours.

B. Existing Conditions:

1. Take necessary precautions and protective measures to prevent injury to people and damage to property in areas adjacent to the Site, including damage due to wind drift of cleaning materials.
2. Pumping equipment will not be allowed in or on the building.
3. Ensure that painted surfaces (such as exterior doors, windows, window sills, etc.) are not affected by the washing, except for those surfaces designated by the Authority for cleaning.

PART 2 - PRODUCTS**2.01 MATERIALS****A. Cleaning Materials:**

Liquid detergents and water, and solutions of chemical cleaning agents and additives, that will remove the dirt, grime, carbon, surface residues, stains, graffiti, and other foreign material from the masonry surfaces, but will not damage the masonry.

- B. Do not use abrasive blasting aggregate cleaning method, or low pressure micro-abrasive powder process or any other cleaning method until written permission is given by the Authority.

PART 3 - EXECUTION**3.01 PREPARATION****A. Protection:**

1. Protect windows, doors, fixtures, air conditioners, roofing, flashings, painted surfaces and other adjacent surfaces not required to be cleaned, from damage.
2. Protect landscaping, paving, and other improvements near the building from damage.
3. Construct temporary sidewalk sheds at building entrances and other areas to divert cleaning materials and debris away from entrance ways and to provide sheltered access to the building.

B. Surface Preparation:

1. Remove vines, bird nests, stalactite deposits, and heavy accumulations of dirt, bird droppings and other foreign materials from surfaces required to be cleaned. Remove material from the site.
2. Perform this preliminary cleaning by brushing, sweeping, wiping, scraping, vacuuming, and other approved methods as required by existing conditions. Use tools that will not damage the masonry.

3.02 CLEANING MASONRY**A. Chemical Solutions or Liquid Detergent and Water:**

1. Prewet the masonry surfaces with water.
2. Prepare cleaning solutions and operate pressure spray equipment in accordance with cleaning materials manufacturer's recommendations, unless otherwise indicated.
 - a. Clean areas not accessible to spray equipment with bristle brushes.

B. Water Cleaning Methods:

1. Low pressure (water soak) for limestone and marble.

2. Medium pressure: Use 200 psi to 600 psi.
- C. Clean masonry equal in appearance to the approved sample panels.
 - D. Clean masonry free of dirt, grime, soot, carbon, efflorescence, moss, stains, graffiti, tendrils, and other foreign materials. Leave masonry uniformly clean and undamaged.
 - E. Clean all features and appurtenances of the masonry such as sills, arches, lintels, returns, reveals, projecting courses, coping, entablature work, back of parapets and balustrades, balconies, friezes, fascias, cornices, chimneys and other features, except for those building features which are painted and are not included in the scope of work.
 - F. Thoroughly rinse off the masonry surfaces with water.

3.03 CLEAN-UP

- A. Clean and restore sidewalks, paving, and lawns soiled or damaged as a result of the cleaning operations. Remove all protective materials.

END OF SECTION

* * *

LIST OF SUBMITTALS

<u>SUBMITTAL</u>	<u>DATE SUBMITTED</u>	<u>DATE APPROVED</u>
Product Data:	_____	_____
1. Cleaning materials Mfr's catalog sheets, specs, application instructions		
Quality Control Submittals:	_____	=====
1. Cleaning Subcontractor's qualifications data		
2. Cleaners' qualifications data (names, addresses, projects)		
3. Schedule of cleaning activities		
Cleaning Procedure: (equipment, scaffolding types)	_____	_____
Description of Protection Procedure:	_____	_____

* * *

SECTION 04520
MASONRY RESTORATION

PART 1 - GENERAL**1.01 DESCRIPTION OF WORK:**

- A. Provide all masonry restoration Work as indicated on the Drawings and as specified herein.

1.02 RELATED SECTIONS

- | | |
|--------------------------------|---------------|
| A. Exterior Paint Removal..... | Section 02085 |
| B. Unit Masonry..... | Section 04200 |
| E. Cast Stone..... | Section 04435 |
| F. Masonry Cleaning..... | Section 04510 |
| G. Joint Sealers..... | Section 07900 |

1.03 REFERENCES

References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

- A. American Society for Testing and Materials (ASTM)

A240 Standard Specification for Heat-Resisting Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.

A580 Standard Specification for Stainless and Heat-Resisting Steel Wire.

C67 Standard Methods of Sampling and Testing Brick and Structural Clay Tile.

C109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50 MM Cube Specimens).

C126 Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.

C144 Standard Specification for Aggregate for Masonry Mortar.

C150 Standard Specification for Portland Cement.

C207 Standard Specification for Hydrated Lime for Masonry Purposes.

C270 Standard Specification for Mortar for Unit Masonry.

C404 Standard Specification for Aggregates for Masonry Grout.

C476 Standard Specification for Grout for *Reinforced* and Nonreinforced Masonry.

C780 Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

C979 Standard Specification for Pigments for Integrally Colored Concrete.

B. Brick Industry of America (BIA): BIA Technical Notes

1.04 **SUBMITTALS**

A. Product Data

1. Portland Cement: Brand and manufacturer's name.
2. Lime: Brand and manufacturer's name.
3. Mortar Pigments: Brand and manufacturer's name.
4. Packaged Products: Manufacturer's specifications and application instructions.
5. Sand: Location of pit, name of owner, and previous test data.
6. Masonry reinforcement, anchors and helical masonry ties.

B. Shop Drawings

If bracing/shoring of the masonry is required, submit stability drawings and calculations prepared, signed and sealed by a New York State Professional Engineer or Registered Architect.

C. Samples

Deliver to the Site for comparison with existing masonry.

1. Mortar for Exposed Joints and Cracks: Each required type, minimum 12" long by full thickness, showing finish and color.
2. Masonry Units: Each required type, full size, showing finish and full color range. Remove one unit of each existing type in order to allow for full size comparison.
3. Masonry reinforcement, anchors and helical masonry ties.

D. Quality Control Submittals

1. Schedule of Uses: By mortar type.
2. Certificates
 - a. Furnish notarized Building Department affidavit from masonry manufacturer (Form 10H) stating materials delivered to project comply with the Specification requirements.
 - b. Furnish notarized Building Department affidavit from masonry supplier (Form 10J) stating materials delivered to project comply with the Specification requirements.
 - c. Provide a letter signed and sealed by a New York State Professional Engineer or Registered Architect describing the Contractor's "Method of Operation" for removal and installation of masonry, and stating whether bracing/shoring for structural stability is required or not required. Provide calculations, if requested.
3. Tests
 - a. Provide test reports on masonry units utilized showing conformance to specification

requirements. Reports shall be dated within two years of project.

- b. Provide test results prepared by the helical masonry tie manufacturer's Company Field Representative (CFR) for the helical masonry tie pull out tests with recommendations.
4. Contractor Qualifications: Provide proof of manufacturer and installer qualifications specified under "Quality Assurance".
5. Mock-up: Provide mock-ups as indicated under Quality Assurance.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Company specializing in the Work of this Section shall have a minimum of three years experience and at least three successful projects with similar quantity of materials.
2. Technicians performing the work must pass the mock-up test indicated in Par. D.3 below.

B. Regulatory Requirements

Building Code: Work of this Section shall conform to all requirements of the NYC Building Code and all applicable regulations of governmental authorities having jurisdiction, including safety, health, noise, and anti-pollution regulations. Where more severe requirements than those contained in the Building Code are given in this Section, the requirements of this Section shall govern.

C. Certification

Masonry construction shall conform to the material acceptance, certification and inspection requirements of Section BC 1701 of the 2008 NYC Building Code.

3. All technicians performing masonry removal and joint cutting must successfully complete five linear feet of cutting and raking of mortar joints in the presence of the Authority's representative. Unsuccessful performance of this test is grounds

for the rejection of the technician for this project.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packaged Products

1. Deliver materials to the site in manufacturer's original, sealed containers. Do not deliver materials that have exceeded shelf life limitation set forth by the manufacturer. Material containers shall bear the manufacturer's label indicating manufacturer's name, trade name of product, lot number, shelf life of product, and mix ratio (if applicable). This includes individual bags of pre-bagged mortar mixes.
2. Comply with manufacturer's printed instructions for storing and protecting materials.

B. Bulk Aggregate

Store in a manner which will keep aggregate clean and protected from the weather elements.

1.07 ENVIRONMENTAL REQUIREMENTS

A. **Cold Weather** Construction Requirements

Salt or other chemicals for lowering the freezing temperature of the mortar shall not be used.

Masonry units, mortar, and grout shall be preconditioned and masonry protected for the following cold weather conditions per Section 2104.3 of the 2008 NYC Building Code:

1. Air temperature 40°F to 32°F:
 - a. Heat mixing water or sand to minimum of 70°F and to maximum of 140°F.
 - b. Mortar and grout temperature shall be between 40°F and 120°F at the time of mixing.
2. Air temperature 32°F to 25°F:
 - a. Heat mixing water and sand to minimum of 70°F and to maximum of 140°F.

- b. Mortar and grout temperature shall be between 70°F and 120°F at the time of mixing. Grout temperature shall be maintained above 70°F at the time of grout placement.
 - c. Provide heat source to maintain a minimum air temperature 32°F on each side of masonry construction.
3. Air temperature 25°F to 20°F:
- a. Heat mixing water and sand to minimum of 70°F and to maximum of 120°F.
 - b. Provide heat source to maintain a minimum air temperature of 32° on each side of masonry construction.
 - c. Provide wind breaks for wind in excess of 15 miles per hour.
 - d. Keep temperature of masonry units a minimum of 40°F when laid and prior to grout placement.
4. Air temperature 20°F and Below:
- a. Heat mixing water and sand to a minimum of 70°F and to maximum of 120°F.
 - b. Provide enclosures and heat source to maintain a minimum air temperature of 32°F on each side of masonry construction during construction.
 - c. Keep temperature of masonry units a minimum of 40°F when laid and prior to grout placement.

B. Cold Weather Protection Requirements

1. Mean Daily Air Temperature of 40°F to 32°F:
- a. Protect masonry with weather resistive membrane from rain or snow for 24 hours.
2. Mean Daily Air Temperature of 32°F and Below:
- a. Protect masonry with weather resistive membrane from rain or snow for 24 hours.
 - b. An air temperature of at least 32°F shall be maintained on each side of masonry for a period of at least 48 hours if Type M or S

mortar is used and at least 72 hours if Type N or O mortar is used.

C. Hot Weather Construction

Follow the requirements of BC 2104.4. When temperatures exceed 100°F, or 90°F with a wind speed of 8 mph, provide necessary conditions and equipment to produce mortar having a temperature below 120°F and to maintain the mortar and grout below 120°F.

D. Wetting of Clay Masonry Units

Provide prewetting of masonry for units with initial rates of absorption that require their wetting before laying (21.42 grams per 30 square inches or 0.025 ounce psi). In cold weather requirements, follow the following requirements:

1. If surface temperatures are above 32°F, use water heated to about 70°F.
2. If surface temperatures are below 32°F, use water heated to about 120°F.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Reinforcement and Ties

1. Hohmann & Barnard, Inc., Hauppauge, N.Y.
2. Dur-O-Wall, Arlington Heights, IL.
3. Helifix North America Corporation (Rep.: Patrick Sweeney, 888 992-9989)
4. Blok-Lok Ltd. (Rep.: Scott Burns, 800 561-3026),

B. Mortar Coloring

1. "SGS" Mortar Colors, Solomon Grind-Chem Services, Inc.
2. "True Tone Mortar Colors", Davis Colors, Rockwood Industries, Inc.
3. "Flamingo Colors ", The Riverton Corporation.

C. Masonry Cleaner

1. ProSoCo, Inc., South Plainfield, N.J.
2. Sure-Kleen

D. Restoration Mortar

1. Cathedral Stone Products
2. Edison Coatings, Inc.

2.02 FACE BRICK MANUFACTURERS/DISTRIBUTORS - NOT USED

2.03 MATERIALS

A. Base Materials

1. Portland Cement: Type I ASTM C150
2. Sand for Mortar Mix ASTM C144
Sand shall be natural sand
matching the gradation and color
of the existing mortar aggregate.
3. Hydrated Lime ASTM C207
Type "S"
4. Water: Shall be clean potable water free of
injurious foreign matter conforming to the
requirements of Section BC 1903.4 of the 2008 NYC
Building Code.
5. Mortar Coloring: Provide pure mineral pigments,
natural and synthetic iron oxides, and chromium
oxides compounded for use in mortar mixes.
Material shall conform to ASTM C979. Coloring
shall not contain alkalyde salts. No liquid
colorants shall be permitted.
6. Premixed sand and lime for mortar mixes is not
permitted. The use of batched material by Spec-Mix
and factory-packaged cement-lime-pigment by major
mortar manufacturers is permitted. Each individual
bag of material shall have the manufacturer's label
identifying the mortar type.
7. No air-entraining admixtures or material containing
such shall be permitted in the mortar. Also, no
anti-freeze compounds, calcium chloride, or other

compounds, unless expressly permitted otherwise, shall be permitted in the mortar.

B. Masonry Units

1. Match existing units in type, grade, size, appearance, texture, and color unless otherwise indicated. Provide multiple types, sizes, and colors of brick to match existing brick patterns.
2. In addition to 1. above, brick shall be clay or shale, ASTM C216, grade SW, solid. Brick shall be tested for efflorescence in accordance with ASTM Test Methods C67 and the rating shall be "Not Effloresced".
3. Lip brick are to be factory manufactured only. Do not use field cut lip brick.
4. Use 100% solid brick over exterior relieving angles/lintels or other brick projections on exterior face of building. (Use of solid brick with cores is acceptable if cores are filled solid with mortar and the cores are not visible to view.)

C. Accessories:

1. Material

a. Reinforcement and anchors

- 1) Stainless Steel: 18-8, type 304
- 2) Sheet Steel: (No. 2B finish), cold-rolled, annealed, ASTM A240.
- 3) Wire Steel: ASTM A580

b. Manufactured Units: All manufactured units shall be as follows:

- 1) LOX-ALL #120 Truss-Mesh, 9 gage, of proper width for the wall thickness.
- 2) Veneer Anchor: DW-10HS Manufacturers Hohmann & Barnard or approved equal. Stainless steel Type 304, ASTM A580.

- 3) Vee Tie: Stainless steel, masonry wire ties. Manufacturer - Hohmann & Barnard or approved equal.
 - 4) Anchors: Manufacturers - Rawlplug; RKL. 1/4" diameter, 2" long flat head stainless steel Zamac Nailing Fastener by Rawlplug Company Inc. of approved equal.
 - 5) Wire: Stainless steel continuous wire by Hohmann & Barnard or approved equal.
 - 6) If the actual space between wythes of solid masonry limits the use of a particular anchor, notify the Engineer of Record for an acceptable alternate anchor.
 - 7) Seismicclips: #187 by Hohmann & Barnard or approved equal.
- c. Electrode for Welding to Stainless Steel to carbon steel: E309-16. Keep electrode dry. Oven dry electrode after exposing it for more than 6 hours.
- d. Mortar mesh: "Mortar Net" high density polyethylene or nylon, full width of cavity, with stepped top to catch mortar droppings.
- D. Helical Masonry Ties for Stabilization of Existing Masonry Walls:
1. Ties shall be fabricated from round stock stainless steel, Type 304, subject to the requirements specified herein. Tie diameters available: 8mm, 10mm. Sizes, type and length of ties shall be as recommended by the helical tie manufacturer's Company Field Representative (CFR) based on pull out load tests performed at the site and field conditions. A minimum 10mm diameter ties shall be used for cinder block.
 2. Where necessary, as in ties installed through mortar joints into concrete backup, provide asymmetric helical ties.
- E. Masonry Repair Mortar:

1. Material shall be capable of filling the holes created due to the installation of the helical masonry ties in bricks. Material shall match properties of the existing natural material, be freeze-thaw resistant and shall be color to match the existing bricks.
2. Masonry repair mortar for bricks shall be Jahn Repair Mortar M100 as manufactured by Cathedral Stone Products or Custom Series 45 as manufactured by Edison Coatings, Inc.

2.04 MIXES

A. Mortar Types

1. All Mortar:
 - a. Comply with ASTM C270 and BIA-M1-88.
 - b. Provide Type I Portland cement. Masonry cement shall not be used as a substitute.
 - c. Preconstruction testing with the proportions carefully monitored is to be used to establish the upper end of the strength range of the mortar, which should generally be near the minimum strength of the next higher strength mortar.
 - d. The maximum strength of each mortar shall generally not exceed the minimum strength of the next higher strength mortar type. The preconstruction testing will determine the general range of strengths to be found and may end up higher than the threshold above.
 - e. Air content of mortar shall be less than 12%.
2. Rebuilding/Setting Mortar; Type N: 1 part Portland cement, 1 part lime, 6 parts dry sand. Minimum compressive strength shall be 750 psi.
3. Repointing Mortar: Comply with ASTM C 270, X3 Tuck Pointing Mortar.
 - a. Brick: (Type O) 1 part Portland cement, 2 parts lime, 7 parts dry sand. Minimum compressive strength shall be 350 psi.

- b. Stone: (Type N) 1 part Portland cement, 1 part lime, 6 parts dry sand. Minimum compressive strength shall be 750 psi.
- c. Terra Cotta: (Type N) 1 part white Portland cement, 1 part lime, 6 parts dry sand. Minimum compressive strength shall be 750 psi.

B. Mortar Color

For exposed mortar, select materials (complying with the requirements) and proportion pigments with other ingredients as necessary to match the color and texture of existing corresponding materials. White Portland cement and colored aggregates similar to the existing may be used as required to accomplish the matching of mortar color desired.

2.05 SOURCE QUALITY CONTROL

- A. The Authority will assign a Special Inspector who will inspect the masonry construction under the requirements of Section BC 1704.5 of the 2008 NYC Building Code.
- B. Preconstruction Testing
 - 1. Preconstruction testing of mortar properties will be done in accordance with ASTM C780. The Contractor shall assist the Authority's laboratory by any means necessary and shall provide the mock-up prior to beginning the installation work to allow for adjustments of the mix if necessary. Do not proceed with masonry work until the preconstruction testing is completed. Contractor shall mix mortar as it intends for the actual construction.
 - 2. Compressive strength tests of field mixed mortar **and factory batched/prepackaged mortar** are to be done during construction of the mock-up, or earlier if desired by the Contractor, to provide a benchmark for the strength based on actual field conditions and proportioning of the mortar. If mortar strengths are too high **or too low**, proportions **and material source** may be required to be modified if directed by the Architect or Engineer of Record.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine all adjoining Work on which this Work is in anyway dependent for proper installation and workmanship. Report to the Authority any conditions that prevent the performance of this Work.

3.02 PREPARATION AND PROTECTION

A. Protection

1. Protect adjacent surfaces not being restored. Protect sills, ledges, and projections from material droppings. Also protect any painted surfaces that are not included in the Work from impact or damage.
2. Cover top of masonry wall with waterproof plastic membrane at the end of the work period and at other times when Work needs to be protected from rain and other precipitation. Extend cover down sides as needed to thoroughly protect the Work.
3. During cold weather, do not use wet masonry units and frozen masonry units.
4. Do not use frozen materials or lay masonry on frozen materials; remove frozen materials from wall. Refer to Part 1 of this Section, "Environmental Requirements" for temperature restrictions.
5. Remove excess mortar from walls as soon after laying units as practicable to prevent staining and to facilitate cleaning of wall.
6. Brace walls as needed until sufficiently set, or until intersecting walls provide lateral support.
7. Scaffolding shall not be supported from a parapet wall on which work is being performed.
8. Work on the exterior face of a parapet wall shall not be done concurrently with work on the interior face of the parapet wall.

B. Surface Preparation

1. Prepare surfaces to be restored in compliance with product manufacturer's printed instructions and as specified.
2. Remove dirt, dust, and foreign material from surfaces to be restored.
3. Clean areas to be restored with compressed air or water flushing, except as otherwise recommended by the mortar manufacturer.

C. Material Preparation

1. Do not further wet concrete masonry units and stone that are already wet.
2. Wet bricks that have a high initial absorption rate (greater than 20 g/min). Wet bricks until water runs off. Install bricks when surface is slightly damp.
3. Prepare exposed mortar to match the color and appearance of existing adjoining mortar.

3.03 MIXING PROCEDURE FOR MORTAR

A. Measure material by volume or equivalent weight. In measuring by volume, use a container to measure ingredients. Do not measure by shovel.

B. Rebuilding/Setting Mortar

1. Mix ingredients in a clean mechanical mixer for a minimum of 3 minutes, maximum of 5, with the minimum amount of water to produce a workable consistency.
2. Mortar that has stiffened because of evaporation of water from the mortar may be retempered only once, and only during the first hour of placement to restore the required consistency. Use mortar within 2¹/₂ hours of its initial mixing; tempering is permitted only once and during the first hour only. Limit amount of mortar batched at one time to stay within these requirements.

C. Pointing Mortar

1. Add sufficient water to dry mix to produce a damp mix that will retain its shape when pressed into a

ball by hand. Mix from 3 to 7 min. in a mechanical mixer.

2. Let mortar stand for not less than 1 hour nor more than 1½ hours for prehydration. Add sufficient water to bring mortar to proper consistency for tuck-pointing, somewhat drier than mortar used for laying units.
 3. Use mortar within 2½ hours of its initial mixing; tempering is permitted only once after bringing mortar to proper consistency. Limit amount of mortar batched at one time to stay within these requirements.
- D. For prepackaged masonry repair mortar, mix with water or manufacturer's polymer in proportions defined by manufacturer to provide the required consistency.

3.04 REPOINTING JOINTS

- A. The Contractor shall take all precautions required to ensure the original appearance of the building is maintained (not changed) and the existing brick is not damaged. The new mortar shall match the original in color & texture and the new joint shall match the existing joint tooling, size and profile. For joints that are set back from the brick face (raked joints), provide a sloping joint starting at the original depth at the top and sloping to the brick face at the bottom that will prevent water sitting on the brick while maintaining the intended shadow line.
- B. Rake or cut out joints to a minimum uniform depth of 3/4" and until sound surface is reached. Do not spall edges of masonry units or widen joints. Replace all brick damaged by such operations with new to match color, size, and texture.

1. Mortar Removal

Where cutting is required to remove existing mortar and joint filler, use a rotary power masonry saw wherever possible without damaging masonry. Masonry saw shall have a vacuum attachment to reduce dust. Use non-power tools for vertical brick joints or where rotary power masonry saw will damage joint.

2. Cut the mortar and joint filler cleanly from the sides of the joints, leaving square corners. Flush joints clean with water or compressed air.
- C. Dampen joints slightly before application of mortar, making sure there is no free water. Pack pointing mortar tightly in joints in thin layers (1/4" max.), with each layer "thumbprint hard" before applying the next layer. Tool joints to match existing adjoining joints.
1. Where joint sealant is required, backpack the joints tightly out to a uniform depth of 1/4", or as indicated on Drawings. Refer to Section 07900 for sealants. Apply bondbreaker tape prior to installing sealants.
- D. Cure mortar by maintaining in a damp condition for at least 72 hours.

3.05 REPLACING MASONRY UNITS

- A. The Contractor is responsible for performing Work in a safe manner. Provide temporary shoring or other supports as required to prevent displacement of existing masonry that is to remain. Perform the removal Work with such care as may be required to prevent failure of the masonry or damage to adjoining masonry that is to remain. Follow method of operation and/or bracing scheme required to be provided in Article 1.04 titled "Submittals".
- B. Remove the deteriorated and damaged masonry units to their full depth, including the surrounding joint mortar. Wet masonry to reduce dust. Install helical masonry ties at perimeter of replacement prior to removal as indicated in details on the Drawings. Wherever possible without damaging masonry, use a rotary power masonry saw for cutting Work. Masonry saw shall have a vacuum attachment to reduce dust. For SHPO designated/landmark buildings, removal of perimeter brick in the area designated for removal shall be done by first cutting the joint utilizing methods specified in Art. 3.04,B.,2. Leave square corners at adjoining masonry that is to remain. Clean joints and cavities by flushing with water or compressed air.
- C. Dampen contact surfaces slightly before application of mortar, making sure there is no free water. Install matching masonry units with Type N mortar. Install units to match and align with existing masonry. Maintain bonding and coursing pattern of existing masonry. Use

presoaked wood wedges where necessary to properly set the units and maintain uniform matching joints. Backpack and fill joints full of mortar. Finish joints to match existing adjoining joints as described in Art. 3.04-Repainting Joints. Fill open joints in backup. In solid masonry construction, ensure that entire collar joint is filled between the backup and the face masonry. Collar joint is likely to vary substantially, up to 3" in locations.

D. Install accessories as indicated on Drawings. In cavity wall construction provide mortar mesh directly on flashing, such as at base of wall, and at relieving angles and lintels, with flashing extending at least 6" above top of mortar mesh.

E. Area Face Brick Replacement

1. Single wythes of brick shall be replaced in 4 foot lengths maximum unless indicated otherwise by the "methods of operation" submitted by the Contractor's Engineer as required to be submitted in the Article 1.04 titled "Submittals".
2. Install reinforcement every 16" each way and secure it to backup masonry as indicated on Drawings.

F. Replacement by Brick Stitching

Remove and replace existing brick to their full depth with new face brick, one brick each on both sides of crack in masonry. Also, remove and replace all existing pushed-out, missing, split or otherwise defective face bricks to match the adjoining existing good sound masonry. If the existing masonry work has a solid masonry common-bond pattern, existing sound header bricks shall remain. However, any cracked, defective or loose header brick shall be replaced. All new brick work shall be toothed into existing good work. At horizontal and diagonal cracks, the replacement of bricks shall be done in 4-foot lengths maximum unless indicated otherwise by the "methods of operation" submitted by the Contractor's Engineer as required to be submitted in Article 1.04 titled "Submittals". Existing mortar bed for replaced brick shall be thoroughly removed and the back parged with a coat of new mortar to fill the collar joint.

3.06 STABILIZATION OF EXISTING MASONRY WALLS

- A. The existing face masonry shall be stabilized to the backup material by means of helical masonry ties. The installation and procedure shall be inspected by the Authority's Representative and the Company Field Representative to verify proper installation of the helical ties.
- B. Prior to start of the Work, the existing conditions shall be examined by a Company Field Representative (CFR) authorized in writing by the manufacturer of the helical ties (see Art. 2.01, Par. F.) The CFR shall instruct the Contractor in the installation of the ties. The CFR shall recommend the diameter, length, type, and spacing of ties and drill bits to be used at each location and masonry condition, based on tests described in paragraph C., below. The CFR shall submit this information in written or graphic form, through the Contractor, to the Authority for review and approval by the Architect or Engineer of Record.
- C. The design spacing of the ties shall typically be 16" vertically and 16" horizontally. Spacing shall be closer where required because of existing conditions, and where pull-out load tests show it to be necessary. Pull-out tests shall be performed at each masonry condition by the CFR prior to the start of the Work, and the results of the tests shall be submitted to the Authority. Separate pull-out tests shall be performed on the face masonry, mortar joints and on the backup material. For tie spacing of 16" x 16" a load of 300 lbs. shall be achieved for the face masonry and for the backup material separately, without failure by loss of resistance or slippage. Where a 500 lbs. test load is achieved for each material separately, it will be permissible to increase spacing of ties to 16" x 24".
- D. A pilot hole shall be drilled through the face masonry and into the backup material using a high-speed rotary percussion drill (Bosch model 1194VSR, or equivalent), 3-jaw chuck type. If acceptable pullout results are achieved through the mortar joints, this shall be the preferred method of installation of the ties rather than through the face masonry, particularly for SHPO eligible buildings. At certain conditions, as recommended by the CFR, the drill bit used for the face masonry shall be of different diameter than the bit used in the backup material. The helical tie shall be driven into position using an electric hammer drill with SDS type chuck and specialized insertion tool. The electric hammer drill with SDS type chuck shall not be used for drilling pilot

holes in face masonry. The electric hammer drill with SDS type chuck shall only be used for drilling pilot holes in backup material when recommended by the manufacturer such as in concrete.

- E. Each wall condition shall be examined by the Architect or Engineer of Record and the CFR to determine specific installation requirements. The following is presented as an example of a 10mm diameter tie in face brick with concrete block backup. The installation shall be performed in the following manner, subject to actual project conditions and modification by the CFR:
1. For use of 10 mm helical ties, drill an 8mm-entry\ hole through face brick using high speed rotary percussion drill. (Where location is a mortar joint, drill a 6.5mm hole near the approximate center point of the brick, not at T-joints or ends).
 2. Change bits and drill a 6.5mm entry hole through the concrete block backup to a minimum of 3 inches, using high-speed rotary percussion drill.
 3. Drive helical tie into place, recessed for final patching, using a setting tool mounted on an electric hammer drill with an SDS type chuck.

3.07 FIELD QUALITY CONTROL

- A. The Authority will assign under the requirements of Section 1704.5 of the 2008 NYC Building Code a Special Inspector who will inspect the masonry construction. If the masonry work is not designated for Controlled Inspection, the masonry work will be subject to Quality Control Inspection, with testing and inspection similar to that listed below for Special Inspection. Inspections performed by the Authority do not relieve the Contractor of its obligation to conform to all requirements specified in this Section.
- B. The Special Inspector will make inspections and any testing deemed necessary. Mortar suspected or tested to be too strong or too weak will be subject to petrographic analysis or other methods deemed necessary by the Engineer of Record and Special Inspector. The Contractor shall pay for all tests if they verify improper work. Inspections will include, but not be limited to, the following:

1. Proper installation of reinforcement of brick on angles.
 2. Proper depth of mortar cutting for pointing.
 3. Proper installation of mortar, including proportioning and mixing. Those mortar properties listed in the Appendix of ASTM C780 are to be tested at the discretion of the Special Inspector or the Architect/Engineer of Record. Mortar strengths, when tested, will be determined in accordance with ASTM C780 using cylinders.
 4. Proper installation of weeps, flashing, drip edges, mortar mesh, cleaning of cavity (if cavity wall construction), etc.
 5. At solid masonry construction, all bed, head, and collar joints are filled completely. For cavity wall construction, all bed and head joints are filled completely.
- C. The Architect or Engineer of Record will analyze any results not found to be in conformance with the applicable ASTM, industry practice, and the Specifications and determine if the masonry in question is to be removed and redone.
- D. Cooperate with the Special Inspector and the Testing Laboratory performing Special Inspection testing.
- E. The Contractor's engineer shall monitor the restoration procedure to ensure compliance with the "methods of operation" and to ensure safety of the structure.

3.08 PROTECTION AND CLEANING

- A. Protect face of adjacent walls and surfaces from water, mortar, and grout used for terra cotta installation.
- B. Remove excess mortar and mortar smears as work progresses.
- C. After mortar has cured (a minimum of 30 days), clean soiled surfaces with detergent and clean water. Use fiber brushes and cloths. Do not use metallic tools or acids. Perform a mock-up of the cleaning procedure.

END OF SECTION

* * *

LIST OF SUBMITTALS

<u>SUBMITTAL</u>	<u>DATE SUBMITTED</u>	<u>DATE APPROVED</u>
Product Data:	_____	_____
1. Portland Cement Mfr & Brand		
2. Lime Mfr & brand		
3. Mortar Pigments Mfr & Brand		
4. Packaged Products: Mfr's specs & application instructions		
5. Sand: Location of pit, Owner's name, & previous test data		
6. Masonry reinforcement, anchors, helical masonry ties		
Shop Drawings:	_____	_____
1. Bracing/Structural Stability		
Samples:	_____	_____
1. Exposed joint mortar		
2. Masonry Units: each type, full size		
3. Masonry reinforcement, anchors, helical masonry ties		
Schedule of Uses:	_____	_____
1. Mortar type		
Certificates	_____	_____
1. Notarized Bldg Dept. affidavit re: Mas. Producer, Materials comply		
2. Notarized Bldg Dept. affidavit re: Mas. Supplier, Materials comply		
3. Letter from Contractor's Engineer		

Tests:

1. Helical tie pullout test
for each condition
and separately for
face masonry, mortar
joints & back up material.

Qualifications

1. Manufacturer
2. Installer
3. Engineer

Mock Up:

1. Cutting of Joints
2. Pointing of Joints
3. Face brick replacement

* * *

SECTION 07900
JOINT SEALERS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Provide all joint sealer Work as indicated on the Drawings, as required for the completed Work, and as specified herein. This Section includes joint sealants for the following applications:

1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Construction joints in cast-in-place concrete.
 - b. Joints between plant-precast architectural concrete units.
 - c. Control and expansion joints in unit masonry.
 - d. Joints in dimension stone cladding.
 - e. Joints in glass unit masonry assemblies.
 - f. Joints in exterior insulation and finish systems.
 - g. Joints between metal panels.
 - h. Joints between different materials listed above.
 - i. Perimeter joints between materials listed above and frames of doors, windows and louvers.
 - j. Control and expansion joints in soffits and other overhead surfaces.
 - k. Joints in walks, pavements and curbs.
 - l. Other joints as indicated.
- 2, Exterior joints in the following horizontal traffic surfaces:
 - a. Control and expansion joints in brick pavers.

- b. Isolation and contraction joints in cast-in-place concrete slabs.
 - c. Joints between plant-precast architectural concrete paving units.
 - d. Joints in stone paving units, including steps].
 - e. Tile control and expansion joints.
 - f. Joints between different materials listed above.
 - g. Other joints as indicated.
3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
- a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical joints on exposed surfaces of interior unit masonry concrete walls and partitions].
 - e. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
 - f. Joints between metal display boards, display cases, electric panel boards and partitions or other facing materials.
 - g. Control and expansion joints in ceilings and other overhead surfaces.
 - h. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - i. Other joints as indicated.
4. Interior joints in the following horizontal traffic surfaces:

- a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated.
- B. The work of this section shall not take place until all paint (as designated by the Authority) has been removed in accordance with Section 02085 - Exterior Paint Removal.

1.02 REFERENCES

- A. References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work
 - 1. American Society for Testing and Materials (ASTM)

1.03 SUBMITTALS

- A. Product Data
 - Catalog sheets, specifications, and installation instructions for each product specified except miscellaneous materials.
- B. Samples for Initial Selection:
 - 1. For general purpose use around windows and at relieving angles, Colors of Exposed Joint Sealants: Match Architect's samples. Provide custom colors as specified.
 - 2. For all other uses: provide Manufacturer's color charts consisting of strips of cured sealants showing the full range of Manufacturer's standard colors available for each product exposed to view.
- C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-(13-mm-) wide joints formed between two 6-inch-(150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants

D. Quality Control Submittals

1. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
2. Installer's Qualifications Data: Affidavit required under Quality Assurance Article.
3. Company Field Advisor Data: Name, business address, and telephone number of Company Field Advisor.
4. Test Results
 - a. Sealant manufacturer's test reports certifying compatibility with all contiguous materials.
 - b. Sealant manufacturer's test reports certifying that the sealant will not stain contiguous materials.
 - c. The results of field adhesion testing.

E. Low Emitting Materials Compliance Submittals

1. Provide documentation for each sealant, sealant primer and cleaner to be used on site and within the weatherproofing/waterproof membrane (interior) of the building, indicating that the sealants and primers with V.O.C. requirements as stated in Specification Section G01600.

1.04 QUALITY ASSURANCE**A. Installer's Qualifications**

The persons installing the sealants and their supervisor shall be personally experienced in the installation of sealants and shall have been regularly employed by a company engaged in the installation of sealants for a minimum of two years.

1. Furnish a letter from the sealant manufacturer, stating that the Installer is authorized to install the manufacturer's sealant materials.

B. Container Labels

Include manufacturer's name, trade name of product, kind of material, federal specification number (if

applicable), expiration date (if applicable), and packaging date or batch number.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joint sealer materials as recommended by the Manufacturer, to protect from damage.

1.06 PROJECT CONDITIONS

A. Environmental Requirements

1. Temperature: Unless otherwise approved or recommended in writing by the sealant manufacturer, do not install sealants at temperatures below 40 degrees F or above 85 degrees F.
2. Humidity and Moisture: Do not install the Work of this Section under conditions that are detrimental to the application, curing, and performance of the materials.
3. Ventilation: Provide sufficient ventilation wherever sealants, primers, and other similar materials are installed in enclosed spaces. Follow manufacturer's recommendations.
4. Do not proceed with installation of joint sealants under the following conditions
 - a. When joint substrates are wet.
 - b. Where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
 - c. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - d. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.
 - e. Surfaces are frozen.
 - f. Surfaces are superheated by the sun.

B. Protection

1. Protect all surfaces adjacent to sealants with non-staining removable tape or other approved covering to prevent soiling or staining.
2. Protect all other surfaces in the Work area with tarps, plastic sheets, or other approved covering to prevent defacement from droppings.
3. Protect any painted surfaces which are not included in the Work from impact or damage.

PART 2 - PRODUCTS**2.01 MANUFACTURERS**

- A. General Electric Co., Waterford, NY 12188
- B. Dow Corning Corp., Midland, Michigan 48686
- C. Pecora Corp., Harleyville, PA
- D. ChemRex Inc. - Sonneborn, Shakopee, MN 55379
- E. Tremco Sealing and Coatings, Wading River, NY 11792
- F. Bostik, Midland, MA 01949
- G. Protective Treatments, Inc. (PTI), Dayton, OH 45413
- H. Products Research & Chemical Corp., Gloucester City, NJ 08030
- I. Sika Corporation, Lyndhurst, NJ 07071
- J. Mameco International, Inc./RPM, Cleveland, Ohio 44128

2.02 SEALANTS

- A. Type 1 Sealant (for use in vertical expansion joints where movement occurs; for general purpose use around windows, door frames, louvers, and other junctures).
 1. One-part low-medium modulus silicone sealant (plus or minus 50% movement); ASTM C920 classifications type S, grade NS, class 25, uses NT, M, G, and A: General Electric Silpruf, Dow Corning's 791, Pecora's 864, Sonneborn's Omniseal, Tremco Spectrem 2 or Sika SikaSil C-955.

Silicones shall meet the following requirements:

- ASTM C719 - Low-Medium Modulus (+ or - 50%). Sealants shall not exhibit any cracking or surface degradation after 5000 hours exposure in the Atlas Twin Arc Weatherometer.
- ASTM C661 - Shall not incur a durometer increase greater than 10 points.
- Sealants shall contain zero parts of toxic isocyanurate ingredients.

Provide custom colors for use around window perimeters, to match window frame or masonry, or other colors as determined by the Architect.

Thoroughly clean surfaces on which sealant is to be applied and prime surfaces as recommended by Manufacturer before applying sealant.

B. Type 1A Sealant (for use for pavements, walks, and curbs)

1. For Horizontal Joints: Two-part, self-leveling polyurethane sealant for traffic bearing construction; ASTM C920 classifications type M, grade P, class 25, uses T, M, A, and O (granite): Mameco's Vulkem 255, Pecora's Urexpan NR-200, or Bostik's Chem-Calk 550, Products Research & Chemical's RC-2SL, Tremco THC 900/901 or Sika's Sikaflex 2C SL.
2. For Vertical Joints: Two-part, non-sag polyurethane sealant; ASTM C920 classifications type M, grade NS, class 25, uses NT, M, A and O (granite): Mameco's Vulkem 227, Pecora's Dynatrol II, or Bostik's Chem-Calk 500, Products Research & Chemical's RC-2, Tremco Dymeric 511 or Sika's Sikaflex 2C NS.

C. Type 1B Sealant (for Plaza Decks)

1. For Horizontal Joints: One-part, self-leveling polyurethane sealant for traffic bearing construction; Mameco's Vulkem 45, Pecora's Urexpan NR-201, or Sika's Sikaflex-1C SL, Products Research & Chemical's PR-6006, or Tremco Tremflex .

2. For Vertical Joints: One-part, non-sag polyurethane sealant; ASTM C920 classifications type S, grade NS, class 25, uses NT, M, A and O (granite): Mameco's Vulkem 116, Pecora's Dynatrol I, or Sika's Sikaflex 15 LM, Products Research & Chemical's RC-1, Tremco Dymonic.

Type 1C Sealant - For general use around windows, door frames, louvers, cast stone copings and other junctures.

One-part silicone sealant; ASTM C920 classifications type S, grade NS, class 25, uses NT, M, G, A and O: Pecora 890; Tremco Spectrum-1 or Sika's SikaSil **WS 295**.

Provide custom colors for use around window perimeters, to match window frame or masonry, or other colors as determined by the Architect.

- D. Type 1D Sealant (use at interior wet areas only-- Bath and Shower areas)

One-part, mildew resistant silicone sealant; ASTM C920 classifications type S, grade NS, class 25, uses NT, M, G and A: Dow Corning's 786, General Electric's Sanitary 1700, Bostik's Silicone Rubber Bathroom Caulk, or Tremco Proglaze.

- E. Type 2 Sealant (for joints & cracks 1/4" or less in width)

One-part acrylic polymer sealant; Pecora's 60+ Unicrylic, PTI's 738, or Tremco's Mono.

- F. Type 2A Sealant (joints & cracks 1/4" or less in width).

One-part clear acrylic sealant for sealing small joints; PTI's 200 or Tremco's 830.

- G. Type 3 Sealant (for concealed bedding only).

One-part butyl rubber sealant; Pecora's BC-158, PTI's 707, Bostik's Chem-Calk 300, or Tremco Butyl.

- H. Type 4 Sealant (use at high temperature applications, e.g., flues)

One-part silicone sealant for high temperature; ASTM C920 classifications type S, grade NS, class 25, uses NT, M, G, and A: Dow Corning's Silastic 726 RTV, General Electric's RTV 106, or Tremco Spectrem 1.

- I. Type 5 Sealant (use at relieving angles - between brick and stainless steel sealant edge).

One-component polyurethane sealant; ASTM C920 classifications type S, grade NS, class 25, uses NT, M, and A, Federal Specification TT-S-00230C: Tremco Dymonic, Sikaflex-15LM, Pecora Dynatrol I-XL

Provide custom colors for use at relieving angles.

- J. Pre-formed Sealant

Bitumen impregnated flexible polyurethane foam precompressed to 20% of its uncompressed length such as Progress Unlimited's Compriband.

- K. For sealants used on site and within the weatherproofing/waterproof membrane (interior) of the building comply with V.O.C. requirements specified in Section G01600.

2.03 JOINT FILLERS

- A. Elastomeric Tubing Sealant Backings: (for precast panel joints not compatible with Silicone Sealants): Neoprene, butyl or EPDM tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.

ASTM D 1056, Class SC (oil resistant and medium swell), 2 to 5 psi compression deflection.

- B. Expanded Polyethylene Joint Filler (for existing joints) Flexible, compressible, closed-cell polyethylene of not less than 10 psi compression deflection (25 percent).

- C. Closed-Cell Polyurethane or Closed-Cell Expanded polyethylene Joint Filler (for all cast-in-place concrete work).

Resilient, compressible, semi-rigid; W.R. Meadow's Ceramar; A. C. Horn's Closed Cell Plastic Foam Filler, Code 5401; Sonneborn's Sonoflex F.

D. ASTM D1056, Class RE41 (for masonry joints) where shown on the Drawings.

E. Filler Sealant (for Parapet Expansion Joints)

Polybutylene impregnated compressible polyurethane foam precompressed to 50% of its uncompressed length: "Polytite" by Polytite Manufacturing Corp. and distributed by W.R. Grace Co.

2.04 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

1. For primers used on site and within the weatherproofing/waterproof membrane (interior) of the building comply with V.O.C. requirements specified in Section G01600.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

1. For cleaners used on site and within the weatherproofing/waterproof membrane (interior) of the building comply with V.O.C. requirements specified in Section G01600.

C Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

D. Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

1. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin)], O (open-cell material)] or B (bicellular material

with a surface skin, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

E. Bond Breaker Tape

Polyethylene or other plastic tape as recommended by the sealant manufacturer; non-bonding to sealant; self-adhesive where applicable.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine all joint surfaces for conditions that may be detrimental to the performance of the completed Work. Do not proceed until satisfactory corrections have been made.

3.02 PREPARATION

A. Clean joint surfaces immediately before installation of sealant and other materials specified in this Section.

1. Remove all loose materials, dirt, dust, rust, oils and other foreign matter that will impair the performance of materials installed under this Section.
2. Remove lacquers, protective coatings and similar materials from joint faces with manufacturer's recommended solvents.
3. Use methods such as grinding, acid etching or other approved and manufacturer's recommended means, if required, to clean the joint surfaces, assuring that the sealant materials will obtain positive and permanent adhesion.

B. For Pavements, Walks, and Curbs

1. Set joint fillers at proper depth and position as required for installation of bond breakers, backer rods, and sealants. Do not leave voids or gaps between the ends of joint filler units.
 - a. Smooth Edged Joints: For joints between two concrete slabs or where new concrete abuts

smooth-edged materials, use either cork joint filler or closed cell polyurethane joint filler.

- b. Irregular Edged Joints: For joints where new concrete abuts granite curbs or other irregular edges, use closed cell polyurethane joint filler.
- c. Priming Joint Surfaces:
 - 1) Prime joints which are to receive Type 1A and 1B Sealants.
 - 2) For joints of friable (crumbly, chalky) masonry surfaces and other surfaces which are to receive Type 1 Sealant, prime as recommended by Manufacturer.
 - 3) Prime joints other than those above if so recommended by the manufacturer's printed instructions.
 - 4) Do not allow the primer/sealer to spill or migrate onto adjoining surfaces.

3.03 JOINT BACKING INSTALLATION

- A. Install bond breaker tape in relaxed condition as it comes off the roll. Do not stretch the tape. Lap individual lengths.
- B. Install backer rod of sufficient size to fill the joint width at all points in a compressed state. Compress backer rod at the widest part of the joint by a minimum of 25 percent. Do not cut or puncture the surface skin of the rod.

3.04 SEALANT INSTALLATION

- A. Except as shown or specified otherwise, install sealants in accordance with the manufacturer's printed instructions.
- B. Install sealants with ratchet hand gun or other approved mechanical gun. Where gun application is impracticable, install sealant by knife or by pouring, as applicable.

C. Finishing

Tool all vertical, non-sag sealants so as to compress the sealant, eliminating all air voids and providing a neat smoothly finished joint. Provide slightly concave joint surface, unless otherwise indicated or recommended by the manufacturer.

1. Use tool wetting agents as recommended by the sealant manufacturer.

3.05 FIELD QUALITY CONTROL

A. Field Adhesion Testing of Sealants - Test completed elastomeric joints as follows:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet of joint length for each type of elastomeric sealant and join substrate.
 - b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
2. Test Method - Test joints by hand pull method described below:
 - a. Make knife cuts from one side of the joint to the other, followed by two cuts approximately 2 inches long at sides of joint and meeting cross cut at one end. Place a mark 1 inch from cross-cut end of 2 inch piece.
 - b. Use fingers to grasp 2 inch piece of sealant between cross-cut end and 1" mark, pull firmly at a 90 degree angle or more in direction of side cuts while holding a ruler along sides of sealant. Pull sealant out of joint to the distance recommended by the sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension, hold this position for 10 seconds.
 - c. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this

by extending cut along one side, checking adhesion to opposite side.

3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field-adhesion-test log.
4. Inspect tested joints and report on the following:
 - a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 - b. Whether sealants filled joint cavities and are free of voids.
 - c. Whether sealant dimensions and configurations comply with specified requirements.
5. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
6. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
7. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.06 CLEANING

- A. Immediately remove misapplied sealant and droppings from metal surfaces with solvents and wiping cloths. On other materials, remove misapplied sealant and droppings by methods and materials recommended in writing by the manufacturer of the sealant material.
- B. After sealants are applied and before skin begins to form on sealant, remove all masking and other protection and clean up remaining defacement caused by the Work.

END OF SECTION

* * *

LIST OF SUBMITTALS

<u>SUBMITTAL</u>	<u>DATE SUBMITTED</u>	<u>DATE APPROVED</u>
------------------	-----------------------	----------------------

Product data: _____

1. Catalog sheets, specifications, installation instructions for each item specified

Samples: _____

1. Manufacturer's color charts for Initial Selection
2. Samples for Verification for each type and color of joint sealant

Quality Assurance

1. Manufacturer's Product Certificates
2. Installer's Qualifications Data
3. Company Field Advisor Data
4. Manufacturer's test reports certifying compatibility
5. Manufacturer's test reports certifying that sealant will not stain
6. Field adhesion test reports

Low Emitting Materials: _____

1. Documentation of VOC content for each sealant, sealant primer and cleaner to be used inside the building to show compliance with Section G01600.

* * *

SECTION 09900
PAINTING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This Section includes surface preparation and field painting of the following:

1. Exposed exterior items and surfaces.
2. Surface preparation, priming and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

1.02 REFERENCES

A. References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

1. Federal Specifications (FS)
2. N.Y.S. Department of Environmental Conservation
3. U.S. Department of Labor
4. Occupational Safety and Health Administration (OSHA)
5. Steel Structures Painting Council (SSPC)

DEFINITIONS

A. The term "Painting" as used in this Section, means the application of all coatings such as paint, primer, enamel.

- B. The term "Painting" also includes preparation of surfaces for such applications, and the clean-up as hereinafter specified.
- C. Touching-up bare spots specified for previously primed or painted surfaces is in addition to the coats specified for the paint system.
- D. Finishes:
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 - 2. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
 - 3. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
 - 4. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.
- d. Elevator shafts.

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1.04 **SUBMITTALS**

A. Product Data

Provide manufacturers' product literature for all materials specified and material manufacturer's printed directions and recommendations for environmental conditions, surface preparation, priming, mixing, reduction, spreading rate, application, storage and VOC content, as applicable for each of the materials specified.

B. Samples

- 1. Initial Selection

Submit manufacturer's color charts for each type of finish for approval by the Authority. Verify colors specified with manufacturers' color charts for availability and notify the Authority if any discrepancies should occur.

2. Verification prior to installation
 - a. Contractor shall furnish color chips for surfaces to be painted.
3. All samples shall be labeled; and include the following information:
 - a. Manufacturer's name
 - b. Type of paint/stain/hardener
 - c. Manufacturer's stock number
 - d. Color: name and number
 - e. Federal Specification number, as specified
 - f. Federal regulations for amount of lead in paint.
 - g. VOC content

C. Quality Assurance

1. Certification that materials for each system are obtained from a single manufacturer.
2. Certification that Work shall be performed by personnel with a minimum of three years experience who meet the qualifications set forth in OSHA, 29 CFR 1926.62 (Lead In Construction Standard).
3. Certification that material meets or exceeds the performance requirements of Federal Specifications.

D. Guarantee

Provide Guarantee per Article 1.08.

1.05 QUALITY ASSURANCE**A. General**

1. All painting materials shall arrive at the job ready-mixed.
3. Remove all rejected materials from the premises immediately.
4. All thinning and tinting materials shall be as recommended by the manufacturer. Generally, all paints shall not require additional thinning.
5. Verify that the specified shop prime paint for each applicable item in this Project is compatible with the total coating system, prior to application.

B. Qualifications

1. Work of this Section shall be performed by personnel with a minimum of three years experience in performing this type of Work.
2. The Contractor shall ensure that all employees meet the qualifications set forth in OSHA, 29 CFR 1926.62 (Lead In Construction Standard).

F. Field Samples

1. Provide samples of each color and finish, under natural lighting conditions, in a location where each finish is to be applied.
2. Primer coat is to be inspected and approved in all locations before any subsequent finish coats are applied.

1.06 DELIVERY, STORAGE, AND HANDLING**A. Delivery**

Deliver materials to the site in original, unopened containers bearing manufacturers name and label containing the following information:

1. Product name or title of material
2. Manufacturer's stock number, batch number, VOC content in grams per liter and date of manufacture.
3. Manufacturer's name
4. Federal Specification number, if applicable.
5. Federal regulations for amount of lead in paint (less the 0.06% lead in non-volatile ingredients)
6. Contents by volume for major pigment and vehicle constitutions
7. Thinning instructions
8. Application instructions
9. Color name and number

1.07 PROJECT CONDITIONS

A. Environmental Requirements

1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied.
2. Do not apply finish in areas where dust is being generated or will be generated while the material is drying.
3. Provide paint and coating products to comply with applicable environmental regulations, VOC requirements and local authorities.

1.08 GUARANTEES

- A. Adherence of workmanship and materials to Specifications requirements shall be maintained for the one year Contract guarantee period. These requirements shall include the following:
1. There shall be no evidence of blistering, peeling, crazing, alligatoring, streaking, staining, or chalking.
 2. Dirt shall be removed without blemishing the finish by washing with mild soap and water.
 3. Colors of surfaces shall remain free from serious fading; the variation, if any, shall be uniform.
- B. Correct all defects, appearing within the guarantee period, by removal of the defective work and replacement as directed.
- C. All corrective measures shall be the Contractor's responsibility, and shall be made at no extra cost to the Authority. The requirements set forth in Part 3 of these Specifications shall be strictly adhered to.

PART 2 - PRODUCTS**2.01 MANUFACTURERS**

- A. Subject to compliance with specified requirements, provide "First Line" or "Top Quality" products of one of the following manufacturers:
1. Benjamin Moore and Co.
 2. Devoe and Reynolds Co.
 3. Glidden Coatings and Resins.
 4. PPG Industries, Pittsburgh Paints Inc.
 5. Pratt and Lambert
 6. The Sherwin-Williams Co.

7. Tnemec Company, Inc.
8. MAB Paints
9. Carboline
10. Mercury Paint Corp.

2.02 MATERIALS

- A. Provide products which meet all Federal regulations for amount of lead in paint (less than 0.06% lead in non-volatile ingredients).
- B. Provide best quality grade of various types of coatings as regularly manufactured by the paint materials manufacturers. Materials not displaying manufacturers' identification as a standard, best-grade product will not be acceptable.
- C. Use only thinners approved by paint manufacturers for applications intended and use only within recommended limits.

2.03 REFERENCE STANDARDS

- A. Paint materials shall meet or exceed the requirements of the following standards:

Federal Specifications

1. Primers, Sealers, Undercoats

- A. Acrylic Primer TT-P-650-C

2. Finish Paints

- A. Ext. Acrylic Latex Paint; Flat: FS TT-P-19
 - B. Gloss Acrylic Latex Enamel: FS TT-P-1511-B

2.04 COLORS**A. Selection**

1. Paint colors, surface treatments and finishes will be selected by the Authority.
2. Color Schedule will be issued to the Contractor after award of the Contract.
 - a. Final acceptance of colors will be from actual job applications.

2.05 EXTERIOR PAINT SYSTEMS**A. New Ferrous Metal**

Structural steel, all ferrous metals, and steel window trim.

1st Coat - Touch up with epoxy Polyamide
Paint

2nd Coat - Polyamide Epoxy Paint
applied at the rate of -- 4.0 to 6.0
Mils DFT.
SSPC-PS
Guide 13.01

3rd Coat (Top Coat) - Acrylic Aliphatic
Polyurethane applied at rate of -- 1.5 to 2.0
Mils DFT.
SSPC-PS
Guide 17.00
Type 5.

PART 3 - EXECUTION**3.01 EXAMINATION****A. Verification of Conditions**

1. The application of painter's finish to any surface shall be taken to indicate that the Contractor considers such surfaces suitable for a first-class finish.

2. Do not apply painter's finish in any locations until the Work of other Contractors that might damage the new finish is completed.
3. Notify the Authority in writing regarding Work by others that does not provide a suitable surface for the new finish.
4. In case of dispute regarding the suitability of any surface, the Authority's decision shall be final and conclusive upon all concerned.
5. Contractor shall check the compatibility of previously painted surface with the new coating by applying a test panel 4 foot wide x wall height. Allow test panel to dry thoroughly; verify proper adhesion before proceeding with painting Work.

3.02 PREPARATION AND APPLICATION

A. Protection

1. For exterior metal surfaces on the building or site the ground beneath the work area shall be surrounded on all sides by a washable construction tarp or 10-mil polyethylene. The covering need not be airtight; however, it must be of adequate size and durability to completely enclose the work area and prevent the dispersal of any paint chips or dust during paint removal activities. Any dust and debris shall be contained in the work area and shall be removed immediately upon generation. Protect from damage landscaping, paving, and other improvements near the building. Protect and seal all windows and openings within the work area with a minimum of 1 layer of 6-mil polyethylene sheeting.
2. All protection is to be carefully removed, cleaned or discarded after painting is complete.

3. Touch-Up

1. Spot prime defects in existing Work and Work primed under other Paragraphs of Work as necessary to produce an even plane in the new finish.

B. Existing Metal:

- a. Prepare surfaces as indicated in Art. 3.02,C., Subparagraphs 1., 2., 3., 4., above.
- b. Machine tool clean exposed steel to an SSPC-SP3 surface preparation.
- b. For steel surfaces exposed to view, repair defects in surfaces to provide for an even plane in the new finish. Use auto-body filler to even out surface and sand smooth.

3.03 APPLICATION

A. General

1. No Work shall be performed where cement or plaster is being applied or is in the process of drying.
2. No Work shall be performed in spaces that are not broom clean and free of dust and waste.
3. Apply paint materials to produce smooth finished surfaces, free of brush or roller marks, drops, runs, or sags.
4. Paint materials shall be kept at a proper and uniform consistency.
5. Thin only when necessary to achieve best results.
6. Thinners shall be material recommended by manufacturer of paint, and in quantity as recommended.
7. Excessive use of thinner as indicated by variation in absorption, lack of "hide", thickness of dry film, mottled or streaky coat, shall be cause for rejection. Correct as directed.

8. Apply all coats with brush or roller, varying slightly the color of succeeding coats. Spraying will not be permitted.
9. Brush out or roll on first or prime coat; work well into surface.
10. Each coat shall be inspected, approved and dry before proceeding with additional coats.
11. Allow at least 48 hrs for enamels and exterior oil paint to dry.

3.04 FIELD QUALITY CONTROL

- A. The Authority reserves the right to require the following material testing procedures at any time, and any number of times during period of field painting:
 1. Measurement of dry film thickness (DFT) by use of a dry film thickness gauge in accordance with use and calibration requirements of Structural Steel Painting Council [SSPC], "Method of Measurement of Dry Paint Thickness with Magnetic Gauges".
 2. Engage services of an independent testing laboratory, recommended by the Authority, to sample paint being used. Samples of materials delivered to construction site will be taken, identified and sealed, and certified in presence of Contractor
 3. Testing laboratory will perform appropriate tests for any or all of the following characteristics: Abrasion resistance, apparent reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness, recoating, skinning, color retention, alkali resistance and quantitative materials analysis.
 4. If test results show that material being used does not comply with specified requirements, Contractor shall be directed to stop painting Work, and remove non-complying paint; repaint surfaces coated with rejected paint; remove rejected paint from previously painted surfaces if, upon

repainting with specified paint, the two coatings are non-compatible.

- a. If the samples do not comply with requirements of the Specifications, costs of testing and remediation of rejected work shall be borne by Contractor.
- b. If the tests find that the samples do comply with the requirements of the Specifications, the cost of the testing will be borne by the Authority.

3.05 CLEANING

A. General

Contractor shall clean-up behind each paint crew such that painting and clean-up will be a continuous uninterrupted operation. The practice of one general clean-up after completion of all painting will be strictly prohibited. This clean-up will include, but not be limited to the following:

1. Remove spots or defacement resulting from Work of this Section.
2. Retouch all damaged surfaces to leave Work in perfect finished condition.
3. If spots or defacement cannot be satisfactorily removed and retouched, re-finish the surfaces as directed.

3.08 PROTECTION

- A. Provide caution tape and/or locked entryways during paint removal activities in existing buildings to prevent access to the work area from unauthorized personnel.
- B. Provide "Wet Paint" signs to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their Work after completion of painting operations.

C. At the completion of Work of other trades, touch-up and restore all damaged or defaced painted surfaces as

END OF SECTION

LIST OF SUBMITTALS

<u>SUBMITTAL</u>	<u>DATE SUBMITTED</u>	<u>DATE APPROVED</u>
Product Data:	_____	_____
1. Manufacturer's product literature for all materials with directions and recommendations for environmental conditions, surface preparation, priming, mixing, reduction, spreading rate, application, storage and VOC content.		
Samples:	_____	_____
1. Initial selection: manufacturer's color charts for each type of finish.		
2. Verification prior to installation: color chips for surfaces to be painted.		
3. Verification prior to installation: two samples of each color and material on 12" x 12" hard-board.		
Quality Assurance:	_____	_____
1. Certification that materials for each system are obtained from a single manufacturer.		
2. Certification that Work shall be performed by personnel with a minimum of three years experience who meet the qualifications set forth in OSHA, 29 CFR 1926.62 (Lead In Construction Standard.		
Field samples:	_____	_____
1. Samples of each color and Finish.		
2. Corridor wall sample.		

Guarantees

* * *

SECTION 15401
GENERAL PROVISIONS FOR PLUMBING AND DRAINAGE WORK

1.01 SCOPE AND INTERPRETATION

- A. These Specifications and accompanying Drawings provide for the furnishing, setting and connection of sanitary fixtures, the installation of drainage, water supply, and gas supply systems.
- B. The specifications and Drawings require the Contractor to provide all labor, materials, equipment and appliances to perform of all Work pertaining or incidental thereto, which is needed to complete the Work shown on the Drawings and called for in the Specifications.
- C. The complete systems and the Work shall be so installed as to give proper and continuous service under all conditions, and shall be in accordance with the requirements of all public authorities having jurisdiction and to the complete satisfaction of the Authority. Any Work shown on the Drawings and not particularly described in the specifications, or vice versa or any Work which may be deemed necessary to complete the Contract shall be provided by the Contractor as part of its Contract.
- D. For purposes of clearness and legibility, plumbing Drawings are essentially diagrammatic and size and location of equipment are drawn to scale wherever possible. The Drawings indicate size, connection points and routes of pipe. It is not intended, however, that all offsets, rises and drops are shown. Provide piping as required to fit structure, avoid obstruction, and retain clearances, headroom openings and passageways.
- E. Fixtures shown and described on the Drawings shall be connected with waste, vent and water supply piping in accordance with the requirements of New-York City Building Code, despite the omission of indication of such piping on the plans. Any question involving the installation of such piping shall be referred to the Authority for resolution.
- F. Fixtures, piping and other plumbing items which are shown and described on the Drawings and are not specifically labeled "Future" or "N.I.C." shall be provided by the Contractor. Related Work necessary for the proper installation shall be performed by the Contractor.
- G. The Plumbing Contractor shall comply with the Commissioning Requirements of Section S01660 for Plumbing Fixtures, Domestic Water Heaters, Gas System, Pumping Apparatus and Tanks. Testing of plumbing systems as required by Section 15414 shall be completed prior to commencement of the commissioning process, as written tests results and sign-

offs by the Authority must be submitted to the Commissioning Agent prior to starting the commissioning process.

H. Scope of Work: The plumbing and drainage work of this contract shall include but shall not be limited to the following systems, equipment and services:

1. Cold Water Service Piping: (Main domestic service): Complete piping system including curb valve and box from connection to city mains and ending within building with a service header consisting of O. S. & Y. valve, check valves, connection to fire service, water service meter assembly and an approved backflow preventer device.
2. Fire Service Piping: Complete piping system including curb valve and box & signs from connection to city water main and ending within building with a service header consisting of O.S. &Y. valve, check valve, connection to domestic water service, and a fire service double detector check valve assembly.

Note: If the two (2) water services are fed from one street main, a sectional valve should be installed per DEP requirements and approvals.

3. Cold Water Distribution Piping: Complete piping system including water pressure booster system, controls, mains, risers, and branches from connection to cold water service piping to all fixtures and equipment.
4. Hot Water/Hot Water Circulating Piping: Complete piping systems; mains, risers, and branches to and from all fixtures and equipment including gas fired and/or electric water heaters, in-line circulating pumps, aquastats and controls.
5. Gas Piping: Complete piping system; service piping, meter piping and distribution piping from connection to gas main in street and extending into building and to equipment including meters, gas pressure booster system, gas safety shut-off valves, master gas control valve and gas cocks.
6. Sanitary Drainage/Vent piping: Complete piping system; soil, waste, drain and vent piping, building house drain and building house sewer including sewage ejector, sump pumps, floor drains, from all fixtures and equipment to connection into public sewer, and vent extensions through roofs. Vent piping shall include required roof openings, pipe sleeves and flashing.

7. Acid Waste/Vent Piping: Complete piping system; acid waste and vent piping, individual acid neutralizing sumps or centralized pH Neutralizing System from all laboratory sinks and equipment and connections into the sanitary waste and vent system or acid vent extensions through roofs. Acid vent piping through roof shall include required roof openings, pipe sleeves and flashing.
8. Storm Water Drainage Piping: Complete piping system including roof drains, area drains, catch basins, piping and connection to detention basins and from detention basins to public sewer.
9. Plumbing Fixtures: Including water closets, urinals, lavatories, combination sink and drinking fountains, electric water coolers, wash centers, drinking fountains, service sinks, showers (complete with all accessories), mixing valves, supports and carriers.
10. Water Service Meter Assembly: For the main water service to building - complete with approved compound water meter, backflow preventer device, strainer, valves, pipe, fitting, foundation pad.
11. Fire Service Double Detector Check Valve Assembly: Complete with approved double detector check valve, strainer, valves, pipe and fittings.
12. Reduced Pressure Zone Backflow Preventers (RPZ): Install RPZ's in cold water distribution piping per SCA standards, and cold water make-up line to equipment installed under HVAC work.
13. Gas (Flue) Venting: From water heater flue outlet connection to and including connection to chimney, including gas tight sealing of vent and connection.
14. Equipment furnished under other Sections of this Contract: Including kitchen equipment and Heating, Ventilating and Air Conditioning equipment shall be piped for gas, hot and cold water, waste and vent.
15. Piping, Equipment Supports, and seismic restraints: To comprise all restraints, hangers, pipe guides, rods, beam clamps, brackets, pipe anchors, other attachments, floor flanges, masonry anchors, bolts, nuts, washers, and other items as required to fully support all piping, gas venting, and equipment installed under this contract inclusive of spring hangers, seismic restraints, and vibration mounts where recommended by equipment manufacturers, where required to meet noise abatement regulations and as necessary to prevent piping and equipment vibrations being transmitted to structure.

16. Provide unions and stop valves at all equipment connections and where required for service, repairs and draining.
17. Piping - General: Piping, Piping installation or hook-up shall mean a complete installation in all respects including pipe, fittings, valves, unions, traps, strainers, specialties and other miscellaneous items to make piping systems and equipment operational.
18. Instrumentation: Provide thermometers, pressure gauges and other items for all piping and equipment installed under this contract, as indicated on contract drawings and as necessary for operation, maintenance and adjustments.
19. Insulation, Painting and Identification: As specified in their respective sections of this Contract.
20. Miscellaneous Work: Included shall be all items of materials, piping, controls, wiring and other miscellaneous items not specifically shown on Contract Drawings or called for herein but which are normally furnished and required for a complete installation of this type.
21. Tests: The Contractor shall perform pressure, performance and operating tests and other tests as hereinafter specified, as directed by the Authority and as required by agencies having jurisdiction as specified in Section 15414 "TESTS".
22. Sealing of Openings: Openings left in walls, floors, ceilings or partitions shall be sealed. Finish shall match existing adjoining finish in all respects.
23. The NYC Building Code classifies schools as Occupancy Category III in BC Table 1604.5. Seismic requirements of the New York City Building code apply to New Buildings, Additions, and retrofit work on Existing Buildings constructed after LL 17/1995 became effective.
 - a. Refer to Section 15403, Vibration Isolation and Seismic Controls, HVAC Systems for the bracing requirements of equipment and appurtenances.
 - b. Calculations (including the combining of tensile and shear loadings) to seismic bracing designs shall be stamped by Contractor's Registered Professional Engineer with at least five years of seismic design experience in non-structural building components in New York State. The Contractor shall retain a registered professional engineer who shall provide all required shop

drawings (signed and sealed). Contractor's engineer shall also field inspect all installations of vibration isolators and seismic bracing and shall submit affidavit that all isolators/bracing have been installed in accordance with the signed/sealed coordinated shop drawings.

24. Coordination Drawings: The plumbing contractor shall cooperate with the HVAC, Fire Protection Systems, and Electrical contractors in the development of the coordination drawings. The drawings, indicating ductwork, steam, hydronic and fuel piping, etc. shall be generated by the HVAC contractor, who in turn is to provide them to the Plumbing & Drainage contractor for inclusion of sanitary, storm, gas, and domestic piping in this coordination set, and subsequently to the Fire Protection Systems and Electrical contractors. The specified order in which the various trade contractors impose their work on the coordination drawings is not intended to grant priority to any one trade contractor in the allocation of space. At the completion of this phase, hold a coordination meeting to eliminate any interference among the trades that the drawings indicate and to avoid any conflicts in installing the Work.
25. **All penetrations made into other trades work are to be sealed to air tight/watertight condition. Penetrations through insulated systems, such as refrigerated rooms/equipment, etc, shall be insulated and sealed on both sides of penetration. Sealant on interior side of such insulated spaces/equipment shall be silicone recommended by manufacturer.**
26. Project Record Documents: For the requirements under this provision, refer to Section G01720.

1.02 CODES AND STANDARDS

- A. It shall be unlawful for any person to perform the work referred to under this Plumbing and Drainage Specifications and/or shown on the Plumbing and Drainage Contract Drawings unless such person is a licensed master plumber, partnership, corporation or other business association as permitted by the NYC Building Code and unless such work is performed under the direct and continuing supervision of a licensed master plumber.
- B. Where requirements for products, materials, systems, equipment, methods and other portion of the work specified herein exceed minimum requirements of regulatory agencies having jurisdiction over the construction work, contractor shall comply with such requirements specified herein, unless specifically approved otherwise by the Authority.

1.03 TORCH BURNING OPERATION

- A. The storing and use of oxygen and combustible gases in conjunction with torch burning apparatus is subject to the Rules and Regulations of the Division of Fire Prevention of the Fire Department of the City of New York, latest Fire Prevention (F.P.) Directive. Fire watches shall be provided during all operations using torches for burning, cutting or welding.
- B. Contractor shall apply for and obtain permits for the use and storage of such equipment on school premises. The operator of such equipment shall have a certificate of fitness issued by the Fire Department.
- C. The cost of permits, certificates, fire watches, apparatus and other items required in the torch burning operation shall be borne by the Contractor at no additional cost to the Authority.

1.04 PROTECTION OF MATERIALS AND WORK

- A. New Building
 - 1. Open ends of piping shall be temporarily closed by a proper fitting, until piping is approved and ready for service. The use of water closets and other plumbing fixtures during the progress of the Work is strictly prohibited.
 - 2. Motors and appurtenances shall be covered and protected during the progress of the Work.
 - 3. Plumbing fixtures and other items shall be protected during the progress of the Work. When the building is practically complete and ready for use the fixtures and other items shall be cleaned and all metal work polished and the entire installation put in perfect working order.

1.05 GUARANTEES AND WARRANTIES

- A. The Requirements of Section G01740 and this Article shall apply to Guarantees and Warranties.
- B. Contractor's Guarantees: The Contractor guarantees that all Work of this Contract is free from all defects, and is as specified, and that should any defects, which cannot be proven to have been caused by improper use, develop within the space of one year from the date of substantial completion of the Work, such defects shall be made good by the Contractor, free of cost to the School Construction Authority.

- C. Manufacturer's Warranty: Hermetically sealed compressor units for water coolers, or any other equipment mechanically refrigerated, shall have a five-year warranty. This warranty shall cover the replacing the hermetically sealed compressor unit if it shall become defective within 5 years from the date as defined in the General Conditions. It shall be replaced free of charge, by the manufacturer, to the Authority.

1.06 GAGES

- A. Wherever thickness of metals are designated on the Drawings or in the Specifications by gage number, and the type of gage, or thickness in decimals of an inch, is not stated, the following gages shall apply.

<u>Material</u>	<u>Gage</u>
Aluminum Sheet	Brown & Sharpe or American Wire
Wire Aluminum, Brass and Copper	Brown & Sharpe or American Wire
Sheet Brass and Copper	Brown & Sharpe or American Wire
Brazed Brass and Copper Tubing	Brown & Sharpe or American Wire
Seamless Brass and Copper Tubing	Birmingham Wire (Stubs Iron)
Seamless Steel Tubing	Birmingham Wire (Stubs Iron)
Stainless Steel Sheets.....	U.S. Standard
Stainless Steel Seamless Tubing	Stubs Iron
Monel Metal Tubing	Birmingham Wire (Stubs Iron)
Monel Metal Sheets	U.S. Standard
Sheet Steel and Iron	U.S. Standard
Steel Wire	American Steel and Wire
Zinc	Zinc

1.07 OPENINGS AND CHASES

- A. In addition to the requirements in the Article entitled Cutting, Patching and Removals of Section S01010, the following shall also apply:

Openings through exterior foundation walls shall be made watertight by the Contractor after pipes, conduits and other items passing through the wall have been installed. This building is planned and detailed, and is the intent of these specifications to provide a structure that will prevent the penetration by rodents and vermin of any vacant space where they might find a harborage. The Contractor will be held responsible for securing this condition by the closing of all points of access to such spaces, including the passage of piping and conduits, through all walls, partitions, ceilings and furred out spaces, the closing of access to voids in hollow tile or cinder blocks. There shall be a special inspection of the building with regard to this matter before final acceptance.

1.08 INSTRUCTION OF CUSTODIAN

- A. After the plumbing, drainage, and gas systems have been tested, and fixtures, apparatus and all other items adjusted and operating properly to the satisfaction of the Authority, Contractor shall furnish a competent person to instruct the Custodial staff in the operation and maintenance of the systems. Contractor shall video **record** all the training sessions for various equipment and systems as specified in individual sections of these Specifications. Determination of the date and time of such instruction shall be under the direction of the Authority's Representative.

1.09 TEMPORARY FIELD OFFICE

- A. In addition to the requirements in **the** Article **entitled** Temporary Field Offices of Section S01500, the following shall also apply:
1. Each trailer shall be provided with plumbing fixtures, soil, waste, vent and supply piping. Provide underground temporary soil and water piping for all temporary plumbing facilities, making connections to outlets provided at bottom of each trailer and completing all other outside plumbing Work required for proper and continuous functioning of these trailers. Provide a temporary wood trap pit where required.
 2. Temporary drainage pipe and fittings shall be service weight cast iron. Trap shall have two hand holes with cast-brass screw plugs. All joints shall be caulked with oakum and lead.

3. Exposed water and drainage piping, including traps and fittings, subject to frost shall be insulated with two 1" thick layers of molded fiberglass pipe insulation. The outer layer shall have a vapor barrier jacket as specified for cold water piping in Section 15413. The vapor barrier jacket shall then be covered with a weatherproof jacket of asphalt saturated roofing felt having a nominal weight of 15 lbs. per square. The weatherproof jacket shall be applied with all joints lapped at least 3". Horizontal joints shall be lapped downward to shed water. The jacket shall be secured in place with No. 20 gage galvanized annealed steel wire.
4. Provide adequate water to toilet fixtures and connect water supply line in the street in accordance with the requirements of the Bureau of Water Supply or Private Water Company.
5. Provide 1" branch water supply line from temporary lines if necessary into boiler room; Provide a valved outlet where directed and connect from said outlet to boilers for temporary heat.
6. When the temporary field offices are removed, all temporary plumbing Work including supply line for temporary heat shall be removed and all necessary work such as plugging mains, sewers, and other miscellaneous items shall be done by the Contractor.
7. After the temporary toilet facilities have been removed from the site, the Contractor will assign a toilet room within the building for the use by the workmen and a toilet for the use by the Authority's Inspectors. The Contractor shall complete the work in and make these rooms available.

1.10 SUBMITTALS

- A. Formal submission for approval of manufacturer is not required if the Contractor provides equipment as per manufacturer/model number or series listed in the specification. Formal submissions are also not required for materials and appurtenances (ex. sheet metal, pipes, etc.) if the Contractor provides items as defined in the specification. In this case, Contractor must submit affidavit (for record purposes only) stating that listed equipment and/or items as defined in the specification will be provided. Submittals are mandatory for certain critical items and will be so noted in the respective specifications. Submittals are always required to verify capacity. Schedules, installation instructions, startup manuals, operation and maintenance manuals, and shop drawings are always required to be submitted.

1.11 CLEANING AND REPAIR

- A. At the completion of the Work and before the final inspection is made the Contractor shall thoroughly clean all fixtures, apparatus, appurtenances, piping, brass and chrome and nickel-plated work, marble and stone work, and leave these items free from all marks, scratches, stains, and other damage. All pumps, filters, heaters, and other equipment shall be cleaned and left in condition to operate, and the work, as a whole, left in perfect working order. Remove all tools, debris and excess materials from the premises.
- B. Contractor shall not leave sharp exposed metal edges (bottom of threaded rods, P&D equipment supports, etc.) that could otherwise present safety hazards to the building's occupants/work staff.

1.12 BMS/DDC COORDINATION

- A. Refer to the Article entitled BMS/DDC Coordination of Section S01010 for the coordination of work related to P&D and TCC Contractor. Coordinate with General Contractor as to actual scope to be included in the P&D and Temperature Control Work and delineation with the Electrical subcontractor's work.

END OF SECTION

* * *

LIST OF SUBMITTALS

<u>SUBMITTAL</u>	<u>DATE SUBMITTED</u>	<u>DATE APPROVED</u>
Coordination Drawings:	_____	_____
Contractor's affidavits For submission of specified Materials/or appurtenances	_____	_____

* * *

SECTION 15403
POOL PLUMBING SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. All piping and equipment must be seismically secured with the exception of systems qualifying for exclusions as defined herein.
1. All equipment as noted in the specification shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.
 2. The work in this section includes, but is not limited to the following:
 - a. Flexible piping connections
 - b. Seismic bracing for isolated equipment
 3. All vibration isolators and seismic bracing described in this section shall be the product of a single manufacturer.

1.02 DEFINITIONS

- A. Positive Attachment:

A positive attachment is defined as a cast-in anchor, a seismic drilled-in wedge anchor or anchor bolt ICC certified for cracked concrete, adhesive anchor, or a welded or bolted connection to structure. Beam clamps (2 sided or 1 sided beam clamps with restraining straps) are only allowed for hangers and are not permitted for seismic braces.

1.03 RELATED SECTIONS

Related Sections include the following but are not limited to:

A. Plumbing piping

Section 15410

1.04 SUBMITTALS

Contractor's Registered Professional Engineer shall sign and seal submittals. Architect/Engineer of Record shall verify that the structural support system can support all seismic loads where the bracing is attached to the structure.

A. Descriptive Data:

1. Manufacturer's product data, including manufacturer's SPEC-DATA product sheet.
2. Manufacturer's installation instructions.
3. Catalog pages illustrating products to be incorporated into project.

B. Shop Drawings

1. Layout of control panels and hydraulics.
2. Detail of connections of feed and return lines to the pool filtration system.
3. Detail of connections of control panels to feed and return lines.
4. Provide specific details of control panels, size and locations for each piece of equipment.
5. Shop drawings shall be signed/sealed by Contractor's registered professional engineer.
6. House-keeping pad details
7. Pipe details for service entry penetrating seismic or expansion joints.

1.05 INFORMATION SUBMITTALS

A. General: Submit listed submittals in accordance with Contract Conditions.

B. Test and Evaluation Reports:

1. Certified test reports showing compliance with specified performance characteristics and physical properties.

C. Qualification Statements:

1. Submit letter of verification for Installer's Qualifications.

1.06 CLOSEOUT SUBMITTALS

- A. General: Submit listed submittals in accordance with Contract Conditions.

B. Operation and Maintenance data:

1. Submit operation and maintenance data for installed products.
 - a. Manufacturer's instructions detailing maintenance requirements.
 - b. Parts catalog giving showing complete list of available parts.
 - c. Replacement parts with cuts and identifying numbers.

- C. Warranty Documentation: Submit warranty documents Specified.

1.07 QUALITY ASSURANCE

A. Qualifications

1. Installer: Acceptable to the manufacturer, experienced in performing work of this section and has specialized in installation of work similar to that required for this project.

1.08 DELIVERY, STORAGE & HANDLING

A. Delivery and Acceptance requirements:

1. Deliver material in accordance with manufacturer's instructions.
2. Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.

- B. Storage and Handling Requirements:
 - 1. Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
- C. Packaging Waste Management:
 - 1. Separate waste materials in accordance with Construction Waste Management and Disposal.
 - 2. Remove packaging materials from site and dispose of at appropriate recycling facilities.
 - 3. Collect and separate for disposal plastic packaging material for recycling.
 - 4. Fold metal and plastic banding, flatten and place in designated area for recycling.

1.09 WARRANTY

- A. Warranty: Refer to Contract Conditions and Section for project warranty provisions.
- B. Manufacturer's Warranty: Submit for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and doesn't limit, other rights. Owner may have under other Contract Documents.
 - 1. Warranty Term: 12 years commencing on date of substantial completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Hayward Inc.
- B. Contact: Technical Services; One Hayward Industrial Drive. Clemmons, NC 27102. Telephone (908)355-7995; website: www.haywardpool.com.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Verify that conditions of substrates previously installed under other section or contracts are acceptable for product installation in

accordance with manufacturer's instructions prior to installation of valves and accessories.

1. Inform owner of unacceptable conditions immediately upon discovery.
2. Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval from Owner.

3.02 PREPARATION

- B. Surface Preparation: Prepare surface in accordance with manufacturer's written recommendations and coordinate with other sections.

3.03 INSTALLATION

- A. Coordinate installation of components according with manufacturer's instructions.

3.04 FIELD QUALITY CONTROL

- A. Site Tests, Inspection: Coordinate site test with Sections.
 1. Pressure test system in accordance with manufacturer's instructions.

3.05 SYSTEM STARTUP

- A. Site Tests, Inspection: Coordinate site test with Sections.
 1. Pressure test system in accordance with manufacturer's instructions.

3.06 CLEANING

- A. Perform cleanup in accordance with Section.
- B. Upon completion, remove surplus materials, rubbish, tools and equipment.
- C. Waste Management:
 1. Coordinate recycling or waste materials.
 2. Collect recyclable waste and dispose of or recycle field generated construction waste created during demolition, construction or final cleaning.
 3. Remove recycling containers and bins from site.

3.07 PROTECTION

- A. Protect installed product from damage during installations.
- B. Repair or replace damaged products before Substantial Completion.

* * *

SECTION 15410
PLUMBING PIPING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Extent of plumbing piping work is indicated on Drawings and by the requirements of this Section including but is not limited to the following:

1. Pipe
2. Fittings
3. Piping Joints
4. Sleeves for Pipes
5. Unions

1.02 RELATED SECTIONS

A. Painting..... Section 09900

1.03 CODES AND STANDARDS

A. Comply with applicable portions of the Building Code of the City of New York. Where requirements for products, materials, equipment, methods and other portion of the work specified herein exceed minimum requirements of N.Y. City Building Code, contractor shall comply with such requirements specified herein, unless specifically approved otherwise by the Authority.

B. Standards listed below are referenced in this section.

1. American Society for Testing and Materials (ASTM)
2. American Standards Association (ASA)
3. American National Standards Institute (ANSI)

C. Brazing: Certify brazing procedures and brazers.

- D. Approved Agency Certification: Certification and listing by an Approved Agency in accordance with NYC Dept. of Buildings rules, indicating that the materials and assemblies as regulated by the NYC Building Code are acceptable for the intended use. When test methods are stipulated in the NYC Building Code, the tests utilized shall be stated in the Certification. Prior MEA approvals are acceptable for materials and assemblies conforming to current Code requirements

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipe materials properly protected, and undamaged.
- B. Properly protect all piping so as to prevent damage to the pipe or the introduction of foreign material into the pipe. For the purpose of protecting piping from pre-installation contamination, all piping shall be shipped to job site with suitable caps, sheet metal covers or plugs. Pipe caps shall not be removed until just before installation.
- C. Examine all pipe and fittings before laying. Do not install any piece that is found to be defective.

1.05 SUBMITTALS

- A. Submit a compliance affidavit, if pipe and fittings match contract documents. Manufacturer's technical product data submission will be required if a substitution is proposed.
- B. Submit Shop Drawings for all piping installations.
- C. Pipe Schedule: Itemize pipe and fitting materials for each specified application.
- D. Brazing Certifications: Submit as required for piping work.
- E. Sample: Polypropylene pipe & fittings with the required marking.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Piping shall conform to the following:

1. Polypropylene Plastic Pipe:

- a. Pipe shall be similar to a product manufactured by GF Piping Systems LLC, Enfield "Enfusion", Orion BlueLine, Zurn Chemical Drainage or other approved pipe manufacturers, having flame retardant pattern, Schedule 40 polypropylene approved by New York City Materials and Equipment Acceptance Division. Materials shall be in accordance with ASTM D4101 and shall be flame retardant in accordance with ASTM Test D635. All piping shall be compatible with the Coil Fusion method. Each length of pipe shall be plainly marked with manufacturer's name, pipe size, schedule, type and ASTM information. The marking may be stenciled or otherwise applied on the pipe so as to be clear and legible at the time of installation. The sample of pipe showing required markings shall be submitted for approval.
- c. Pipe shall be joined with a bell-and-spigot joint and shall be watertight. Pipe shall be Hancor BLUESEAL, ADS N12 WT, or pre-approved equal.
- d. The bell-and-spigot HDPE piping network shall be joined using watertight connections in accordance with the requirements of ASTM D3212. Elastomeric seals (gaskets) made of polyisoprene and meeting the requirements of ASTM F477 shall show no visible water leaks when tested under 10 feet hydrostatic water test. A joint lubricant recommended by the manufacturer shall be used on the gasket and bell during assembly.
- e. To preclude crumbling and provide better joint performance of the HDPE pipe, the bell and spigot ends shall be reinforced, including a bell tolerance device. The bell tolerance device must be installed by the pipe manufacturer.

f. Approved Manufacturers:

Hancor Inc., ADS Inc.

B. Fittings and Joints

1. Fittings for polypropylene plastic pipe shall be DWV pattern flame retardant schedule 40 polypropylene fittings. Materials shall be in accordance with ASTM D4101 and shall be fire retardant in accordance to ASTM test D635. Fittings shall be legibly marked with molded on letters showing manufacturer's trademark, pipe size of each socket, manufacturer's part number, and symbol PPFR. Joints and fittings shall be DWV electric fusion made of the same material as the piping. Submit samples of fitting, showing required markings, for approval.
2. Fittings for Polyvinylidene Fluoride Plastic Pipe (PVDF) shall be DWV pattern fittings flame retardant manufactured to Schedule 40 dimensions. Materials shall be in accordance with ASTM F1673 and shall be fire retardant in accordance to ASTM test D635. Fittings shall be legibly marked with molded on letters showing manufacturer's trademark, pipe size of each fitting, manufacturer's part number, and symbol PVDF. Fittings shall be joined to the PVDF pipe by means of a fusion method.

C. Water service pipe, water distribution pipe and all pipe fittings utilized in water supply systems shall conform to NSF 61

D. Pipe Nipples

1. All pipe nipples shall be of the same materials as the connecting piping.
2. The use of close nipples is prohibited

E. Unions

1. Unions 2" and smaller shall be threaded. Unions 2¹/₂" and larger shall be flanged.
2. Unions shall be as manufactured by

Anvil International
NIBCO Inc.
Ward Manufacturing LLC
The Viking Corporation

F. Pipe Sleeves: Provide pipe sleeves of one of the following. Pipe sleeve must be appropriate type and thickness for the UL firestopping assembly selected:

1. Material for sealing spaces between pipe and sleeve through foundation walls below grade shall be Link-Seal Type "C" as manufactured by Thunderline Corp; Belleville, Mich. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve. Links shall be loosely assembled with bolts to form a continuous rubber bolt around the pipe with a pressure plate under each bolt head and nut. Link-Seal pressure plates shall be Type "C" (insulating type) to provide for electrical insulation and cathodic protection.
2. Materials for sealing space between each pipe and sleeve through non-fire rated exterior walls above grade shall be Non-shrinking cement. Materials for sealing space between each pipe and sleeve through non-rated interior walls shall consist of mineral wool and sealant.
3. Waterproof sleeves shall be Link-Seal Wall Sleeve as manufactured by Thunderline Corp, or MetraSeal wall sleeve by the Metraflex Co.

PART 3 - EXECUTION

3.01 PIPE AND FITTING SCHEDULE

A. Domestic Water: Service Underground - Exterior & Interior

1. 2½" and Less: Type K soft annealed copper tube with cast bronze solder joint fittings; Brass, seamless drawn pipe with threaded fittings.

2. 3" and Up: Ductile iron and fittings with mechanical joints

3.02 INSTALLATION

A. Piping (General)

1. The run and arrangements of all pipes shall be approximately as shown on drawings or specified and as directed during installation, and shall be as straight and direct as possible, forming right angles or parallel lines with building walls and other pipes, and neatly spaced. No pipe shall be installed where the headroom will be interfered with unless the conditions are such that it is unavoidable and permission is obtained from the Authority. Offsets will be permitted where walls reduce in thickness or beams interfere with direct runs; offsets shall be made at an angle of 45° to the vertical; in no case shall the space between the pipes, partitions, walls, etc., exceed 5". All exposed risers shall be erected plumb, standing free, close to and parallel with walls and other pipes and be uniformly spaced. All horizontal runs of piping hung from structural floor, slab or floor beams shall be erected as closely as possible to bottom of floor slabs, ceilings, or I-beams as the case may be. In no case shall the headroom, beneath the pipe, be less than (7'-0") where the pipe is installed more than (1'-0") from wall, partition, etc., except where piping is required to be installed in Boiler Room and Mechanical spaces above floor. Horizontal piping shall be so graded as to drain to the low points and water lines to drain bibbs. All piping installed in floor shall be painted with a heavy coat of asphaltum. All piping shall be installed with ample space for pipe covering. All exposed plumbing piping in the Kitchen Areas shall be chrome plated brass pipe except for gas line. Provide threaded fittings. Chrome (silver) paints will not be accepted.
2. For work in existing buildings the following addition requirements shall be adhered to:

- a. Piping shall run as straight as possible with the fewest number of changes in direction, with such variations from the layout shown on the Drawings as conditions at the premises may require, as approved by the Authority at no extra cost to the Authority. Provide piping without sharp bends, quick changes of sections, pockets or bushings.
- b. The locations of all existing piping which are indicated on the Drawings are approximate. The Contractor shall investigate and ascertain the exact locations of such piping and make whatever minor variations in runs of new piping that may be required at no extra cost to the Authority.
- c. Contractor shall consider the location of all equipment, piping, electric conduits, supports, etc., and all new piping shall be installed without interference therewith.
- d. Wherever existing branch piping interfere with installation of new branch piping, the existing branch piping shall be removed and re-routed to accommodate the new work. The rerouted work shall be of new material.
- e. All new extensions and relocations of existing piping systems shall be concealed in existing or new walls, floors, ceilings, pipe chases or as otherwise specified.

B. Piping Joints

1. Polypropylene piping:

- a. Polypropylene pipe and fittings shall be joined by use of electrical fusion coils, energized by a variable, low voltage power supply according to the manufacturer's recommendation. Piping systems made by different manufacturers are usually not compatible.

2. Polyvinylidene Fluoride Plastic Pipe (PVDF) piping:
 - a. Polyvinylidene Fluoride Plastic Pipe (PVDF) and fittings shall be joined by the fusing method approved by the manufacturer. The method shall be submitted with the shop drawing. All joints shall be made with the fusion tool indicated by the manufacturer to produce a hermetically sealed joint. Polyvinylidene Fluoride Plastic Pipe (PVDF) and Polypropylene Piping (PP) will not fuse together since they are dissimilar materials. Piping systems made by different manufacturers are usually not compatible.
3. Unions shall be used to connect equipment (pumps, circulators, tanks, meters, etc.) to water lines. The union shall be installed as close to the equipment as practical. Where valves are adjacent to equipment, union shall be on down stream side of valves.

C. Sleeves for Pipes

1. General: All plumbing pipes passing through floors, roofs, walls, partitions, furring, beams, trenches, and wherever else indicated on drawings shall be provided with sleeves installed and maintained by the Contractor. Core drilled holes shall be provided with sleeves.

END OF SECTION

* * *

LIST OF SUBMITTALS

<u>SUBMITTAL</u>	<u>DATE SUBMITTED</u>	<u>DATE APPROVED</u>
Product Data:		
1. Clean-outs	_____	_____
2. Escutcheons	_____	_____
3. Pipe & fittings _____		_____
<u>OR</u>		
Contractor's affidavit Stating compliance with Piping materials requirements	_____	_____
Shop Drawings	_____	_____
Schedule:		
1. Pipe & fittings	_____	_____
Certifications:		
1. Brazing	_____	_____
Sample:		
1. Polypropylene pipe & fittings	_____	_____

* * *

SECTION 15412 - VALVES**PART 1 - GENERAL****1.01 DESCRIPTION OF WORK**

- A. Extent of Valve Work is indicated on the Drawings and by the Requirements of this Section.

1.02 SUBMITTALS

- A. Product Data
1. Manufacturer's product technical data for each valve.
 2. Installation Instructions
 3. Include list indicating valve and its application
- B. Shop Drawings indicating methods of assembly of components.

PART 2 - PRODUCTS**2.01 MATERIAL**

- A. Maximum content of lead permitted in materials used in the manufacture of valves shall be 5%.
- B. All valves shall be designed for packing under pressure with valve open or closed.
- C. Valves 2" and under shall be all bronze. Valves 2½" and over shall have iron bodies with bronze mountings (IBBM), and with outside screw and yoke (OS&Y), unless space conditions prevent the use of O.S. & Y. valves, in which case non-rising stem valves may be used.
- D. All gate valves shall be of the solid wedge disk type.
- E. All valves up to 2" in diameter shall have threaded or solder ends, 2½" in diameter and over shall have flanged ends.
- F. Iron body flanged-valves, strainers and other items shall be provided with gaskets and sealing as manufactured by Garlock. All flanges shall be drilled for American Standard Association 125 pound standard.
- G. All valves, except as otherwise specified, shall be type and number as specified below:
1. Gate Valves:

Class 125, threaded, bronze body, solid wedge, inside screw non-rising stem, screw-in bonnet: Stockham B-103, Milwaukee 105, Hammond IB645, NIBCO T-113, **Crane 438, Lukenheimer 2129, Walworth 4, Apollo Valves 102T, Jenkins 992AJ.**

Class 125, Solder end, bronze body, solid wedge, inside screw non-rising stem, screw-in bonnet: Stockham B-104, Milwaukee 115, Hammond IB647, NIBCO S-113, **Crane 1320, Lukenheimer 2133, Walworth 4SJ, Apollo Valves 102S, Jenkins 993AJ.**

Class 125, flanged, iron body bronze mounted (IBBM), bolted bonnet, O.S.& Y., solid wedge: Stockham G-623, Milwaukee F-2885M, Hammond IR1140, NIBCO F-617-0, **Crane 465-1/2, Lukenheimer 1430, Walworth 8726F, Apollo Valves 611F, Jenkins 651J.**

Class 125, flanged, iron body bronze mounted (IBBM), non-rising stem, bolted bonnet, solid wedge: Stockham G-612, Milwaukee F-2882M, Hammond IR1138, NIBCO F-619, **Crane 461, Lukenheimer 1428, Walworth 8719F, Apollo Valves 610F, Jenkins 326J.**

- H. Ball valves shall be two-piece, full port, 600 W.O.G., bronze body, chrome plated bronze or brass ball and Teflon seals, with thread or solder ends. Ball valves shall have a lever handle. Threaded ends ball valve shall be Conbraco Industries, Inc.; Apollo Valves **77C-100, Crane 9211**, Milwaukee BA-**400**, Hammond **8301AN61**, NIBCO T-585-70, Dwyer Series BV2MB or Stockham **T-255-BR-R** and soldered ends ball valve shall be Conbraco Industries, Inc.; Apollo Valves **77C-200**, Milwaukee BA-**450**, Hammond **8311AN61**, NIBCO S-585-70 or Stockham S-**255 BR-R**. Ball valves should be used for up to 2" sizes only.

1. **Press-Fit Ball Valves: Valves shall be two-piece bronze body with full port, chrome or brass plated ball, blow-out proof stem and PTFE or RTFE seats, rated at 600 psi with press fitting ends. Ball Valves shall be Viega Model 2970.10, NIBCO PS585-70, Conbraco Industries, Inc.; Apollo Valves 77W. Ball valves shall have a metal lever handle.**

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install valves in accordance with the manufacturer's instructions. Follow valve manufacturers recommendations when brazing solder end valves.
- B. Valves shall be installed so that they shall be readily accessible. It is brought to the Contractor's attention that all valves shall be so located that they can be easily and safely operated. No valve shall be installed with the stem pointed downward. If, in the opinion of the Authority, valves are so installed as to create a hazardous and unsafe condition, this Contractor shall relocate these valves as directed without additional charge.
 1. Valve shall be full size of pipe. Iron body bronze mounted (IBBM), flanged, outside screw and yoke (OS&Y) valves shall be used on: water service and sprinkler service assemblies, suction and discharge piping for pumps and water distribution piping 2½" and larger. Valves on water distribution piping 2" and smaller shall be brass or bronze body.
- C. Gate valves shall be provided at the base of all risers, on all mains, branch lines, take-offs, drains, etc., and at all pumps, equipment, and at all apparatus; so located and arranged as to give complete shut-off and regulating control of all systems piping and apparatus.
 1. Ball valves may be substituted for Gate Valves on water distribution pipes up to 2" in size for risers, branches and hot and cold headers in accessible toilet pipe spaces.
- E. All valves shall have the name or trademark of the manufacturer and guaranteed working pressure cast or stamped on the body of the valve. All flanges shall be drilled for American Standards Association 125-pound Standard. Companion flanges for all iron body gate valves, check valves, strainers, etc., shall be iron.

3.02 VALVE APPLICATION SCHEDULE

A. Compressed Air: Above Ground-Interior

1. 2" and Less: Screwed or solder ends; Class 125, bronze body gates and bronze body swing checks.
2. 2½" and Up: Flanged ends, Class 125, OS&Y iron body gates; and iron body swing checks.

END OF SECTION

LIST OF SUBMITTALS**SUBMITTAL****DATE SUBMITTED****DATE APPROVED**

Product Data:

1. Mfgs product data

2. Installation Inst. _____

Shop Drawings _____

Valve List _____

* * *

SECTION 15414
TESTS**PART 1 - GENERAL****1.01 DESCRIPTION OF WORK**

- A. Every new plumbing system and every part of an existing plumbing system that has been altered or repaired shall be inspected and tested. Inspections and tests shall comply with the requirements of this Section.
- B. Defects disclosed by tests shall be repaired, or, if required by the Authority, defective work shall be replaced with new work. Tests shall be repeated after defects have been repaired or replaced and shall be repeated as often as necessary until all work passes the required tests.

1.02 SUBMITTALS

- A. Certification of Tests.
- B. Notices (72 hours) prior to all tests

PART 2 - PRODUCTS**2.01 MATERIALS**

- A. Provide all materials, equipment and other items required for tests, retests, repairs and replacements that are required to complete the Work of this Section.
- B. All gauges, instruments and test devices shall be provided with a certificate of calibration and calibration curve or letter indicating that a minimum of five (5) test points have been calibrated. The certificate and letter must show the date of last calibration. The calibration date must be within a year of the testing date.

PART 3 - EXECUTION**3.01 PIPING SYSTEM TESTS - GENERAL**

- A. All new piping and equipment shall be tested prior to application of insulation, painting, concealing or placing of backfill. Testing as stipulated herein shall be considered minimum, and where tests stipulated by authorities having legal jurisdiction exceed these

requirements, such more stringent tests shall be performed.

- B. The work of the Contractor shall include the furnishing of all labor, testing instruments, gauges, pumps, and other equipment required or necessary for tests, required by law, rules, and regulations and as specified.
- C. Provide all other tests required by local inspectors and all other authorities having jurisdiction.
- D. All appurtenances shall be operated after installation to determine whether or not they meet the requirements of the Specifications.
- E. Where controls and accessories are not designed to withstand pipe test pressures, they shall be removed or otherwise properly protected against damage during such test. After approval of such tests, controls and accessories shall be installed and tested with operating medium to operating pressures.
- F. If in any tests leaks are observed, the defective work or material shall be replaced. No caulking of screwed joints or holes will be acceptable. Peening of welds is prohibited. Repetition of the entire test will be required as many times as leaks can be observed from the tests, until no leak results in successful completion of the test.
- G. All tests shall be made in the presence and to the satisfaction of a representative of the Authority, and of the A/E, or their representatives, and the local authorities having legal jurisdiction over the work to be tested, and as may be directed; and at least 72 hours notice shall be given to all parties in advance of all tests.

3.02 TESTING OF AUTOMATIC CONTROLS

- A. In cooperation with control manufacturer's representative, adjust controls to operate as specified. Testing personnel shall check all controls for proper calibrations and list all controls requiring adjustment by control installers.

3.03 INACTIVE POTABLE WATER SYSTEM FLUSHING AND TESTING

- A. For potable water systems in vacant or inactive buildings which are being renovated for use as a school and where new plumbing and fixtures/outlets are not being installed, the following procedure shall apply:
 - 1. Upon receipt of the bacteriological sample results which verify that the bacteriological results are "negative/absent" for E. coli and Total Coliform and are less than 500 Cfu/ml for HPC, a determination will be made by the Authority's IEH Division as to the suitability of the water for potability. If the sampling results are deemed unacceptable by the Authority, the flushing and sampling procedures shall be repeated until an acceptable water quality is demonstrated.

3.04 WATER SERVICE PIPE TEST

- A. Each new service pipe or repaired service pipe shall be subjected to a water test under the street main pressure by the plumber in the presence of the tapper or inspector. All pipes and appurtenances shall remain uncovered for the duration of the test and shall show no sign of leakage. Water test shall be done as per rules and regulations of the Department of Environmental Protection of the City of New York.

3.05 WATER SUPPLY PIPING FOR SWIMMING POOL SYSTEM

- A. Piping, excluding sprinklers and hoses, shall be thoroughly and completely tested for pressure strength and leakage. Piping installed underground shall be tested before backfill operations are undertaken.
- B. The Contractor shall close all openings and the piping system shall be filled with water, taking care to bleed all entrapped air in the process. The pressure shall be slowly built up to 1.5 times operation pressure but not less than 125 PSI for at least one hour. The piping shall be inspected in its entirety while the 125 PSI pressure is maintained. Where leaks or damage of any kind are discovered, they shall be properly repaired and the line shall be re-tested.
- C. For piping installed underground, it may be necessary to partially backfill the line before testing in order to hold the line in place. Where such is the case, the partial backfill shall cover only the body of the pipe sections leaving all joints and connections uncovered for inspection purposes. It shall be demonstrated by testing

that the piping system will function properly at a pressure of 125 PSI. At or below design pressure rating, the delivery of water shall be steady and there shall be no leaks or damage to the piping system and no water hammer.

3.6 ADJUSTMENTS

- A. During the preliminary operation, the manufacturers of the different apparatus installed, including the starting and stopping devices, shall make adjustments as may be necessary.

3.7 FIXTURE TEST

- A. Fixtures shall be tested for soundness, stability of support, and satisfactory operation of all parts. All water-closet floor flanges must be tested.

3.8 PUMP TESTS

- A. All pumps shall be tested by the manufacturers prior to shipment of the pump. The test shall show the characteristic curves, indicating the relations of capacity, head, efficiency and H.P. throughout the pump's entire range. For each pump three certified copies of the tests shall be delivered to the Authority before the pumps are set in position.

3.9 VALVE TESTS

- A. Isolate system gages, sensor, etc. from pressure tests so instruments and devices are not damaged. Test pressure shall not exceed the maximum allowable test pressure for any pump, valves or other component in the system.

3.10 FINAL OPERATING TEST

- A. After the completion of the entire work, the Contractor shall operate the entire installation of plumbing and drainage in the presence of the Authority's Representative and of the representatives of the manufacturers of the different apparatus and appliances installed.

3.11 NOTIFICATION OF OFFICIALS, ETC.

- A. The Contractor shall provide written notification to The Authority and all department agencies and bureaus with

jurisdiction required to witness any tests falling within their jurisdiction.

In addition, the manufacturers of the apparatus to be tested must have qualified representation at all tests of apparatus supplied by them.

3.12 FUEL, MATERIAL, AND LABOR FOR TESTS, ETC.

- A. The Contractor shall furnish all fuel, apparatus, material and labor required for preliminary and final operations, cleaning, testing and adjusting, including the necessary oil, electric current and the services of competent mechanics.

3.13 FINAL TEST OF FIXTURES

- A. After all the fixtures are set and connected, Contractor shall turn water on at all fixtures, traps, etc., and the proper working of all shall be demonstrated by him to the satisfaction of the Authority.

3.14 NOT USED

3.15 INSPECTION

- A. The Authority reserves the right to order the Contractor to disassemble or take apart any or all material and equipment called for in order that it may be inspected to see that it has been constructed in strict accordance with the plans, specifications and details. If after inspection, it is found to fully comply, then the Contractor shall properly reassemble all such material and equipment.

Any material or equipment that does not fully comply with the requirements of the plans, details and specifications will be rejected and shall be at once removed from the premises and shall be replaced with new material and equipment that complies fully with the requirements of the plans, details and specifications.

3.16 PIPE FLUSHING PROCEDURE WHEN REPLACING FAUCETS OR EXISTING PLUMBING FIXTURES

- A. These procedures are to be implemented when faucets or other plumbing fixtures (i.e. valves, hose bibs, temperature or flow gauges, etc.) are installed or

replaced at a school which does not involve the replacement or installation of piping.

1. Plumbing fixtures/ or faucets shall be delivered to the school new and in intact factory-wrapped packaging. Fixtures/ or faucets not in intact factory-wrapped packaging will not be accepted for use. All fixtures/ or faucets must be maintained in a clean area prior to installation.
2. Prior to installation, turn the water on to flush out any residual entrained sediment or debris in the piping.
3. Install all fixtures/ or faucets in accordance with applicable codes and regulations.
4. Only remove fixtures/ or faucets from the factory-wrapped packaging immediately before and at the installation location.
5. Immediately install the fixtures/ or faucets after they are removed from the package. Tools used for installation shall be clean and free of deleterious material.
6. During installation, the plumber must handle fixtures(s) / or faucets in a sanitary manner to avoid potential contamination.
7. Following installation, turn on the hot and cold water valves separately and then simultaneously to confirm proper operation and water flow.

END OF SECTION

LIST OF SUBMITTALS

<u>SUBMITTAL</u>	<u>DATE SUBMITTED</u>	<u>DATE APPROVED</u>
Test Data: 1.Certified Pump tests	_____	_____
Shop Drawings: 1.Disinfection & Water Quality Testing Plan As per Art.3.03.B.C & D	_____	_____
Inspection reports: 1.72-hour notices prior to all tests	_____	_____

SECTION 15453
PUMPING APPARATUS AND TANKS

PART 1 - GENERAL**1.01 DESCRIPTION OF WORK**

- A. Provide all electrical motor-driven pumps and appurtenances as indicated on the Drawings and as specified herein.

1.02 SUBMITTALS

- A. Manufacturer's installation and operation instructions, catalog sheets, specifications, and maintenance manuals for each item specified.
- B. Shop Drawings.
1. Cuts of each pump, indicating parts and materials.
 2. Motor data.
 3. Cuts of each control panel and components
 4. Wiring Diagrams
 5. Cuts of each float switch assembly
- C. Submit a compliance affidavit, if all items in subparagraph B match contract documents. Manufacturer's technical product data submission will be required if a substitution is proposed.
- D. Certificates:
1. MEA or Approved Agency Certification listed and/or label for tank lining
 2. Certified pump test curves
 3. Manufacturer's data report for tank pressure testing
- E. Training Videos:
- Submit the videotapes produced during the training. All tapes shall be labeled and turned over to the Authority's representative within 48 hours of training. Obtain receipt from the Authority that the tapes have been received.
- F. Maintenance data:
1. Spare parts
 2. Maintenance manual

1.03 QUALITY ASSURANCE

- A. Each pump control panel must have UL label and panel wiring shall comply with the latest New York City Electrical Code.
- B. Pump manufacturer shall submit proof of 5 years experience in producing the specified equipments.

PART 2 - PRODUCTS**2.01 MOTORS**

- A. Provide motors and motor starters in accordance and in compliance of the requirements of Section 16480: Motors, Control Equipment and Circuitry.

2.02 PUMPS-GENERAL

- A. The casing for pumps shall be of close-grained cast iron for bronze fitted pumps or bronze on all bronze pumps. The waterways must have large cross-section areas with smooth turns so that the water will pass through at a low velocity without shock. Suitable openings shall be provided for the suction gauge, discharge gauge, air vent and cock. Openings shall be tapped and plugged.
- B. Unless otherwise specified, the shaft shall be of the best grade of 18-8 stainless steel and of ample size to transmit safely the maximum amount of power required. Shaft shall be provided with ample keyway and key to accurately hold the impeller in place. The impeller shall be secured to the shaft using a nut and locking washer. The impeller shall be hydraulically balanced for all pressures and shall be of bronze, hand finished on the inside, machine turned and polished on the outside, dynamically balanced at all speeds, and with liberal keyway to fasten to shaft. Coupling shall be flanged and of the flexible type with pin and rubber bushing construction. That portion of the shaft passing through the pump casing and stuffing boxes shall be encased in a bronze sleeve, securely fastened to the shaft.
- C. A name-plate showing the serial number, discharge GPM and Head of each pump shall be attached to the respective pump. The necessary wiring and controlling devices will be furnished and installed complete under the Electrical Division, unless otherwise specified.
- D. Certified test curves of the pumps to be installed shall be provided for all pumps in accordance with Section 15414.
- E. Flexible Hose Connections

Where indicated on Drawings or specified, connect the pumps to piping with flexible hose as manufactured by Chicago

Metal Hose Co., Tite Flex Metal Hose Co., Anaconda Metal Hose Co. or Flex-Hose Co., Inc. Corrugated inner tube and outer shield of wire braid: Stainless steel or Bronze with carbon steel or copper end connections. The flexible hose shall have minimum of 24" live length and design for 150 psi. working pressure.

2.03 SUMP PUMP (HEAVY DUTY)

- A. Where indicated on the Drawings, provide bronze fitted heavy duty duplex sump pumps of the vertical submerged centrifugal type. Impeller, pump bearings and intermediate bearings shall be bronze. Casing, suction plate, suspension plate, motor pedestal and strainer shall be cast iron. Suspension pipe and discharge pipe shall be extra-strong (Schedule 40) galvanized steel pipe. Each pump shall be of the capacity specified and shall be directly connected to an electric motor by means of a flexible coupling For Model of pump, H.P. of motor, etc., see pump schedule on the Drawings. Approved manufacturers are Allied Pump Corp. Model #SE/NYBE, Ketcham Pump Co., Federal Pump Co., Peerless Pump Co., Weil Pump Co., Paco Pumps, Grundfos Pumps Corporation U.S.A or Armstrong Pumps Inc. Submit shop drawing for approval.
- B. Thrust ball bearing shall be provided approximately 6" above the suspension plate in a fully enclosed dust and moisture-proof housing to take the weight of the pump shaft and impeller. Pumps shall have 18-8 stainless steel shafts and shall be provided with individual automatic pressure grease lubricators to each bearing. The shaft seal at the support plate shall be a packing gland type seal. Mechanical seals will not be accepted in lieu of packing glands.
- C. The motor shall be mounted on pedestals. The exact depth of the sump pit shall be measured at the site so as to determine the length of the shaft. Where depth of pit exceeds 5 feet pumps shall be provided within intermediate guide sleeve bearings.
- D. Control panel shall be UL listed, factory wired for remote wall mounting and shall be furnished in a NEMA-4 enclosure. Panel shall be suitable for operation with pedestal type float switches and other level controllers.
 - 1. Control panel shall be furnished with: Two magnetic across the line starters with three leg overload and low voltage protection; two fused disconnect switches with lockout handles through cover; two green pump running lights; two HOA selector switches; two fused control circuit transformers (208/110V); two overload reset buttons; one numbered and wired terminal strip; and one HASP for locking panel door.

- E. Duplex Sump pump shall be controlled by a pedestal mounted float switch with built in alternator, Square D Company Class 9038 type AW-1 in a NEMA Type 4 watertight and dust-tight enclosure that is actuated by a minimum 7" stainless steel ball float and stainless steel rod guided above and below floor plate of pump.
- G. Materials, equipment, labor, etc. for electric connections to float switches and high water alarms shall be provided under Div. 16 - Electrical.
- H. Provide a 2"x 2" x 1/4" angle frame and 3/8" sump pit cover plate. The General Construction Contractor will install the angle frame and cover when sump pit is poured. Sump pit cover to be provided by the pump manufacturer and have all required openings for pumps and piping. Pump supplier shall verify the depth of the pit so that proper length shaft will be supplied.
- I. The Contractor shall, upon the completion of the cellar or basement floor, or when directed by the Authority, install the sump pump complete, making, if necessary, temporary connections to the house drain or sewer. The Contractor shall, at all times during the construction of the building, maintain the pump in working order for use when temporary heat is required, and shall be solely responsible for its operation and shall make good any damage to the pumping apparatus which may be caused by its use. The electric connections and current shall be provided by Electrical. This sump pump shall not be used at anytime for any other purpose.
- J. Factory Finishing:
 - 1. Cover and angle frame for sump pit shall be given one coat of iron primer paint.
 - 2. Underside of sump pit cover shall be given one finish coat of black asphaltum paint over the iron primer paint.
 - 3. Pumps and motors shall be given one coat of iron primer paint and one finish coat of water resistant metallic enamel paint.
 - 4. For additional materials and method of painting refer Section 09900 - Painting.
- K. Submit Shop Drawings of the pumps, motors, angle frame and cover for approval before installing pumps.

2.04 CIRCULATING PUMP (COLD WATER)

- A. Where indicated on Drawings, provide in cold water circulating piping inline circulating pump units with all connections as shown. Cold water circulating pumps shall be in-line bronze body, with mechanical seal and stainless pump shaft. Pump shall be Weil Pump Co., Thrust Co., or Bell and Gosset, Paco Pumps, Grundfos Pumps Corporation U.S.A or Armstrong Pumps Inc.
- B. Capacity, head, model of pump and pump motor requirements shall be as shown on the Drawings or specified herein.
- C. Provide immersion type automatic electric control switches to control the operation of circulating pumps. The switches shall have bulb installed in a bulb well into the circulating line, and shall be arranged for conduit connection.
- D. Electric Control shall have an adjustable range from 40°F to 180°F., where temperature of water in storage tank is 140°F. Aquastat shall be a Honeywell L4006A with bulb assembly. Aquastat set points for their respective pump shall be as indicated in schedule on the Drawing.
- E. A fused motor switch and automatic starter providing overload and low voltage protection will be furnished and installed by the Electrical Subcontractor, who will do all wiring required.
- F. Submit shop drawings of pump and motor for approval.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Pumps
 - 1. Install all pumping apparatus as detailed on the Drawings, or as specified herein, or as recommended by the respective Manufacturer, to be completely operable for its intended use.
 - 2. The Contractor shall have the pump supplier verify the depth of each sump pit so that proper length of shaft shall be supplied.
 - 3. Make all required connections of pumps, filters and chemical feeder to the pool plumbing piping systems. Use flexible connectors to connect pumps to piping.
 - 4. The use of grooved type fittings is acceptable in lieu of threaded or flanged fittings on sump pump discharge where only clear water will be discharged.

B. Tanks

1. Tanks and stands shall be delivered welded and tested while the area of installation remains accessible for rigging into place, on all new buildings. Contractor shall provide all equipment and materials required for setting tank and stand in place.
2. Tanks and stands for installation in existing building may at the option of the contractor be welded and tested on the site.
3. Make all piping connection as shown on drawings and install all appurtenances.
4. Lining of tanks shall be done after the tanks are installed and all piping connections are made. Tanks shall be thoroughly cleaned in accordance with the cement lining manufacturer's instruction. Plug all openings in tank except manhole before lining tank.
5. Tank stand legs shall be shimmed and grouted level before installing tank on stand. Saddles shall be bolted to the stand.
7. Cement Lining
 - a. After the tank has been cleaned and all openings plugged the lining contractor shall apply a cement lining having a total thickness of not less than 3/4 inch, which shall be applied in no less than two (2) coats. The lining shall be trowled smooth.
 - b. After the cement lining has been completed, inspected, and approved, remove all objects plugging openings and install manhole. The tank shall be filled with water and allowed to reach normal building pressure. This operation shall occur while the cement is still plastic, in order to insure that the lining will bond and conform to the shape of the tank under pressure.

3.02 DEMONSTRATION

- A. The service of a factory trained representative shall be made available on the job site for start-up and for instructing the Custodian (or building manager) and staff in the operation and maintenance of each system installation. A minimum of two visits is required
 1. Training of NYC DoED Custodian or building manager shall be digitally video recorded by the trainer (or Contractor).

3.03 COMMISSIONING OF PUMPING APPARATUS AND TANKS

- A. Plumbing Contractor shall comply with the Commissioning Requirements of Contract Specification Section S01660 for Domestic Water Circulating Pumps, Sump Pumps, Chemical feeder components.
- B. All domestic water, air, drainage, shall be completed prior to commencement of the commissioning process.

END OF SECTION

* * * *

LIST OF SUBMITTALS

<u>SUBMITTAL</u>	<u>DATE SUBMITTED</u>	<u>DATE APPROVED</u>
Product Data:		
1. Mfr's product data	_____	_____
2. Installation instructions	_____	_____
3. Capacities	_____	_____
4. Certifications.		
a. MEA or Approved Agency Certification listed and/or label for tank lining	_____	_____
b. certified pump test curves	_____	_____
c. Manufacturer's data report for tank pressure testing	_____	_____
Shop Drawings:		
1. Pumps	_____	_____
2. Control panels	_____	_____
3. Wiring Diagrams	_____	_____
4. Float switch assembly	_____	_____
DVD's of Training	_____	_____
Maintenance Data:		
1. Spare Parts lists	_____	_____

2. Maintenance Manual

* * *

SECTION 15836
UNIT HEATERS**PART 1 - GENERAL****1.01 DESCRIPTION OF WORK**

- A. Provide unit and cabinet heaters as specified herein, as scheduled or indicated on the Drawings, and as needed for a complete and proper installation. Product specific requirements are contained herein; Section 15501, **General Provisions for Heating, Ventilating and Air Conditioning Work**, shall be referred to for general requirements.

1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Deliver the following products to the Division 16 Electrical Contractor for installation and connection to power wiring:
1. Remote mounted speed switches.
- B. Deliver the following product to the General Construction Contractor for installation:
1. Outside air intake box assembly.

1.03 RELATED SECTIONS

- A. Division 15 Sections
- B. Division 16 Sections

1.04 SUPPLEMENTAL SUBMITTALS

- A. Schedule: List manufacturer, unit type, model number, location and performance data for each unit and cabinet heaters.
- B. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to unit and cabinet heaters. Submit manufacturer's wiring diagrams for interlock and control wirings. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- C. Contractor's P.E. shall detail required seismic restraints and submit seismic calculations for the Unit/Cabinet Heaters.
- C. Maintenance data
- D. Certificate: Contractor's start-up and demonstration affidavit

E. Digital Videos produced during training

1.05 SUPPLEMENTAL QUALITY ASSURANCE

A. Codes and Standards

1. All the electrical components of the heaters and electric unit heaters shall be UL **or ETL** listed or labeled.
2. All fans shall be AMCA certified.
4. All electrical devices shall conform to NEMA Standards.
5. All wiring shall conform to 2005 NEC Standards as amended by the NYC Electrical Code.
6. All appliances regulated by the New York City Construction Codes shall be listed and labeled (reference MC 301.4, MC 301.6). Testing of material and equipment shall be in accordance with 28-113 of the Administrative Code (reference MC 301.5). Whenever the NYC Construction Codes or the Rules of the Department of Buildings requires that material be listed or labeled and material proposed to be used is not so listed or labeled, the use of such material shall be subject to prior approval by the Commissioner (Office of Technical Certification and Research OTCR) and such material shall be used only to the extent set forth in such approval. Materials that were previously approved by the Board of Standards and Appeal (BSA) or by the Department (MEA) before the effective date of the NYC Construction Codes may continue to be used, but only to the extent set forth in such approval, and only if such approval is not specifically amended or repealed by the Commissioner.
7. All work shall be in accordance with the NYC Construction Codes and NYC Electrical Code.

PART 2 - PRODUCTS

2.01 UNIT HEATERS (ELECTRIC - For Freeze Protection)

- A. Provide electric unit heater(s) as specified and scheduled and at the location(s) shown on the Drawings. Each unit heater shall consist of an electric heating element, fan, motor, controls, and all other items and accessories, factory assembled in a sheet steel casing. Casing shall

receive a bonderized rust-preventive coating and a finished coat of baked enamel. Controls, provided by the unit manufacturer, shall consist of an automatic temperature controlling sensor (0-10VDC or 4-20mA or RTD or thermister) located at the air intake to the heating element and a fan delay switch that will prevent the fan from starting until the heating element is warm. Integral sensor shall be capable of field adjustment and shall be set initially at 50° F (no unoccupied setback will occur for units located in crawl spaces or other unoccupied spaces that have pipes subject to possible freezing. Unit heaters for freeze protection located in mechanical rooms shall have occupied/unoccupied setpoint adjustments). Temperature Control Contractor (TCC) shall provide remote LonWorks controller in the field that shall use the integral sensor hard-wired signal as input to the LonWorks controller. The TCC shall also connect the communications network wiring to the TCC provided field LonWorks controller. Alternate option is for the TCC to provide field Lon thermostat in lieu of sensor/Lon controller. Each unit heater shall be suspended by a bracket secured to an overhead floor beam or to an auxiliary steel beam installed for this purpose. Contractor's P.E. shall detail required seismic restraints and submit seismic calculations. Electric unit heaters shall carry the UL The Division 16 Electrical Contractor shall provide service wiring to each unit heater.

The Temperature Control Contractor shall provide integration of monitoring and alarm functions by providing DDC control points as indicated in the Sequence of Operations - Section 15985 and on the control diagrams.

- B. Manufacturers: Unit Heater shall be manufactured by:

Chromalox Co.; Emerson Electric Co
Berko/Q-Mark; Div. of Marley Elec.
Modine Mfg. Co.
Redd-i Products Company, a Division of TPI Corporation
Markel Products; a Division of TPI Corporation

PART 3 - SUPPLEMENTAL EXECUTION

3.01 INSTALLATION

- A. Install the Work of this section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.
- B. Coordinate with other trades to assure correct recess size for recessed cabinet and unit heaters. Install all required access doors.
- C. The Division 16 Electrical Contractor shall install electrical devices (line voltage electric thermostats,

remote mounted speed switches) furnished by the unit manufacturer but not specified to be factory-mounted and specified. The Division 16 Electrical Contractor shall verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-16 Sections. Do not proceed with equipment start-up until wiring installation is acceptable.

3.02 PAINTING

- A. Finish painting the cabinet and unit heaters after installation (Refer to Painting: Section 09900).

3.03 ADJUSTING AND CLEANING

- A. After construction is completed, including painting, clean unit exposed surfaces, vacuum inside the unit and cabinet heaters. Retouch any marred or scratched surfaces, using finish materials furnished by the manufacturer.

3.04 INTERDISCIPLINARY TESTS AND FUNCTIONAL PERFORMANCE TESTS

- A. Interdisciplinary Pre-Start-Up and Start-Up Tests:

The Contractor shall conduct interdisciplinary pre-start up and start up tests as per the manufacturer's start up procedures. Contractor shall submit signed start up affidavit signed by the factory authorized service representative indicating that all of the manufacturer's pre-start up and start up procedures have been successfully completed.

3.05 COMMISSIONING OF UNIT HEATERS AND CABINET HEATERS

- A. HVAC Contractor shall comply with the Commissioning Requirements of Contract Specification Section S01660 for Unit Heaters.

3.06 FIELD QUALITY CONTROL

- A. Instruct and train maintenance personnel in the equipment operations. Training shall be for a minimum of 4 hours. Secure written confirmation that instruction has been provided and approved maintenance manuals received.

END OF SECTION

* * *

LIST OF SUBMITTALS

<u>SUBMITTAL</u>	<u>DATE SUBMITTED</u>	<u>DATE APPROVED</u>
Product Data:	_____	_____
1. Manufacturers Product Data		
2. Installation Instructions		
Shop Drawings:	_____	_____
1. Assembly-type		
2. Mounting Details		
3. Connection Details		
Schedule:	_____	_____
Wiring Diagrams:	_____	_____
1. Power Wiring		
2. Control Wiring		
Seismic Calculations:	_____	_____
Unit		
Maintenance Data:	_____	_____
1. Spare Parts Lists		
2. Maintenance Manual		
Contractor's Start-Up and Demonstration Affidavit	_____	_____
Digital Video Recordings Of Training	_____	_____

* * *

SECTION 15865
EXHAUST FANS

PART 1 - GENERAL**1.01 DESCRIPTION OF WORK**

- A. Provide Exhaust fans as specified herein, as shown on the Drawings, as needed for a complete and proper installation. Product specific requirements are contained herein; Section 15501, **General Provisions for Heating, Ventilating and Air Conditioning Work**, shall be referred to for general requirements.

1.02 RELATED SECTIONS

- A. Division 15 Sections
- B. Division 16 Sections

1.03 SUBMITTALS

- A. Include the performance charts and the certified fan sound-power ratings with the product data.
- B. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Coordination Drawings: Show relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- D. Maintenance data.
- E. Manufacturer's Start-Up and Demonstration Affidavit
- F. Digital Videos produced during training.

1.04 SUPPLEMENTAL QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
1. Fans shall be licensed to bear the AMCA seal.
 2. All electrical components shall be UL listed.
- B. All appliances regulated by the New York City Construction Codes shall be listed and labeled (reference MC 301.4, MC 301.6). Testing of material and equipment shall be in accordance with 28-113 of the Administrative Code (reference MC 301.5). Whenever the NYC Construction Codes or the Rules of the Department of Buildings requires that

material be listed or labeled and material proposed to be used is not so listed or labeled, the use of such material shall be subject to prior approval by the Commissioner (Office of Technical Certification and Research OTCR) and such material shall be used only to the extent set forth in such approval. Materials that were previously approved by the Board of Standards and Appeal (BSA) or by the Department (MEA) before the effective date of the NYC Construction Codes may continue to be used, but only to the extent set forth in such approval, and only if such approval is not specifically amended or repealed by the Commissioner.

- C. All work shall be in accordance with the NYC Construction Codes and NYC Electrical Code.

PART 2 - PRODUCTS

2.01 EXHAUST FANS - GENERAL

- A. Design Criteria: Design fans for installation directly in ductwork. Direct driven units shall be suitable for operation with 110 degree F air and belt driven units with 175 degree F air.
- B. Fan Housings: Fabricate housings from heavy gage sheet all welded construction, properly reinforced to prevent breathing and vibration at all fan speeds. Provide housing and angle collars, with drilled or punched holes at uniform intervals, extending beyond the duct housing to provide continuous duct connections. Provide heavy gage support legs or suspension angle supports, welded to housing, all as required by the particular application.
- C. Finish: Provide all exposed surfaces of fans with a factory applied corrosion resistant finish (Refer to Section 09900: Painting).
- D. Per NYC Mechanical Code MC 513.10 equipment utilized in Smoke Control systems such as fans and automatic dampers shall be suitable for their intended use, suitable for the probable exposure temperatures and shall be as approved by the Commissioner. Fans shall be rated and certified by the manufacturer for the probable temperature rise to which the components will be exposed. This temperature rise is _____. Per BC 909.4.6, all portions of active smoke control systems shall be capable of continued operation after detection of the fire event for not less than 20 minutes. In addition (per NYC Mechanical Code MC 513.10.5 for smoke control fans) belt-driven fans shall have 1.5 times the number of belts required for the design duty with the minimum number of belts being two. Motors driving fans shall not be operating beyond their nameplate horsepower (kilowatts) as determined from measurement of actual

current draw. Motors driving fans shall have a minimum service factor of 1.15.

2.04 FAN ACCESSORIES

- A. Support Legs; Provide integral structural support legs for base mounted fans.
- B. Suspension Angle Supports: Provide integral structural angle supports for fans required to be supported from the overhead construction.
- C. Drive Guards: Provide approved steel guards for the exposed sheave and drive belts on V-belt driven fans as per OSHA requirements.

PART 3 - SUPPLEMENTAL EXECUTION**3.01 INSTALLATION**

- A. Install the Work of this Section in strict accordance with the manufacturer's printed instructions and the requirements of the Drawings
- B. Isolate fans from building construction.
- C. Support fans independent from the ductwork.
- D. Provide fans, supported from the overhead construction, with rubber-in-spring isolators designed for insertion in split hanger rods.

3.02 INTERDISCIPLINARY TESTS AND FUNCTIONAL PERFORMANCE**TESTS**

- A. Interdisciplinary Pre-Start-Up and Start-Up Tests:

The Contractor shall conduct interdisciplinary pre-start up and start up tests as per the manufacturer's start up procedures. Contractor shall submit signed start up affidavit signed by the factory authorized service representative indicating that all of the manufacturer's pre-start up and start up procedures have been successfully completed.

- B. Functional Performance Tests:

Contractor shall also submit signed functional performance testing affidavit signed by the factory authorized service representative indicating that all of the manufacturer's

functional performance tests have been successfully completed.

3.03 COMMISSIONING OF FANS

- A. HVAC Contractor shall comply with the Commissioning Requirements of Contract Specification Section S01660 for Fans.

3.04 FIELD QUALITY CONTROL

- A. Upon completion of installation of the exhaust fans, and after motor has been energized with normal power source, test equipment to demonstrate compliance. Where possible field correct malfunctioning equipment then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected. The Contractor shall perform necessary Interdisciplinary Tests and Functional Performance Tests according to the manufacturer's procedures.
- B. Instruct and train maintenance personnel in the equipment operations. Training shall be for a minimum of 2 hours. Secure written confirmation that instruction has been provided and approved maintenance manuals received.

END OF SECTION

* * *

LIST OF SUBMITTALS

<u>SUBMITTAL</u>	<u>DATE SUBMITTED</u>	<u>DATE APPROVED</u>
Product Data:	_____	_____
1. Manufacturers Product Data		
2. Installation Instructions		
3. Performance Charts		
4. Certified Fan Sound-Power Ratings.		
Shop Drawings:	_____	_____
1. Assembly-type		
2. Mounting Details		
3. Location		
4. Connection Details		
Wiring Diagrams:	_____	_____
1. Power Wiring		
2. Control Wiring		
Coordination Drawings:	_____	_____
Maintenance Data	_____	_____
1. Spare Parts Lists		
2. Maintenance Manual		
Contractor's Start-Up And Demonstration Affidavit	_____	_____
Digital Video Recordings Of Training	_____	_____

* * *

SECTION 16010 - BASIC ELECTRICAL MATERIALS AND METHODS**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 electrical materials and methods:

- 1. Connectors, and splices for branch circuits and feeders.
- 2. Supporting devices for electrical components.
- 3. Concrete equipment bases.
- 4. Electrical identification.
- 5. Electrical demolition.
- 6. Cutting and patching for electrical construction.
- 7. Touchup painting.
- 8. Meter sockets.

1.3 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 and installation of supports and anchorage for electrical items.
- D. Coordination Drawings for electrical installation.
 - 1. Prepare Coordination Drawings according to Division 1 Section "Submittals" to a 1/4-inch-equals-1-foot (1:50) scale or larger. Detail major elements, components, and systems of electrical equipment and materials in relation to each other and to other systems, installations, and building components. Indicate locations and space requirements for installation, access, and working clearance. Show where sequence and coordination of installations are important to the efficient flow of the Work. Coordinate drawing preparation with effort specified in other Specification Sections. Include the following:
 - a. Provisions for scheduling, sequencing, moving, and positioning large equipment in the building during construction.
 - b. Floor plans, elevations, and details, including the following:
 - 1) Clearances to meet safety requirements and for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
 - 2) Equipment support details.

- 3) Sizes and locations of required concrete pads and bases.

- E. Samples of color, lettering style, and other graphic representation required for each identification product for Project.

1.4 QUALITY ASSURANCE

- A. Comply with NYCEC - 2011 for components and installation.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
1. The Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.
 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate electrical equipment installation with existing conditions.
- B. Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work.
- E. Coordinate connecting electrical service to components furnished under other Sections.
- F. Coordinate connecting electrical systems with exterior underground utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.
- H. Coordinate installing electrical identifying devices and markings.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated. Select to comply with Project's installation requirements.

2.2 SUPPORTING DEVICES

- A. Channel and angle support systems, hangers, anchors, sleeves, brackets, fabricated items, and fasteners are designed to provide secure support from the building structure for electrical components.

1. Material: Steel, except as otherwise indicated, protected from corrosion with zinc coating or with treatment of equivalent corrosion resistance using approved alternative finish or inherent material characteristics.
 2. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel, except as otherwise indicated.
- B. Steel channel supports have 9/16-inch (14-mm) diameter holes at a maximum of 8 inches (203 mm) o.c., in at least 1 surface.
1. Fittings and accessories mate and match with channels and are from the same manufacturer.
- C. Raceway and Cable Supports: Riser clamps, straps, threaded C-clamps with retainers, and spring steel clamps or "click"- type hangers.
- E. Sheet-Metal Sleeves: 0.0276-inch (0.7-mm) or heavier galvanized sheet steel, round tube, closed with welded longitudinal joint.
- F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- G. Expansion Anchors: Carbon-steel wedge or sleeve type.
- I. Toggle Bolts: All-steel springhead type.
- J. Powder-Driven Threaded Studs: Heat-treated steel.

2.3 CONCRETE EQUIPMENT BASES

- A. Forms and Reinforcing Materials: As specified in Division 3 Section "Cast-in-Place Concrete."
- B. Concrete: 3000-psi (20.7-MPa), 28-day compressive strength as specified in Division 3 Section "Cast-in-Place Concrete."

2.4 ELECTRICAL IDENTIFICATION

- A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Raceway and Cable Labels: Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.
1. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.
 2. Color: Black legend on orange field.
 3. Legend: Indicates voltage.
- C. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch wide (0.08 mm thick by 25 mm wide).
- D. Underground Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:

1. Size: Not less than 4 mils thick by 6 inches wide (0.102 mm thick by 152 mm wide).
 - a. Compounded for permanent direct-burial service.
2. Embedded continuous metallic strip or core.
 - a. Printed Legend: Indicates type of underground line.
- E. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- F. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.
- G. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched for mechanical fasteners 1/16-inch (1.6-mm) minimum thick for signs up to 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick for larger sizes. Engraved legend in black letters on white face.
- H. Interior Warning and Caution Signs: Preprinted, aluminum, baked-enamel finish signs, punched for fasteners, with colors, legend, and size appropriate to the application.
- I. Exterior Warning and Caution Signs: Weather-resistant, nonfading, preprinted, cellulose acetate butyrate signs with 0.0396-inch (1-mm), galvanized steel backing, with colors, legend, and size appropriate to the application. 1/4-inch (6.4-mm) grommets in corners for mounting.
- J. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.6 TOUCHUP PAINT

- A. For Equipment: Provided by equipment manufacturer and selected to match equipment finish.
- B. For Nonequipment Surfaces: Matching type and color of undamaged, existing adjacent finish.
- C. For Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION REQUIREMENTS

- A. Install components and equipment to provide the maximum possible headroom where mounting heights or other location criteria are not indicated.
- B. Install items level, plumb, and parallel and perpendicular to other building systems and components, except where otherwise indicated.
- C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Give right of way to raceways and piping systems installed at a required slope.

3.2 ELECTRICAL SUPPORTING METHODS

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Conform to manufacturer's recommendations for selecting supports.
- C. Strength of Supports: Adequate to carry all present and future loads, times a safety factor of at least 4; 200-lb- (90-kg-) minimum design load.

3.4 INSTALLATION

- A. Install wires in raceway according to manufacturer's written instructions and NECA's "Standard of Installation."
- B. Conductor Splices: Keep to the minimum and comply with the following:
 - 1. Install splices and taps that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 2. Use splice and tap connectors that are compatible with conductor material.
- C. Wiring at Outlets: Install with at least 12 inches (300 mm) of slack conductor at each outlet.
- D. Connect outlets and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.
- E. Install devices to securely and permanently fasten and support electrical components.
- F. Raceway Supports: Comply with NFPA 70 and the following requirements:
 - 1. Conform to manufacturer's recommendations for selecting and installing supports.
 - 2. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
 - 3. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
 - 4. Spare Capacity: Size supports for multiple conduits so capacity can be increased by a 25 percent minimum in the future.
 - 5. Support individual horizontal raceways with separate, malleable iron pipe hangers or clamps.
 - 6. Hanger Rods: 1/4-inch (6-mm) diameter or larger threaded steel, except as otherwise indicated.
 - 7. Spring Steel Fasteners: Specifically designed for supporting single conduits or tubing. May be used in lieu of malleable iron hangers for 1-1/2-inch (38-mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to channel and slotted angle supports.
 - 8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports, with no weight load on raceway terminals.
- G. Vertical Conductor Supports: Install simultaneously with conductors.

- H. Miscellaneous Supports: Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices except where components are mounted directly to structural features of adequate strength.
- I. In open overhead spaces, cast boxes threaded to raceways need not be separately supported, except where used for fixture support; support sheet-metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.
- J. Sleeves: Install for cable and raceway penetrations of concrete slabs and walls, except where core-drilled holes are used. Install for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- K. Firestopping: Apply to cable and raceway penetrations of fire-rated floor and wall assemblies. Perform firestopping as specified in Division 7 Section "Firestopping" to reestablish the original fire-resistance rating of the assembly at the penetration.
- L. Fastening: Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure. Perform fastening according to the following:
 - 1. Fasten by means of wood screws or screw-type nails on wood; toggle bolts on hollow masonry units; concrete inserts or expansion bolts on concrete or solid masonry; and by machine screws, welded threaded studs, or spring-tension clamps on steel.
 - 2. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts, machine screws, or wood screws.
 - 3. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or any other items.
 - 4. In partitions of light steel construction use sheet-metal screws.
 - 5. Fill and seal holes drilled in concrete and not used.
 - 6. Select fasteners so the load applied to any fastener does not exceed 25 percent of the proof-test load.
- M. Install concrete pads and bases according to requirements of Division 3 Section "Cast-in-Place Concrete."
- N. Install utility-metering equipment according to utility company's written requirements. Provide grounding and empty conduits as required by company.
- O. Install identification devices where required.
 - 1. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
 - 2. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated on the Contract Documents or required by codes and standards. Use consistent designations throughout the Project.
 - 3. Self-Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.
 - 4. Identify raceways and cables of certain systems with color banding as follows:
 - a. Bands: Colored adhesive marking tape. Make each color band 2 inches (51 mm) wide, completely encircling conduit, and place adjacent bands of 2-color markings in contact, side by side.
 - b. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25 feet (8 m) in congested areas.

c. Colors: As follows:

- 1) Fire-Alarm System: Red.
 - 2) Security System: Blue and yellow.
 - 3) Telecommunications System: Green and yellow.
5. Tag or label power circuits for future connection and circuits in raceways and enclosures with other circuits. Identify source and circuit numbers in each cabinet, pull box, junction box, and outlet box. Color coding may be used for voltage and phase indication.
 6. Identify Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above power and communication lines. Locate 6 to 8 inches (150 to 200 mm) below finished grade. Where multiple lines installed in a common trench or concrete envelope do not exceed an overall width of 16 inches (400 mm), use a single line marker.
 7. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

3.5 DEMOLITION

- A. Where electrical work to remain is damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- B. Accessible Work Indicated to Be Demolished: Remove exposed electrical installation in its entirety.
- C. Abandoned Work: Cut and remove buried raceway and wiring indicated to be abandoned in place, 2 inches (50 mm) below the surface of adjacent construction. Cap and patch surface to match existing finish.
- D. Removal: Remove demolished material from the Project site.
- E. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.6 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of the trades involved.
- B. Repair disturbed surfaces to match adjacent undisturbed surfaces.

3.7 TOUCHUP PAINTING

- A. Thoroughly clean damaged areas and provide primer, intermediate, and finish coats to suit the degree of damage at each location.
- B. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

END OF SECTION 16050

SECTION 16120 - CONDUCTORS AND CABLES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, apply to this Section.

1.2 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

- A. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: In addition to requirements specified in Division 1 Section "Quality Control," an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907; or shall be a full-member company of the InterNational Electrical Testing Association.
 - 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.
- B. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- C. Comply with NYCEC-2011.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wires and cables according to NEMA WC 26.

1.6 COORDINATION

- A. Coordinate layout and installation of cables with other installations.
- B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Architect.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wires and Cables:
 - a. Alcan Aluminum Corporation; Alcan Cable Div.
 - b. American Insulated Wire Corp.; Leviton Manufacturing Co.
 - c. BICC Brand-Rex Company.
 - d. Carol Cable Co., Inc.
 - e. Senator Wire & Cable Company.
 - f. Southwire Company.
 - 2. Connectors for Wires and Cables:
 - a. AMP Incorporated.
 - b. General Signal; O-Z/Gedney Unit.
 - c. Monogram Co.; AFC.
 - d. Square D Co.; Anderson.
 - e. 3M Company; Electrical Products Division.

2.2 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Wire and Insulation Applications" Article.
- B. Rubber Insulation Material: Comply with NEMA WC 3.
- C. Thermoplastic Insulation Material: Comply with NEMA WC 5.
- D. Cross-Linked Polyethylene Insulation Material: Comply with NEMA WC 7.
- E. Ethylene Propylene Rubber Insulation Material: Comply with NEMA WC 8.
- F. Conductor Material: Copper.
- G. Conductor Material: Copper, except feeders and services larger than No. 6 AWG may be aluminum.
- H. Conductor Material: Copper.
- I. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.

2.3 CONNECTORS AND SPLICES

- A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 "Wire and Insulation Applications" Article.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRE AND INSULATION APPLICATIONS

- A. Service Entrance: Type USE.
- B. Service Entrance: Type RHW or THWN, in raceway.
- C. Feeders: Type THWN, in raceway.
- D. Feeders: Type UF, 90C insulation.
- E. Feeders: Type MC, 3-conductor, 90C insulation, aluminum corrugated sheath, PVC jacket, in cable tray.
- F. Branch Circuits: Type XHHW, in raceway.
- M. Class 2 Control Circuits: Power-limited tray cable, in cable tray.
- N. Class 2 Control Circuits: Power-limited cable, concealed in building finishes.
- O. Class 2 Control Circuits: Type THWN, in raceway.

3.3 INSTALLATION

- A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."
- B. Remove existing wires from raceway before pulling in new wires and cables.
- C. Pull Conductors: 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.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

- F. Support cables according to Division 16 Section "Basic Electrical Materials and Methods."
- G. Seal around cables penetrating fire-rated elements according to Division 7 Section "Firestopping."
- H. Identify wires and cables according to Division 16 Section "Basic Electrical Materials and Methods."
- I. Identify wires and cables according to Division 16 Section "Electrical Identification."

3.4 CONNECTIONS

- A. Conductor Splices: Keep to minimum.
- B. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
- C. Use splice and tap connectors compatible with conductor material.
- D. Use oxide inhibitor in each splice and tap connector for aluminum conductors.
- E. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.
- F. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
- G. 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.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing agency to perform field quality-control testing.
- B. Testing Agency: Engage a qualified independent testing agency to perform field quality-control testing.
- C. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- D. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

END OF SECTION 16120

SECTION 16130 - RACEWAYS AND BOXES**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 raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
 - 1. Raceways include the following:
 - a. RMC.
 - b. PVC externally coated, rigid steel conduits.
 - d. Wireways.
 - e. Surface raceways.
 - 2. Boxes, enclosures, and cabinets include the following:
 - a. Device boxes.
 - b. Floor boxes.
 - c. Outlet boxes.
 - d. Pull and junction boxes.
 - e. Cabinets and hinged-cover enclosures.
- B. Related Sections include the following:
 - 1. Division 7 Section "Firestopping."
 - 2. Division 16 Section "Basic Electrical Materials and Methods" for raceways and box supports.
 - 3. Division 16 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. LFMC: Liquidtight flexible metal conduit.
- C. RMC: Rigid metal conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

- B. Shop Drawings: Include layout drawings showing components and wiring for nonstandard boxes, enclosures, and cabinets.

1.5 QUALITY ASSURANCE

- A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- B. Comply with NECA's "Standard of Installation."
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Metal Conduit and Tubing:
 - a. Alflec Corp.
 - b. Anamet, Inc.; Anaconda Metal Hose.
 - c. Anixter Brothers, Inc.
 - d. Carol Cable Co., Inc.
 - e. Cole-Flex Corp.
 - f. Electri-Flex Co.
 - g. Flexcon, Inc.; Coleman Cable Systems, Inc.
 - h. Grinnell Co.; Allied Tube and Conduit Div.
 - i. Monogram Co.; AFC.
 - j. Spiraduct, Inc.
 - k. Triangle PWC, Inc.
 - l. Thomas & Betts Corp
 - 2. Nonmetallic Conduit and Tubing:(not used)
 - 3. Conduit Bodies and Fittings:
 - a. American Electric; Construction Materials Group.
 - b. Crouse-Hinds; Div. of Cooper Industries.

- c. Emerson Electric Co.; Appleton Electric Co.
 - d. Hubbell, Inc.; Killark Electric Manufacturing Co.
 - e. Lamson & Sessions; Carlon Electrical Products.
 - f. O-Z/Gedney; Unit of General Signal.
 - g. Scott Fetzer Co.; Adalet-PLM.
 - h. Spring City Electrical Manufacturing Co.
- 4. Metal Wireways:
 - a. Hoffman Engineering Co.
 - b. Keystone/Rees, Inc.
 - c. Square D Co.
- 5. Nonmetallic Wireways:(not used)
- 6. Surface Metal Raceways:
 - a. Airey-Thompson Co., Inc.; A-T Power Systems.
 - b. American Electric; Construction Materials Group.
 - c. Butler Manufacturing Co.; Walker Division.
 - d. Wiremold Co. (The); Electrical Sales Division.
- 7. Surface Nonmetallic Raceways:(not used)
- 8. Boxes, Enclosures, and Cabinets:
 - a. American Electric; FL Industries.
 - b. Butler Manufacturing Co.; Walker Division.
 - c. Crouse-Hinds; Div. of Cooper Industries.
 - d. Electric Panelboard Co., Inc.
 - e. Erickson Electrical Equipment Co.
 - f. Hoffman Engineering Co.; Federal-Hoffman, Inc.
 - g. Hubbell Inc.; Killark Electric Manufacturing Co.
 - h. Hubbell Inc.; Raco, Inc.
 - i. Lamson & Sessions; Carlon Electrical Products.
 - j. O-Z/Gedney; Unit of General Signal.
 - k. Parker Electrical Manufacturing Co.
 - l. Robroy Industries, Inc.; Electrical Division.
 - m. Scott Fetzer Co.; Adalet-PLM.
 - n. Spring City Electrical Manufacturing Co.
 - o. Thomas & Betts Corp.
 - p. Woodhead Industries, Inc.; Daniel Woodhead Co.

2.2 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- D. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
- H. FMC: Zinc-coated steel.
- I. LFMC: Flexible steel conduit with PVC jacket.
- J. Fittings: NEMA FB 1; compatible with conduit/tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING (not used)**2.4 METAL WIREWAYS**

- A. Material: Sheet metal sized and shaped as indicated.
- B. 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.
- C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- D. Wireway Covers: As indicated
- E. Wireway Covers: Hinged type.
- F. Wireway Covers: Screw-cover type.
- G. Wireway Covers: Flanged-and-gasketed type.
- H. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS(not used)**2.6 SURFACE RACEWAYS**

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
- B. Surface Nonmetallic Raceways: 2-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.
- C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.7 OUTLET AND DEVICE BOXES

- A. Sheet Metal Boxes: NEMA OS 1.
- B. Cast-Metal Boxes: NEMA FB 1, Type FD, cast box with gasketed cover.

2.8 FLOOR BOXES

- A. Floor Boxes: Cast metal, fully adjustable, rectangular.

2.9 PULL AND JUNCTION BOXES

- A. Small Sheet Metal Boxes: NEMA OS 1.
- B. Cast-Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.

2.10 ENCLOSURES AND CABINETS

- A. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
- B. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRING METHODS

- A. Outdoors: Use the following wiring methods:
 - 1. Exposed: Rigid steel.
 - 2. Concealed: Rigid steel.
 - 3. Boxes and Enclosures: NEMA 4X
- B. Indoors: Use the following wiring methods:
 - a. Damp or Wet Locations: NEMA 250, Type 4X, stainless steel.

3.3 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- B. Minimum Raceway Size: 3/4-inch trade size (DN21).
- C. All threaded joints in conduit work shall be made watertight by a coating of Kopex shield compound on the male thread only. If threads are cut, the shall be coated with Kopr shield before making connection to the conduit. (or as indicated on drawings - most stringent shall apply)
- D. Install raceways level and square and at proper elevations. Provide adequate headroom.
- E. Complete raceway installation before starting conductor installation.
- F. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."

- G. Use temporary closures to prevent foreign matter from entering raceways.
- H. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- I. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- J. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.
- K. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
- L. Raceways Embedded in Slabs: Install in middle third of slab thickness where practical, and leave at least 1-inch (25-mm) concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in concrete.
 - 3. Run conduit larger than 1-inch trade size (DN27) parallel to or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
- M. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
 - 1. Run parallel or banked raceways together, on common supports where practical.
 - 2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- N. Join raceways with fittings designed and approved for the purpose and make joints tight.
 - 1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
 - 2. Use insulating bushings to protect conductors.
- O. All threaded conduit, no threadless fittings allowed.
- P. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.
- Q. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
- R. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel 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 the pull wire.
- S. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-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 the boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- T. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.
- U. Flexible Connections: Use maximum of 6 feet (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections. Use type LA with integral grounding/bonding copper conductor.
- V. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
- W. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure coatings, finishes, and cabinets are without damage or deterioration at the 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.

3.5 CLEANING

- A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION 16130

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SECTION 16140 - WIRING DEVICES

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 receptacles, connectors, switches, and finish plates.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- | B. TVSS: Transient voltage surge suppressor-

1.4 SUBMITTALS

- A. Product Data: For each product specified.
- B. Shop Drawings: Legends for receptacles and switch plates.
- C. Samples: For devices and device plates for color selection and evaluation of technical features.
- D. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 1.

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.
- B. Comply with NEMA WD 1.
- C. Comply with NYCEC-2011.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

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. Deliver extra materials to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices:
 - a. Bryant Electric, Inc.
 - b. Eagle Electric Manufacturing Co., Inc.
 - c. GE Company; GE Wiring Devices.
 - d. Hubbell, Inc.; Wiring Devices Div.
 - e. Killark Electric Manufacturing Co.
 - f. Leviton Manufacturing Co., Inc.
 - g. Pass & Seymour/Legrand; Wiring Devices Div.
 - h. Pyle-National, Inc.; an Amphenol Co.

2.2 RECEPTACLES

- A. Straight-Blade and Locking Receptacles: Heavy-Duty grade.
- B. Straight-Blade and Locking Receptacles: General-Duty grade.
- C. GFCI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.
- D. Industrial Heavy-Duty Receptacle: Comply with IEC 309-1.

2.3 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
 - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.4 SWITCHES

- A. Snap Switches: Heavy-duty, quiet type.
- B. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
 - 1. Switch: 20 A, 120/277-V ac.
 - 2. Receptacle: NEMA WD 6, Configuration 5-15R.

2.5 FINISHES

- A. Color: Manufacturers standard, as selected by Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- C. Protect devices and assemblies during painting.

3.2 IDENTIFICATION

- A. Comply with Division 16 Section "Basic Electrical Materials and Methods."
 - 1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
 - 2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

- A. Connect wiring device grounding terminal to outlet box with bonding jumper.
- B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
- C. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.

- B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- C. Replace damaged or defective components.

3.5 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 16140

SECTION 16145 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes time switches, photoelectric relays, and multipole lighting relays and contactors.
- B. Related Sections include the following:
 - 1. Division 16 Section "Wiring Devices".
 - 2. Division 16 Section "Dimming Controls" for architectural dimming system equipment.

1.3 SUBMITTALS

- A. Product Data: Include dimensions and data on features, components, and ratings for lighting control devices.
- B. Samples: Occupancy sensors for color selection and evaluation of technical features.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- D. Maintenance Data: For lighting control devices to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain lighting control devices from a single source with total responsibility for compatibility of lighting control system components specified in this Division 16 Section "Dimming Controls."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NYCEC - 2011, Article 100, for their indicated use and installation conditions by a testing agency acceptable to authorities having jurisdiction.
- C. Comply with NYCEC-2011.

1.5 COORDINATION

- A. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and

interconnections for optimum performance of specified functions (see 16520 Lighting Control Panel). Include coordination with the following:

1. Division 16 Section "Panelboards."
2. Division 16 Section "Lighting Control Panel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Contactors and Relays:
 - a. Automatic Switch Co.
 - b. Challenger Electrical Equipment Corp.
 - c. Cutler-Hammer Products; Eaton Corporation.
 - d. Furnas Electric Co.
 - e. GE Lighting Controls.
 - f. Hubbell Lighting, Inc.
 - g. Siemens Energy and Automation, Inc.
 - h. Square D Co.; Power Management Organization.
 - i. Zenith Controls, Inc.
 2. Time Switches:
 - a. Diversified Electronics, Inc.
 - b. Grasslin Controls Corp.
 - c. Intermatic, Inc.
 - d. Leviton Manufacturing.
 - e. Paragon Electric Co., Inc.
 - f. Tork, Inc.
 - g. Zenith Controls, Inc.
 3. Photoelectric Relays:
 - a. Allen-Bradley/Rockwell Automation.
 - b. Area Lighting Research, Inc.
 - c. Fisher Pierce.
 - d. Grasslin Controls, Corp.
 - e. Intermatic, Inc.
 - f. Paragon Electric Co., Inc.
 - g. Rhodes: M H Rhodes, Inc.
 - h. SSAC, Inc.
 - i. Tork, Inc.

2.3 TIME SWITCHES

- A. Description: Solid-state programmable units with alphanumeric display complying with UL 917.
- B. Description: Electromechanical-dial type complying with UL 917.
 - 1. Astronomic dial.
 - 2. Two contacts, rated 30 A at 277-V ac, unless otherwise indicated.
 - 3. Two pilot-duty contacts, rated 2 A at 240-V ac, unless otherwise indicated.
 - 4. Eight-day program uniquely programmable for each weekday and holidays.
 - 5. Skip-day mode.

2.4 PHOTOELECTRIC RELAYS

- A. Description: Solid state, with single-pole, double-throw dry contacts rated to operate connected relay or contactor coils or microprocessor input, and complying with UL 773A.
- B. Light-Level Monitoring Range: 0 to 3500 fc (0 to 37 673 lx), with an adjustment for turn-on/turn-off levels.
- C. Time Delay: Prevents false operation.
- D. Outdoor Sealed Units: Weathertight housing, resistant to high temperatures and equipped with sun-glare shield and ice preventer.

2.5 OMIT

2.6 MULTIPOLE CONTACTORS AND RELAYS

- A. Description: Electrically operated and mechanically held, and complying with UL 508 and NEMA ICS 2.
 - 1. Current Rating for Switching: UL listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballasts with 15 percent or less total harmonic distortion of normal load current).
 - 2. Control Coil Voltage: Match control power source.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment level and plumb and according to manufacturer's written instructions.
- B. Mount lighting control devices according to manufacturer's written instructions and requirements in Division 16 Section "Basic Electrical Materials and Methods."
- C. Mounting heights indicated are to bottom of unit for suspended devices and to center of unit for wall-mounting devices.

3.2 CONTROL WIRING INSTALLATION

- A. Install wiring between sensing and control devices according to manufacturer's written instructions and as specified in Division 16 Section "Conductors and Cables" for low-voltage connections.
- B. Wiring Method: Install all wiring in raceway as specified in Division 16 Section "Raceways and Boxes."
- C. Wiring Method: Install all wiring in raceway as specified in Division 16 Section "Raceways and Boxes," unless run in accessible ceiling space and gypsum board partitions.
- D. Bundle, train, and support wiring in enclosures.
- E. Ground equipment.
- F. Connections: 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.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 16 Section "Basic Electrical Materials and Methods."

3.4 FIELD QUALITY CONTROL

- A. Schedule visual and mechanical inspections and electrical tests with at least seven days' advance notice.
- B. Inspect control components for defects and physical damage, testing laboratory labeling, and nameplate compliance with the Contract Documents.
- C. Check tightness of electrical connections with torque wrench calibrated within previous six months. Use manufacturer's recommended torque values.
- D. Verify settings of photoelectric devices with photometer calibrated within previous six months.
- E. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:
 - 1. Continuity tests of circuits.
 - 2. Operational Tests: Set and operate devices to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.
 - a. Include testing of devices under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.
- F. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.
- G. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
- H. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.5 CLEANING

- A. Cleaning: Clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damaged finishes.

3.6 DEMONSTRATION

- A. Coordinate with training for low-voltage, programmable lighting control system specified in Division 13 Section "Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
 - 1. Train Owner's maintenance personnel on troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of three hours' training.
 - 2. Training Aid: Use the approved final version of maintenance manuals as a training aid.
 - 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

3.7 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested, to adjust light levels, make program changes, and adjust sensors and controls to suit actual conditions.

END OF SECTION 16145

SECTION 16289
TRANSIENT VOLTAGE SURGE SUPPRESSION

PART 1 – GENERAL**1.01 DESCRIPTION OF WORK**

- A. Provide complete transient voltage surge suppression for the protection of the low voltage, control and communication systems.

1.02 SUPPLEMENTAL SUBMITTALS

- A. Product Certificates

Signed by manufacturers of transient voltage suppression devices, certifying that the products furnished comply with the following testing and labeling requirements:

- 1. UL 1283 certification.
 - 2. UL 1449 3rd Edition listing and classification
- B. Operation and Maintenance instructions.
- C. Certificate of compliance with Quality Assurance requirements.
- D. Certificate of compliance with field quality control.
- E. Warranty.
- F. Training videotape as specified under paragraph 3.05 herein.

1.03 QUALITY ASSURANCE

- A. Source Limitations: Obtain suppression devices and accessories through one source 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. IEEE Compliance: Comply with IEEE C62.41, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45, "IEEE Guide for Surge Suppressor Testing."
- D. NEMA Compliance: Comply with NEMA LS 1, "Low Voltage Surge Protective Devices."
- E. UL Compliance: Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449 3rd Edition, "Transient Voltage Surge Suppressors."

1.05 WARRANTY

- A. The surge suppressor manufacturer shall warrant the surge suppression device and supporting components against defects and workmanship for a period of 10 years from date of substantial completion.

- B. The Contractor shall provide preventative maintenance during the warranty period. Maintenance shall include, but not be limited to:
1. Labor and materials, to repair, test and adjust surge suppression devices.
 2. Regular inspections.

PART 2- PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. The approved manufacturers for the surge suppression devices shall be Cutler-Hammer, Siemens Energy & Automation, Square D, Leviton, MCG Electronics, LEA International, Advanced Protection Technologies, Current Technology, Ademco and Transjector Systems.

2.02 SURGE SUPPRESSION DEVICES

A. Service Entrance Suppressors

Modular type suppression devices shall be installed, inside or adjacent to electrical service entrance panel and shall have the following features and accessories:

1. LED indication lights (Green & Red) for power and protection status.
2. Audible alarm, with silencing switch, to indicate when protection has failed.
3. One set of Form C dry contacts (normally open/normally closed) rated at 5 Amp, 250 VAC, for remote monitoring of protection status.
4. Suppression elements shall be between each phase conductor and neutral, between each phase conductor and ground and between neutral conductor and ground.
5. Fuses, rated at 200 KA interrupting capacity.
6. Minimum single impulse current rating (L-N + L-G): 240,000 amps per phase for service entrance
7. UL1449 3rd Edition (ANSI C62.41-2002) clamping voltage for service entrance shall not exceed the following:

<u>VOLTAGE</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>
120/208	700	700	700

8. Suppressors shall exhibit redundant protection with redundant fusing for each phase and consist of solid state components and shall operate bi-directionally. Gas diodes or silicon avalanche diodes in surge path are not acceptable. Series installed protectors are not acceptable.

B. Panelboard Suppressors

Modular type suppression devices shall be installed, inside or adjacent to electrical panel and shall have the following features and accessories:

1. LED indication lights (Green & Red) for power and protection status.

2. Audible alarm, with silencing switch, to indicate when protection has failed.
3. One set of dry contacts rated at 5 Amp, 250 VAC, for remote monitoring of protection status.
4. The suppressor shall be capable of interrupting a 200 KA, short circuit current delivered from the AC power line.
5. Minimum single impulse current rating (L-N + L-G): 120,000 amps per phase for panelboard.
6. UL1449 3rd Edition (ANSI C62.41-2002) clamping voltage for local panel shall not exceed the following:

<u>VOLTAGE</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>
120/208	700	700	700

C. Enclosures

NEMA 250, with type matching the enclosure of panel or device being protected, unless factory installed within equipment enclosure.

PART 3- EXECUTION

3.01 SERVICE ENTRANCE

- A. Install devices at service entrance on line side, with ground lead bonded to service entrance ground.
- B. Conductors between suppressor and point of attachment shall be at least #10 AWG stranded copper conductor or larger. The conductors shall be kept as short and straight as possible for best performance. Lead length of connecting conductors shall be within 36 inches.

3.02 LOCAL PANELS

- A. Install devices for panelboard with conductors between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- B. A 20A overcurrent protection is required at the panel to protect the leads used to connect the surge protector to the panel.

3.03 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.

3.04 FIELD QUALITY CONTROL

- A. Perform the following field quality-control testing:
 1. Complete startup checks according to manufacturer's written instructions.

2. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.19. Certify compliance with test parameters.
- B. Contractor shall engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 1. Certify that electrical wiring installation complies with manufacturer's installation requirements.

3.05 TRAINING

The Contractor shall arrange with the manufacturer of the equipment to instruct school personnel in the proper operation and care of the surge suppression system. In addition, the Contractor shall provide the following:

- A. A set of simple operating instructions for operation and maintenance of the equipment shall be delivered to the Authority.
- B. Training of Personnel shall be videotaped.

LIST OF SUBMITTALS

SUBMITTAL	DATE SUBMITTED	DATE APPROVED
Product Data	_____	_____
Shop Drawings	_____	_____
Product Certificates	_____	_____
Certificate of compliance with Quality Assurance requirements	_____	_____
Certificate of compliance with field quality control	_____	_____
Warranty	_____	_____
Operation and Maintenance instructions	_____	_____
Training videotape	_____	_____

* * *

SECTION 16420
SERVICE ENTRANCE EQUIPMENT

PART 1 - GENERAL**1.01 DESCRIPTION OF WORK**

- A. Immediately upon award of the Contract, the Contractor shall arrange for a meeting at the site with the Utility Company to coordinate the installation of the main service. Advise the Authority at least one (1) week in advance of said meeting.
- B. The Contractor shall apply for and receive from the Utility company information relative to the requirements for property line splice box, end box, meter pans, meter blocks, current transformer cabinets, meter wiring, and other equipment in connection with service entrance.
- C. All work shall be performed in accordance with the Utility Company's rules and regulations; to the satisfaction of the Authority and to be accepted by the Bureau of Electrical Control.
- D. All charges by the Utility Company in performing any part of the installation for the Project shall be paid by the Contractor as a part of the Contract.
- E. Provide ground fault trip devices and relays as required by code.

1.02 ELECTRIC SERVICE

- A. Type of Electric Service
 - 1. Electric service shall be 277/480 Volts, 3-phase, 4-wire, 60-Hz Alternating Current Service.
- B. Approval of Advisory Board
 - 1. Modification to the Existing service equipment of 1,000 KVA or more shall be filed by the Contractor with the Advisory Board of the Bureau of Electrical Control. Plans submitted to the Advisory Board shall include the 1,000 KVA Marina Service portion as required for Approval of the Advisory Board and approval shall be obtained by the Contractor prior to commencement of work.
- C. Approval of Con Edison
 - 1. Service Equipment with total rating over 800 Amps must be submitted to Con Edison to ensure compliance with requirements for service end box and metering arrangements. Existing modification shall be submitted to Con Edison for information and comment and all remarks made by the utility shall be incorporated into the installation to meet current Con Edison requirements. The specific location of the taps to the service bus, section and orientation shall be identified in the Service Entrance box detail for Con Edison approval.

1.03 SUPPLEMENTAL SUBMITTALS

- A. The Contractor shall submit for the Authority's approval, a comprehensive Drawing 1/4" scale showing the assembled arrangement of service switches, current transformer cabinets, meters, pull boxes, conduit, raceways, and all other equipment in connection with service entrance, prior to fabrication of equipment. All dimensions shall be indicated on the Drawing including height, width and depth of each unit and mounting height above floor.

- B. Plans approved by Advisory Board.
- C. Plans approved by Con Edison.
- D. Warranty.

1.04 WARRANTY

- A. In addition to the warranties specified in Section G01740, provide one year manufacturer's warranty for equipment and materials.

PART 2 - PRODUCTS**2.01 SERVICE SWITCHES**

- A. Service switches shall be externally operated, rated at 600-volts minimum, with three blades, three fuses and solid neutral and enclosed in NEMA 4X type enclosures.
- B. Switches shall meet Underwriters Laboratory and NEMA Standards, and labeled for service entrance use.
 - 1. Service Switches rated 800 Amps or less shall be standard quick make, quick break type. When an interlock is provided, provide means of voiding same for access to fuses under load.
 - 2. Service switches rated over 800 Amps shall be pressure type of the bolted pressure load break type. All contacts and line, load and fuse terminal shall be silver or pure tin-plated.
 - 3. Switches serving step-up transformer shall be High Pressure Contact (HPC) type.
 - 4. All HPC switches shall be rated for "making" and "breaking" twelve (12) times nominal current at 600 V ac for at least three operations.
 - 5. Switches operating at 480/277 Volt, rated 1000 Amps and over shall be provided with ground-fault protection.
- C. Switches shall be as manufactured by Square D, General Electric, Siemens, Eaton/Cutler-Hammer and Pringle.

2.02 PROPERTY LINE BOX

- A. The property line box, and all conduits and conductors from that box to the service switches are existing provided by the Marina Contractor. All work within the property line box; its size, material, arrangements, splices, etc shall be as per utility company requirements.

2.03 SERVICE END BOX

- A. Service end box and splices within when required by the Utility Company shall be furnished and installed as per utility company requirements.

2.04 SERVICE EQUIPMENT CABINETS

- A. Provide cabinets of meter pans and all other equipment in accordance with utility company requirements.

2.05 METERING INSTALLATIONS

- A. The Utility Company furnishes, installs, connects, and maintains meters required for metering electric energy and demand for Con Edison billing purposes. Utility Company will furnish and the contractor must install and connect current transformers.

2.06 CABLE LIMITERS

- A. Provide cable limiters on each conductor of each phase of the incoming service feeders. Limiters shall have heat resistant shell to confine the arc and insulating sleeve. Provide sufficient cable slack for replacement. Cable limiters shall be Bussmann, Littelfuse Inc., Burndy.

PART 3 - EXECUTION**3.01 MOUNTING OF SERVICE EQUIPMENT**

- A. Comply with manufacturer instructions. Anchor floor mounted cabinets to floor. Comply with seismic restrictions. Only service equipment with front access only shall be acceptable.

3.02 NAMEPLATES

- A. Each unit of equipment shall be provided with a phenolic nameplate, identifying the equipment and its rating.

3.03 TRENCHING, SIDEWALK AND STREET REPAIR - Not Used**3.04 GROUNDING AND BONDING**

- A. All switchboards, main distribution boards, panels, raceways, and other equipment shall be grounded and bonded as per the latest Electrical Code of the City of New York.

3.05 TESTING

- A. Demonstrate switch operation with circuit unloaded. Test door interlock and defeating device.

END OF SECTION

LIST OF SUBMITTALSSUBMITTALDATE SUBMITTALDATE APPROVED

Product Data _____

Shop Drawings _____

Plans approved by Advisory Board _____

Plans approved by Con Edison _____

* * *

SECTION 16452 - GROUNDING

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 grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other Sections of these Specifications.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division
 - 2. Division 10 Section "Flagpoles" for grounding of flagpoles.
 - 3. Division 16 Section "Underground Ducts and Utility Structures" for manhole bonding and grounding requirements.
 - 4. Division 16 Section "Wires and Cables" for requirements for grounding conductors.

1.3 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 grounding rods, connectors and connection materials, and grounding fittings.
- C. 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.
- D. Field tests and observation reports certified by the testing organization and indicating and interpreting the test reports for compliance with performance requirements.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7, or a full member company of the InterNational Electrical Testing Association (NETA).
 - 1. Testing Agency Field Supervision: Use persons currently certified by NETA or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Comply with NYCEC - 2011

- C. Comply with UL 467.
- D. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Apache Grounding; Nashville Wire Products.
 - 2. Boggs: H. L. Boggs & Co.
 - 3. Chance: A. B. Chance Co.
 - 4. Dossert Corp.
 - 5. Erico Inc.; Electrical Products Group.
 - 6. Galvan Industries, Inc.
 - 7. Hastings Fiber Glass Products, Inc.
 - 8. Heary Brothers Lightning Protection Co.
 - 9. Ideal Industries, Inc.
 - 10. ILSCO.
 - 11. Kearney.
 - 12. Korns: C. C. Korns Co.
 - 13. Lightning Master Corp.
 - 14. Lyncole XIT Grounding.
 - 15. O-Z/Gedney Co.
 - 16. Raco, Inc.
 - 17. Salisbury: W.H. Salisbury & Co., Utility.
 - 18. Thomas & Betts, Electrical.
 - 19. Utilco Co.

2.2 GROUNDING AND BONDING PRODUCTS

- A. Governing Requirements: Where types, sizes, ratings, and quantities indicated are in excess of National Electrical Code (NEC) 2008, as ammended in NYC, requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.3 WIRE AND CABLE GROUNDING CONDUCTORS

- A. Comply with Division 16 Section "Wires and Cables." Conform to NYCEC, except as otherwise indicated, for conductor properties, including stranding.
 - 1. Material: Aluminum and copper. Use only copper wire for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

- B. Equipment Grounding Conductors: Insulated with green color insulation.
- C. Grounding-Electrode Conductors: Stranded cable.
- D. Underground Conductors: Bare, tinned, stranded, except as otherwise indicated.
- E. Bare Copper Conductors: Conform to the following:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Assembly of Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.

2.4 MISCELLANEOUS CONDUCTORS

- A. Grounding Bus: Bare, annealed-copper bars of rectangular cross section.
- B. Braided Bonding Jumpers: Copper tape, braided No. 30 AWG bare copper wire, terminated with copper ferrules.
- C. Bonding Straps: Soft copper, 0.05 inch (1 mm) thick and 2 inches (50 mm) wide, except as indicated.

2.5 CONNECTOR PRODUCTS

- A. Pressure Connectors: High-conductivity-plated units.
- B. Bolted Clamps: Heavy-duty type.
- C. Exothermic-Welded Connections: Provided in kit form and selected per manufacturer's written instructions for specific types, sizes, and combinations of conductors and connected items.

2.6 GROUNDING ELECTRODES AND TEST WELLS

- A. Grounding Rods: Copper-clad steel.
- B. Grounding Rods: Sectional type; copper-clad steel.
 - 1. Size: 3/4 inch by 120 inches (19 by 3000 mm).
 - 2. Size: 5/8 inch by 96 inches (16 by 2400 mm).
- C. Test Wells: Fabricate from 15-inch- (400-mm-) long, square-cut sections of 8-inch- (200-mm-) diameter, Schedule 80, PVC pipe.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Equipment Grounding Conductors: Comply with NYCEC-2011 Article 250 for types, sizes, and quantities of equipment grounding conductors, except where specific types, larger sizes, or more conductors than required by NYCEC-2011 are indicated.

1. Install equipment grounding conductor with circuit conductors for the items below in addition to those required by Code:
 - a. Feeders and branch circuits.
 - b. Lighting circuits.
 - c. Receptacle circuits.
 - d. Single-phase motor or appliance branch circuits.
 - e. Three-phase motor or appliance branch circuits.
 - f. Flexible raceway runs.
 - g. Armored and metal-clad cable runs.
2. Busway Supply Circuits: Install separate equipment grounding conductor from the grounding bus in the distribution panel to equipment grounding-bar terminal on busway.

- B. Metal Poles Supporting Outdoor Lighting Fixtures: Ground pole to a separate equipment grounding conductor run with supply branch circuit.

3.2 INSTALLATION

- A. General: Ground electrical systems and equipment according to NYCEC requirements, except where Drawings or Specifications exceed NYCEC requirements.
- B. Grounding Conductors: Route along the shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- E. Underground Grounding Conductors: Use bare copper wire. Bury at least 24 inches below grade.
- F. Test Wells: One for each driven grounding electrode, except as otherwise indicated. Set top of well flush with finished grade or floor. Fill with 1-inch- (25-mm-) maximum-size crushed stone or gravel.

3.3 CONNECTIONS

- A. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 1. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

- C. Equipment Grounding-Wire Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact Metal Raceway Terminations: Where metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.
- E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and grounding rods.
- F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.
- G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- H. Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.4 OVERHEAD LINE GROUNDING

- A. Lightning Arresters: Separate arrester grounds from other grounding conductors.
- B. Protect grounding conductors running on surface of wood poles with molding manufactured for this purpose. Extend from grade level up to and through communications and transformer spaces.

3.5 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

- A. Manholes and Handholes: Install a driven grounding rod close to wall and set rod depth so 4 inches (100 mm) will extend above finished floor. Where necessary, install grounding rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from grounding rod into manhole through a waterproof sleeve in manhole wall. Protect grounding rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- B. Connections to Manhole Components: Connect exposed metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to grounding rod or grounding conductor. Make connections with minimum No. 4 AWG stranded, hard-drawn copper wire. Train conductors plumb or level around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- C. Grounding System: Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes.

3.6 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Engage an independent electrical testing organization to perform tests described below.
- B. Tests: Subject the completed grounding system to a megger test at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than 2 full days after the last trace of precipitation, and without the 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. Perform tests by the 2-point method according to IEEE 81.
- C. Maximum grounding to resistance values are as follows:
 - 1. Equipment Rated 500 kVA and Less: 10 ohms.
 - 2. Equipment Rated 500 to 1000 kVA: 5 ohms.
 - 3. Equipment Rated More than 1000 kVA: 3 ohms.
 - 4. Unfenced Substations and Pad-Mounted Equipment: 5 ohms.
 - 5. Manhole Grounds: 10 ohms.
- D. Excessive Ground Resistance: Where resistance to ground exceeds specified values, notify Owner promptly and include recommendations to reduce ground resistance and to accomplish recommended work.
- E. Report: Prepare test reports, certified by the testing organization, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

3.7 ADJUSTING AND CLEANING

- A. Restore surface features, including vegetation, at areas disturbed by work of this Section. Reestablish original grades, except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 2 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION 16452

SECTION 16461 - DRY-TYPE TRANSFORMERS (1000 V AND LESS)**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 dry-type distribution and specialty transformers rated 1000 V and less.

1.3 SUBMITTALS

- A. Product Data: Include data on features, components, ratings, and performance for each type of transformer specified. Include dimensioned plans, sections, and elevation views. Show minimum clearances and installed devices and features.
- B. Wiring Diagrams: Detail wiring and identify terminals for tap changing and connecting field-installed wiring.
- C. Product Certificates: Signed by manufacturers of transformers certifying that the products furnished comply with requirements.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- E. Factory Test Reports: Certified copies of manufacturer's design and routine factory tests required by referenced standards.
- F. Sound-Level Test Reports: Certified copies of manufacturer's sound-level tests applicable to equipment for this Project.
- G. Field Test Reports: Indicate and interpret test results for tests specified in Part 3.
- H. Maintenance Data: For transformers to include in the maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: In addition to requirements specified in Division 1 Section "Quality Control," an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907; or shall be a full-member company of the InterNational Electrical Testing Association.
 - 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.
- B. Listing and Labeling: Provide transformers specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

C. Comply with IEEE C2.

D. Comply with NFPA 70 (NYCEC 2011).

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering transformers that may be incorporated into the Work include, but are not limited to, the following:

- B. Manufacturers: Subject to compliance with requirements, provide transformers by one the following:

1. Acme Electric Corp.; Transformer Division.
2. Bryant Electric.
3. Challenger Electrical Equipment Corp.
4. Computer Power Inc.
5. Controlled Power Co.
6. Cutler-Hammer/Eaton Corp.
7. Federal Pacific Co.; Line Power Mfg. Corp. Subsidiary.
8. GE Electrical Distribution & Control.
9. Hammond Co.; Matra Electric, Inc.
10. MagneTek Inc.
11. Micron Industries Corp.
12. Siemens Energy & Automation, Inc.
13. Sola/Hevi-Duty Electric.
14. Square D; Groupe Schneider.
15. Uptegraff: R.E. Uptegraff Mfg. Co.
16. Virginia Transformer Corp.

2.2 TRANSFORMERS, GENERAL

- A. Description: Factory-assembled and -tested, air-cooled units of types specified, designed for 60-Hz service.
- B. Cores: Grain-oriented, nonaging silicon steel.
- C. Coils: Continuous windings without splices, except for taps.
- D. Internal Coil Connections: Brazed or pressure type.

- E. Enclosure: Class complies with NEMA 250 for the environment in which installed.
- F. Low-Sound-Level Units: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.3 GENERAL-PURPOSE DISTRIBUTION AND POWER TRANSFORMERS

- A. Comply with NEMA ST 20 and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Windings: One coil per phase in primary and secondary.
- D. Enclosure: Indoor, ventilated.
- E. Enclosure: Indoor, ventilated, dripproof.
- F. Enclosure: Outdoor, ventilated, raintight, NEMA 250, Type 3R.
- G. Enclosure: Totally enclosed, nonventilated.
- H. Enclosure: Totally enclosed, nonventilated, suitable for outdoor use.
- I. Insulation Class: 185 or 220 deg C class for transformers 15 kVA or smaller; 220 deg C class for transformers larger than 15 kVA.
 - 1. Rated Temperature Rise: 80 deg C maximum rise above 40 deg C.
 - 2. **Rated Temperature Rise: 115 deg C maximum rise above 40 deg C.**
 - 3. Rated Temperature Rise: 150 deg C maximum rise above 40 deg C, for 220 deg C class insulation; 115 deg C maximum rise for 185 deg C class insulation.
- J. Taps: For transformers 3 kVA and larger, full-capacity taps in high-voltage windings are as follows:
 - 1. Taps, 3 through 25 kVA: Two 5-percent taps below rated high voltage.
 - 2. Taps, 3 through 10 kVA: Two 5-percent taps below rated high voltage.
 - 3. Taps, 15 through 500 kVA: Six 2.5-percent taps, 2 above and 4 below rated high voltage.
 - 4. Taps, 750 kVA and Above: Four 2.5-percent taps, 2 above and 2 below rated high voltage.
- K. Electrostatic Shielding: Each winding is independently single shielded with a full-width copper electrostatic shield arranged to minimize interwinding capacitance.
 - 1. Coil leads and terminal strips are arranged to minimize capacitive coupling between input and output connections.
 - 2. Shield Terminal: Separate; marked "Shield" for grounding connection.
 - 3. Capacitance: Shield limits capacitance between primary and secondary to a maximum of 33 picofarads over a frequency range of 20 Hz to 1 MHz.
 - 4. Common-Mode Noise Attenuation: Minus 120 dB minimum, 0.5 to 1.5 kHz; minus 65 dB minimum, 1.5 to 100 kHz.
 - 5. Normal-Mode Noise Attenuation: Minus 52 dB minimum, 1.5 to 10 kHz.
- L. Fungus Proofing: Permanent fungicidal treatment for coil and core.

2.4 CONTROL AND SIGNAL TRANSFORMERS

- A. Units comply with NEMA ST 1 and are listed and labeled as complying with UL 506.
- B. Ratings: Continuous duty. If rating is not indicated, provide capacity exceeding peak load by 50 percent minimum.
- C. Description: Self-cooled, 2 windings.

2.5 FINISHES

- A. Indoor Units: Manufacturer's standard paint over corrosion-resistant pretreatment and primer.
- B. Outdoor Units: Comply with ANSI C57.12.28.

2.6 SOURCE QUALITY CONTROL

- A. Factory Tests: Design and routine tests comply with referenced standards.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project if specified sound levels are below standard ratings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with safety requirements of IEEE C2.
- B. Arrange equipment to provide adequate spacing for access and for circulation of cooling air.
- C. Identify transformers and install warning signs according to Division 16 Section "Electrical Identification."
- D. 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.

3.2 GROUNDING

- A. Separately Derived Systems: Comply with NFPA 70 (NYCEC 2011) requirements for connecting to grounding electrodes and for bonding to metallic piping near the transformer.
- B. Separately Derived Systems: Make grounding connections to grounding electrodes and bonding connections to metallic piping as indicated and to comply with NFPA 70 (NYCEC 2011).

- C. Comply with Division 16 Section "Grounding" for materials and installation requirements.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to supervise the field assembly and connection of components, and the testing and adjusting of transformer components and accessories.
- B. Testing Agency: Owner will engage a qualified independent testing agency to perform field quality-control testing.
- C. Testing Agency: Engage a qualified independent testing agency to perform field quality-control testing.
- D. Test Objectives: To ensure transformer is operational within industry and manufacturer's tolerances, is installed according to the Contract Documents, and is suitable for energizing.
- E. Test Labeling: On satisfactory completion of tests for each transformer, attach a dated and signed "Satisfactory Test" label to tested component.
- F. Schedule tests and provide notification at least 7 days in advance of test commencement.
- G. Report: Submit a written report of observations and tests. Report defective materials and installation.
- H. Tests: Include the following minimum inspections and tests according to manufacturer's written instructions. Comply with IEEE C57.12.91 for test methods and data correction factors.
 - 1. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.
 - 2. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.
 - 3. Insulation Resistance: Perform megohmmeter tests of primary and secondary winding to winding and winding to ground.
 - a. Minimum Test Voltage: 1000 V, dc.
 - b. Minimum Insulation Resistance: 500 megohms.
 - c. Duration of Each Test: 10 minutes.
 - d. Temperature Correction: Correct results for test temperature deviation from 20 deg C standard.
- I. Test Failures: Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest. Verify that transformers meet specified requirements.

3.4 CLEANING

- A. On completion of installation, inspect components. Remove paint splatters and other spots, dirt, and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.5 ADJUSTING

- A. After installing and cleaning, touch up scratches and mars on finish to match original finish.
- B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings and submit with test results.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in readjusting transformer tap settings to suit actual occupied conditions. Provide up to 2 visits to Project site for this purpose without additional cost.
 - 1. Voltage Recordings: Contractor performed. Provide up to 48 hours of recording on the low-voltage system of each medium-voltage transformer.
 - 2. Point of Measurement: Make voltage recordings at load outlets selected by Owner.

END OF SECTION 16461

**SECTION 16470
PANELBOARDS****PART 1 - GENERAL****1.01 DESCRIPTION OF WORK**

Provide panelboards.

1.02 SUPPLEMENTAL SUBMITTALS**A. Submittal Packages**

Submit the Shop Drawings, and the product data specified below at the same time as a package.

B. Shop Drawings; include the following for each panelboard:

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices equipment features, and ratings.
2. Cabinet and gutter size.
3. Bus configuration, voltage and current rating.
4. Unless otherwise noted, Panelboard short circuit rating shall conform to U.L. Standards for fully rated systems only.
5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

D. Field Test Reports: Submit written test reports and include the following:

1. Test Procedures used
2. Test results

E. Panelboard Schedules: For installation in panelboard. Submit final versions after load balancing.**1.03 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the authorities having jurisdiction, and marked for intended use.
- B. Comply with NEMA PB1.
- C. Comply with NFPA 70.
- D. Comply with UL 67.

1.04 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.

PART 2 - MATERIAL - PRODUCTS**2.01 PANELBOARDS - CIRCUIT BREAKER TYPE**

A. Equipment manufactured by General Electric Co., Siemens, Square D Co., Eaton/Cutler-Hammer, All-City Switchboard Corp, having:

1. Bus bars and lugs shall not be less than 98% conductivity, hard drawn copper. All copper bus connections shall be bolted with lock washers and joints shall be silver plated.
2. Full capacity copper neutral bus in panelboards where neutrals are required.
3. Copper equipment grounding bus in panelboards where equipment grounding conductors are required.
4. Section designated "space" or "provision for future breaker" equipped to accept future circuit breakers.
5. Molded-Case Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Circuit breakers shall be bolt on. Plug-in type breakers are not acceptable.

B. GFCI (30mA Type) circuit breakers shall be provided for designated circuits.

C. Panelboard Cabinets

1. Flush and surface mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.

D. Locks

Provide locks for panelboard cabinets located outside electrical rooms/closets. Locks shall be of approved cylinder, paracentric type, Yale No. 511S, Key change No. 47. Two keys shall be supplied with each lock.

E. Directories

A directory consisting of a steel or aluminum frame with a non-breakable, non-inflammable plastic face and cardboard or heavy white paper shall be installed on the inside of the door of cabinets for all panelboards. Frame shall be welded to door or fastened by approved screws to a mat in such a manner as not to leave anything projecting on the outside of the door. The cardboard or heavy paper shall have typewritten directory thereon stating the following: The number of each circuit together with the name of circuits, load controlled, size of circuit feeder and subfeeder conductors. Directory frames shall be not less than 8" x 8".

2.02 PANELBOARD - SWITCH FUSE TYPE

- A. Provide a dead front, handle operated, fusible switch panelboard where indicated. The assembled panelboard shall have a label indicating approval by Underwriters Laboratories, Inc. and shall meet the requirements of NEMA Standards. In general, panelboard construction shall be identical to that specified for circuit breaker panelboards.

All necessary devices and connections shall be complete and in accordance with the following Specifications.

- 1. Fusible Switch Units shall consist of twin or single type units of ampere (and corresponding horsepower) rating indicated. Units shall be quick make, quick break, heavy duty switch and fuse mechanism, individually enclosed by a hinged steel cover and external operating handle indicating "ON" and "OFF" position to switch. Switches shall be of design to minimize arcing and pitting when rupturing current and shall be equipped with arc quenchers. Wiring terminals shall be solderless pressure type lugs. Cover of unit shall be interlocked so that door cannot be opened except when switch is in "OFF" position. Unit shall have provision for padlocking. The individual units shall bear Underwriter's Laboratories, Inc. label of approval. Operating handles shall not exceed 6'-7" above finished floor and not less than 18" above floor.

2.03 NAMEPLATES

- A. Each unit of equipment shall be provided with a riveted phenolic nameplate, identifying the equipment and its rating.
- B. On each circuit breaker and fused switch: ampere rating, fuses size and fuses type (or circuit breaker type and setting) and circuit designation.
- C. On panelboard: ampere rating, nominal voltage, phases and panelboard designation.

PART 3 - EXECUTION**3.01 INSTALLATION**

- A. Install panelboards in accordance with NEMA Publication No. PB1.1 "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or less".
- B. Cabinet Supports
 - 1. Panelboards set in chases shall be supported to chase structural members.
 - 2. Panelboards set in walls where a chase is not provided by others, shall be provided with Kindorf channels on both sides of the panel with these channels running from floor slab to ceiling slab and secured to both.
 - 3. Surface mounted panels shall be fastened to walls by expansion shields, or the equivalent. Heavy panelboards shall be supported from the floor by means of approved angle iron framework.
 - 4. Steel angle or channel supporting members shall be provided to adequately support distribution equipment for floor mounting with all necessary bracing.

C. Setting of Cabinets

Panelboards set above wainscot shall be set so that bottom of trim shall be 1/2" above wainscot. Where wainscot is approximately 7'-0" above floor, top of panel shall line up with it unless otherwise detailed or directed.

Elsewhere in the building, panelboards shall be set so that top of cabinet is approximately 6 feet 6 inches above floor.

D. Flush Cabinets

Where building construction does not permit cabinets being set flush or where cabinet is extra deep, the front shall project out from the wall and the sides of the cabinet shall be trimmed and finished with a metal return molding of approved design, fastened to cabinet so as to conceal the intersection between the wall and the cabinet.

E. Cleaning

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.

3.02 TESTS**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. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.**C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance measure load balancing. Difference exceeding 20% between phase load is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.****END OF SECTION**

LIST OF SUBMITTALS**SUBMITTAL DATE SUBMITTED****DATE APPROVED**

Shop Drawings

Product Data

Field Test Reports

Panelboard Schedules

* * *

SECTION 16475 - FUSES**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. Fuses.
 - 2. Spare fuse cabinet.

1.3 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 fuse type specified.
- C. Product Data for each fuse type specified. Include the following:
 - 1. Descriptive data and time-current curves.
 - 2. Let-through current curves for fuses with current-limiting characteristics.
 - 3. Coordination charts and tables and related data.
 - 4. Fuse size for elevator feeder and disconnect applications.
- D. Field test reports indicating and interpreting test results.
- E. Maintenance data for tripping devices to include in the operation and maintenance manual specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from one source and by a single manufacturer.
- B. Comply with NYCEC 70 for components and installation.
- C. Listing and Labeling: Provide fuses specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Spare Fuses: Furnish quantity equal to 20 percent of each fuse type and size installed, but not less than 1 set of 3 of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fuses that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide fuses by one of the following:
 - 1. Cooper Industries, Inc.; Bussmann Div.
 - 2. Eagle Electric Mfg. Co., Inc.
 - 3. Ferraz Corp.
 - 4. General Electric Co.; Wiring Devices Div.
 - 5. Gould Shawmut.
 - 6. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class as specified or indicated; current rating as indicated; voltage rating consistent with circuit voltage.
- B. In line fuses holders: 600VAC, Model 'FEB' as manufactured by Ferraz Shawmut or equal. Fuses: 5 - Ampere Ferraz Shawmut type 'TRM' or equal.
- C. Class 'G' fuse holders, 600VAC, for SC fuses as manufactured by Bussmann or equal.

2.3 SPARE FUSE CABINET

- A. Cabinet: Wall-mounted, 0.05-inch thick steel unit with full-length, recessed piano-hinged door with key-coded cam lock and pull.
 - 1. Size: Adequate for orderly storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: Stencil legend "SPARE FUSES" in 1-1/2-inch letters on door.
 - 4. Fuse Pullers: For each size fuse.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.

- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Main Service: Class L, fast acting.
- B. Main Feeders: Class J, time delay.
- C. Motor Branch Circuits: Class RK1, time delay.
- D. Other Branch Circuits: Class RK5, non-time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings are readable without removing fuse.
- B. Install spare fuse cabinet where indicated.

3.4 IDENTIFICATION

- A. Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

END OF SECTION 16475

SECTION 16480
MOTORS, MOTOR CONTROL CENTERS,
STARTERS AND CONTROL EQUIPMENT

PART 1 - GENERAL**1.01 DESCRIPTION OF WORK**

- A. Provide and make final connections to all motors, motor control centers, starters and accessories, connect equipment furnished under other Sections of the Specifications.

Obtain all wiring diagrams and other information furnished by the manufacturer of the equipment. Coordinate and supplement the wiring diagrams and schedules with any additional function of operational requirements specified in other Sections of the Specifications. Provide control equipment to execute the sequence of operation.

The Contractor is specifically directed to Division 15 for motors, starters, control equipments and devices furnished by the P&D and HVAC trades.

1.02 REFERENCES

- A. NEMA MG-1 - Motors and Generators
- B. NEMA ICS - General Standards for Industrial Control and Systems

1.03 SUPPLEMENTAL SUBMITTALS

- A. Submittal Package

Submit product data for motors and starters as a package.

- B. Product Data:

1. For each type of controller and each type of motor-control center. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

- C. Shop Drawings: For each starter and motor-control center.

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 ratings of buses and installed units.
- d. Vertical and horizontal bus capacities.
- e. UL listing for series rating of overcurrent protective devices in combination controllers.
Feature, characteristics, ratings, and factory settings of each motor-control center unit.

Wiring Diagrams: Power, signal, and control wiring for class and type of motor-control center. Differentiate between manufacturer-installed and field-installed wiring. Provide schematic wiring diagram for each type of controller.

- D. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around motor-control centers where pipe and ducts are prohibited.
- E. Field Test Reports: Written reports specified in Part 3.
- F. Manufacturer's field service report.
- G. Maintenance Data: For starters and motor-control centers, all installed devices, and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Closeout Procedures," include the following:
 - 1. Routine maintenance requirements for motor-control centers and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- H. 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.
- I. 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.

1.04 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.

1.05 COORDINATION

- A. Coordinate layout and installation of starters and motor-control centers 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 motor-control centers, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- E. Coordinate features, accessories, and functions of each motor-control center, each controller, and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 – PRODUCTS

2.01 MOTORS

- A. Motor (Nameplate) Voltage
 - 1. 120/208 Volt, Three Phase, 4 Wire Incoming Service

- a. Motors less than 1/2 HP: NEMA standard motor voltage 115V single phase, 60 Hz.
 - b. Motors 1/2 HP and larger: NEMA standard motor voltage 200V, three phase, 60 Hz.
- B. Single phase motor shall be capacitor start, open drip-proof unless otherwise noted.
- C. Three-phase motors shall be squirrel-cage, open drip-proof unless otherwise noted.
- D. Motors in general shall have cast iron frame, full voltage starting.
- E. Drawings shall indicate horsepower, voltage and RPM.
- F. Temperature rise and insulation system class shall conform to NEMA standards.
- G. Motors shall be of the highest grade manufactured by: Allis Chalmers Mfg. Co., Baldor Electric Co., Century Electric Co., Continental Electrical Motors Co., General Dynamics Corps., Howell Electric Motors Co., Imperial Electric Co., Peerless Electric Co., Reliance Electric & Engineering Co., Wagner Electric Corp., or Westinghouse Electric & Mfg. Co.
- H. Motor nameplate data shall be in accordance with NEMA Standards.

2.02 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Starters and Motor-Control Centers
 - a. Eaton Corp.; Cutler-Hammer Products.
 - b. General Electrical Distribution & Control.
 - c. Rockwell Automation Allen-Bradley Co.; Industrial Control Group.
 - d. Siemens/Furnas Controls.
 - e. Square D Co.

2.03 MAGNETIC MOTOR STARTERS

- A. Description: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.
- B. Control Circuit: 120 V
- C. Combination Starter: Factory-assembled combination starter and disconnect switch.
 - 1. Fusible Disconnecting Means: NEMA KS 1, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a nationally recognized testing laboratory.
 - 2. Nonfusible Disconnecting Means: NEMA KS 1, nonfusible switch.
 - 3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- D. Overload Relay: Ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

- E. Star-Delta Controller: NEMA ICS 2, closed transition with adjustable time delay.

2.04 FEEDER OVERCURRENT PROTECTION

- A. 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.
- B. Fusible Switch: NEMA KS 1, Type HD, clips to accommodate specified fuses with lockable handle.

2.05 MOTOR-CONTROL CENTER 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.
- 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.

2.06 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and tested controllers before shipping.

2.07 MANUAL ENCLOSED STARTERS

- A. Description: NEMA ICS 2, general purpose, Class A, with toggle action and overload element.

2.08 MAGNETIC ENCLOSED STARTERS

- A. Description: NEMA ICA 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.
- B. Control Circuit: 120 V
- C. Combination starter: Factory-assembled combination starter and disconnect switch.
 - 1. Fusible Disconnecting Means: NEMA KS 1, fusible switch with rejection-type fuse clips rated for fuses.
 - 2. Nonfusible Disconnecting Means: NEMA KS 1, nonfusible switch.
 - 3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- D. Overload Relay: Ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.
- E. Motor Control Push Button Stations and H-O-A Switches

Provide push button stations of the momentary contact type with pilot light, installed with a common faceplate.

Provide "Hand-Off-Automatic" (H-O-A) switches for all starters controlling equipment with automatic actuating apparatus.

2.09 PUSHBUTTON STATIONS

A. Normal Duty

Momentary Start-Stop with pilot light in NEMA 1 enclosure.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Anchor each motor-control center assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with motor-control center mounting surface.
- B. Install motor-control center on concrete basis.
- C. Comply with mounting and anchoring requirements specified in Division 16 Section "Seismic Controls for Electrical Work".
- D. Controller Fuses: Install fuses in each fusible switch.
- E. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks.
- F. Install freestanding equipment on concrete bases.

The arrangement and mounting of all control equipment shall be such, that the handle of the safety switch will be easily operable from the floor, at approximately 5'-0" mounting height.

Manually operated control equipment shall have handles or push buttons 4-feet from floor, unless otherwise noted on Drawings.

Provide a white core phenolic nameplate on all motor control equipment.

- G. In general, roof fan motor circuit wiring is run to starters in grouped locations. Starters shall be mounted on steel framework where shown on Drawings.

Pilot light assemblies shall be installed in the covers of respective starters

- H. Connect hand-off-automatic switch and other automatic-control devices where available.
 - 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 motor-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. [For each motor automatically and/or manually controlled or monitored by the fire alarm system, include control wiring extensions as specified as part of the fire alarm system to an adjacent FPA addressable module.]

4. Control wiring for single phase HVAC motors with manual controllers shall be provided as part of the electrical work. For each such motor, provide wiring and connect to all outlying control devices as directed. Refer to GHAC drawings and specifications for quantities and locations.
- I. Control wiring for plumbing motors will be provided as part of the work of Division 15 as applicable.
- J. Control wiring shall be accomplished utilizing #14 AWG copper conductor with THWN installation.
- K. Nameplates

Identify starters, motor-control center, motor-control center components, and control apparatus wiring. Identify each pushbutton station and motor starter. Identify each interlock switch, indicating purpose of switch.
 1. NEMA 1 Enclosures: Rivet or bolt nameplate to the cover
 2. NEMA 3R, 4, 4X, 7, or 9 Enclosures: Attach name-plates to the cover using adhesive specifically designed for the purpose.

3.02 FIELD TESTS

- A. Perform tests, in the presence of the Authority's Representative to demonstrate:
 1. That each control device and its related motor starter operate properly.
 2. That each overload and undervoltage protection safety device functions properly.
 3. That each safety shut-off valve and device operates properly.
- B. Tests shall be performed in accordance with the equipment manufacturers' start-up and field test instructions and made jointly with all relevant trades.
- C. Should the tests reveal any defects, promptly correct such defects and rerun the tests until the entire installation is satisfactory in all respects.
- D. Tests shall be coordinated by the Contractor who shall provide (48) hrs. min. notice to the Authority's Representative for approval of schedule.

3.03 TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-control centers [and variable-frequency drives].
 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 2. Review data in maintenance manuals.

END OF SECTION

* * *

LIST OF SUBMITTALS

SUBMITTAL	DATE SUBMITTED	DATE APPROVED
Product Data		_____
Shop Drawings		_____
Wiring Diagrams		_____
Coordination Drawings	_____	_____
Maintenance Data		_____
Load-Current and Overload-Relay Heater List	_____	_____
Load-Current and List of Settings of Adjustable Overload Relays	_____	_____
Certificate of compliance with the Quality Assurance requirements	_____	_____
Field Test Reports		_____
Videotape of personnel Training	_____	_____

* * *

Lighting Controls Network Controller Specification
Division 16520

PART 1. GENERAL**1.1 INTRODUCTION**

- A. The intent of this specification is to provide for furnishing, installing, testing and placing into operation, a complete and functional lighting control system with provision for integrated switching and dimming control of the indicated lighting.

1.2 DESCRIPTION OF WORK

- A. Extent of lighting control system work is indicated by drawings and by the requirements of this section. It is defined to include lighting control panels, control stations and other user interface devices, wiring, and ancillary programming equipment. Type of lighting control equipment and wiring specified in this section includes the following:
 - 1. Programmable relay/dimmer panels
 - 2. Over-ride switch stations
 - 3. Preset dimming control stations
 - 4. Daylighting controls
 - 5. Lighting control PC workstation
 - 6. Network routing and repeating devices
- B. Requirements are indicated elsewhere in these specifications for work including, but not limited to, raceways, electrical boxes and fittings required for installation of the lighting control system, which are not part of this section.

1.3 QUALITY ASSURANCE

- A. Independent Testing Laboratory - The control panels shall be tested and listed under the UL 916 Energy Management Equipment standards.
- B. System Checkout and training - A factory trained technician or other factory authorized personnel shall functionally test the system and verify performance after contractor installation. Factory authorized personnel shall conduct a training session (8 hours max) to train the building operations personnel on the set-up, programming, operation and maintenance of the lighting control system.
- C. Factory Programming – The system shall be turned over to the owner fully programmed and ready for immediate operation. It shall be the responsibility of the contractor to coordinate with the owner and supply the necessary “as-installed” information and desired schedules to the manufacturer in a timely manner.
- D. Manufacturer experience - To insure a uniform installation and single responsibility, all switching and dimming equipment described herein shall be supplied by a single manufacturer. Manufacturer shall have a minimum of 10 years experience in lighting control systems. Manufacturer shall be Synergy Lighting Controls or equal.

1.4 CODES AND STANDARDS

- A. Network - ANSI 875.1, ARCNET®
- B. Protocol - ASHRAE 135 – 1995, BACnet®
- C. IEEE Std 2000.1-1998

1.5 SUBMITTALS

Prior to fabrication manufacture shall submit the following materials for approval.

- A. Manufacturer’s published catalog data sheets for all equipment and components of the lighting control system.

- B. Shop Drawings - Submit detailed drawings and documentation of lighting control system components and interconnection. As a minimum, the shop drawings shall include the following:
1. One-line schematic diagram with wire type details
 2. Network wiring details
 3. Lighting control panel load schedules
 4. Input and output wiring details
 5. Programming worksheets for system configurations
 6. A complete BACnet *Protocol Implementation Conformance Statement* (PICS).

PART 2. PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. The lighting control system shall provide seamless control and monitoring of all lighting included in the scope of work regardless of whether it is relay switched or dimmed. All relay and dimmer panels, unless otherwise noted, shall be interconnected by a communication bus making possible the sharing of control functions and status system wide. Control inputs shall be transferable over the network to affect lighting control patterns and zones regardless of to which relay or dimmer panel the loads are connected. Overrides for after hour use or cleaning shall be accomplished via pushbutton switch, via individual user workstations. A single PC software application shall provide the means to configure, set-up, and monitor the operation of all lighting control panels. Individual lighting control panels shall provide a user interface and display permitting local set-up, override, monitoring and diagnostics.

2.2 HARDWARE

- A. Enclosures
1. Shall be NEMA 4 rated, code gage steel cabinet. Enclosure and contents shall be designed to operate in interior spaces with temperatures of 32°-104° F (0°-40° C) and , 0-90% non condensing humidity. Enclosure shall be available with optional recessed mounting hardware. See drawings for mounting requirements.
 2. Enclosure Dimensions:
 - a.) Medium - 34.5”(876mm) H X 20”(508mm) W X 6”(152mm) four power modules maximum .
 3. Multi-tapped Transformer - The enclosure shall be supplied with multi-tapped transformer and shall not require specification of voltage for each control location. Provide a dedicated power feed of 120/230/277, 50/60 Hz, 225 VA. for each enclosure.
 4. Modular Design - The power modules and system controller shall be modular and designed for ease of field service or upgrade.
- B. Relay Power Modules
1. Mechanical - All Relay Power Module components shall be mounted to heavy steel back plane. Module shall install into enclosure with keyed tab and slot hardware, secured in place with heavy duty screws.
 2. Relay Power Module shall provide eight relay outputs designed for the control of lighting circuits. The Power Module shall be operable without the system controller installed for direct operation of lighting loads or with the system controller for programmable input to output mapping. Terminal block shall accept two (2) #8 AWG maximum wire(s).
 3. Relay Certification – Relays shall be Underwriters Lab (UL) listed.
 4. Relay Status Indicators - The system shall provide LED status indicators for all relay outputs.
 5. Relay Ratings - Relays shall be SPST, mechanically latching, individually replaceable with enclosed contacts. Relays shall be rated to at least 18K SCCR, 30 amps at 277 VAC electronic or HID ballast, 15 amps 120VAC tungsten, 20A at 347V. A limited 3-year warranty shall be provided on the individual relays.
 6. Relay Response - Relays shall be individually settable to respond as normally open, normally closed, momentary on, momentary off, Inteliswitch, or for Sweep Switch operation through the System Controller.

7. Standard Inputs – The Relay Power Module shall provide:
 - a.) One (1) HOA switch to manually force all relays On, Off or Automatic control. Whenever active, the On or Off override condition shall be visually and audibly annunciated via the User Interface Panel (UIP) on the System Controller.
 - b.) One (1) Remote override switch input shall be provided to accept a dry contact closure from a remote control device such as an A/V system, building automation system, fire alarm panel or other similar device to force all relays on or off. Terminal block shall be removable. Whenever active, the On or Off override condition shall be visually and audibly annunciated via the UIP on the System Controller.
 8. Input/Output Expansion Module - The I/O expansion module shall connect directly to the Relay Power Module and provide:
 - a.) Eight (8), programmable dry contact low voltage switch/occupancy sensor inputs with removable terminal blocks. Momentary or maintained contacts shall be supported as 3-wire momentary, 2-wire momentary, alternate action or 2-wire maintained contact. 24VDC power shall be provided to power occupancy sensors. Inputs shall be dry contact and internally sourced. Inputs shall be linkable to any number of relays for override control.
 - b.) Two (2) inputs per module shall be capable of monitoring external analog sensing devices such as a photocell. It shall be possible to control the output relays in response to analog input values with 100 steps of analog control resolution. Terminal block shall be removable.
 - c.) Eight (8), pilot light outputs with removable terminal blocks. Pilot light output voltages shall be jumper selectable for 5V, 20V or 24V.
 - d.) Eight (8), 0-10vdc analog outputs for dimming control of 0-10vdc dimmable ballasts.
 9. Fade Time – The system shall support an adjustable fade rate from 0 to 99 minutes with a 1 sec resolution when changing from a preset level to another preset level.
 10. Removable Low Voltage Terminal Blocks – All low voltage terminal blocks shall be removable to provide the capability for the installer to remove the connector from the header when terminating wire. Systems that do not provide removable low voltage terminal blocks shall not be acceptable.
 11. BACnet integration – Provide the capability for relays/analog outputs, dry contact low voltage switch inputs, and analog inputs to be accessible from BACnet network when used with a networked System Controller.
- C. Dimming Power Modules
1. Mechanical - All power module components shall be mounted to heavy steel back plane. Module shall install into enclosure with keyed tab and slot hardware, secured in place with heavy duty screws. All module electronics and power device elements shall be mounted to a removable sub-assembly and shall be replaceable without removal of the dimmer module.
 2. Input/output features - Dimmer module shall provide low voltage switch input terminals, analog input terminals, and line voltage output terminals for control of lighting loads. Dimmer modules shall be operable without the system controller installed for direct operation of lighting loads or with the system controller for programmable input to output mapping. Each module shall provide the following:
 - a.) Six 20 amp relays with output terminal blocks
 - b.) Six universal dimmers with output terminal blocks
 - c.) Two switch inputs, configurable for raise/lower or on/off operation
 - d.) Three analog inputs for 0 – 10VDC operation
 - e.) Two 24VDC accessory power terminals
 - f.) Six 20 amp circuit breakers at 120 volts or four 20 amp circuit breakers at 277 volts.
 3. Dimmed Status Indicators - The system shall provide an LED status indicator for each dimmer output.
 4. Relays - Air gap relays shall be SPST, normally open with enclosed silver cadmium-oxide isolated contacts. Relays shall be rated to at least 16 amps at 277 VAC electronic or HID ballast, 15 amps 120VAC tungsten. The relays shall be magnetically held by DC current.

5. Sources - Dimmers shall be "universal" type rated for use with incandescent, low voltage, neon, cold cathode, and fluorescent. Digital firing circuits shall ensure that all dimmers set to the same intensity will track together. No adjustments shall be required to ensure this operation.
6. Rise Time - Dimmers shall use toroidal filters to reduce RFI and lamp filament noise. Filter design shall limit current rise time of output wave form to a minimum of 350 microseconds, measured between 10 and 90 percent of total rise with dimmer control set at one half.
7. Response to Control – Dimmer response curve shall be selectable provide a means to optimize the dimmer response to control for the lamp type being controlled.
8. High/low trim – It shall be possible to set high end and low end trim limits for each dimmer individually.
9. Switch Inputs - Each dimmer module shall provide two (2) sets of dry contact input terminals. Momentary or maintained contacts shall be supported as latching 3-wire momentary, 2-wire momentary alternate action or 2-wire maintained contact. Inputs shall be dry contact with 24 VDC, 12 mA. internally sourced. Inputs shall be linkable to any number of relays or dimmers for control.
10. Analog Inputs - Three inputs per dimmer module shall be capable of responding to external analog devices such as a photocell or potentiometer. It shall be possible, through the system logic, to control the output relays and dimmers in response to analog input values with 100 steps of analog control resolution.
11. Fade Time – The system shall support an adjustable fade rate from 0 to 99 minutes with a 1 sec resolution when changing from a preset level to another preset level.
12. Diagnostic features – It shall be possible to manually set dimmer intensity, read current dimmer intensity level and read input control signal values via the UIP on the system controller.
13. Service Override Switch - Each dimming module shall have an On/Auto/Off service override switch that shall control all outputs on the module. Whenever active, the On or Off override condition shall be visually and audibly annunciated via the UIP on the system controller.
14. BACnet integration – Provide the capability for relays/analog outputs, dry contact low voltage switch inputs, and analog inputs to be accessible from BACnet network when used with a networked controller.

D. Intelligent Ballast Power Modules

1. General Description – The Intelligent Ballast Power Module will allow existing input devices, schedules, and user interfaces to control, retrieve status, and retrieve diagnostic information from devices that conform to the DALI/SIMPLY5 standard. The DALI/SIMPLY5 Module shall conform to the Acuity Brands Lighting DALI/SIMPLY5 standard as applicable. The module will also conform to the DALI standard to allow simultaneous control of DALI/SIMPLY5 and Lutron EcoSystem ballasts.
2. Ballast Network - Provide three independent networks. Each network shall support up to 64 digitally controllable ballasts and provide individual dimming control of each digitally controllable ballast. Network power and control shall be provided by the DALI/SIMPLY5 Power Module.
3. Mechanical - All power module components shall be mounted to heavy steel back plane. Module shall install into enclosure with keyed tab and slot hardware, secured in place with heavy duty screws.
4. Overrides – The DALI/SIMPLY5 Power Module shall provide:
 - a.) One (1) HOA switch to manually force all ballasts On, Off or Automatic control. Whenever active, the On or Off override condition shall be visually and audibly annunciated via the User Interface Panel (UIP) on the System Controller.
 - b.) One (1) Remote override switch input shall be provided to accept a dry contact closure from a remote control device such as an A/V system, building automation system, fire alarm panel or other similar device to force all ballasts on or off. Terminal block shall be removable. Whenever active, the On or Off override condition shall be visually and audibly annunciated via the UIP on the System Controller.
5. Fade Time – The system shall support an adjustable fade rate from 0 to 99 minutes with a 1 sec resolution when changing from a preset level to another preset level.

6. BACnet integration – Provide the capability for DALI/SIMPLY5 and Lutron EcoSystem ballasts to be controlled as well as diagnostic information read from a BACnet network when used with a networked controller.

E. System Controller

1. Mechanical - The system controller shall be supplied as a modular chassis consisting of the user interface panel, system control electronics, and provision for installation of up to four industry standard half length ISA accessory boards. The system controller shall plug-into the enclosure as an assembly for ease of installation, service, or upgrade. All system controllers shall be installed into the enclosures only after the rough-in phase of installation is complete.
2. User Interface Panel (UIP) - The user interface shall provide a simple means to set-up, program, and monitor the lighting control system. Provide as a minimum the following features:
 - a.) Multi-lingual operation in English, Spanish
 - b.) Four line, eighty character LCD display with back light
 - c.) Four multi-function menu selection keys graphically associated with the LCD display
 - d.) A twelve key, numeric keypad with Enter and Back functions
 - e.) A four key menu navigation and selection keypad with Up, Down, plus (+) and minus (-) function keys
 - f.) LED status indicators for Network and Local input/output bus.
3. Capacity - The system controller shall have the capacity to operate up to 12 power modules in two enclosures, permitting up to 96 points of control from each system controller.
4. RS232 Port - Provide a front mounted DB9 serial connector for connection of a personal computer or other external serial device. Provide a second DB9 serial connector within the enclosure for permanent connection of serial devices. Option to add up to an additional 4 more serial ports
5. RS485 ARCNET port – Provide a removable terminal block connection for the network bus wire connection.
6. Ethernet Port – Provide an Ethernet port for connection to a Local Area Network.
7. RS485 Control Station port – Provide a removable terminal block connection for the dimming control station and/or addressable network button station bus.
8. Program Back-up - The user program shall be stored in non volatile memory. The system shall utilize a memory back-up device that is system integrated, maintenance free and not require batteries for retention of memory.
9. Modem for Remote Access – The System Controller shall be provided with a modem for remote access to program and trouble shoot the system. Owner shall be responsible for providing a modem compatible analog telephone line to the modem through a dedicated telephone line or a shared fax line. If a shared fax line is used, the owner shall supply a device to automatically direct incoming calls on the fax line to the modem while the fax is not in use.
 - a.) Off-line programming - It shall be possible to program the system off-line via personal computer or laptop located at a remote site.
 - b.) On-line monitoring and control - It shall be possible to monitor and override the status of the system in real time via personal computer located at a remote site. This shall include the current status of individual loads, input status, event log, relay run time/start counters, and graphic screen operation as a minimum.
 - c.) System programming via email – Provide the capability for emailing as an attachment the owner's system programming database to factory support such that the factory personnel can open the programming database to modify the programming and operating problems and email the corrected database back to the owner for upload into "System" via Configuration Software listed in this section.
 - d.) Factory support - Provide free remote dial-in factory support capability for the life of the system such that factory personnel can assist the owner with the diagnosis and resolution or programming and operation problems. It shall be possible for the factory to read the software version currently installed at the site and download an updated version to the site if required without interruption of the user program.

F. Telephone Override

1. Hardware – The telephone interface shall be a plug-in assembly and shall install completely within the system controller module. Modem speed shall be rated at a minimum of 33.6K baud.
2. Connection – The user shall provide one modem compatible analog phone line connection to each controller equipped with telephone interface.
3. Telephone override - It shall be possible to override the status of output loads ON, OFF, or level 1-99% using any touch-tone telephone set. The system shall answer incoming calls with a human voice prompt and guide the user through operation. The system shall support the use of up to 9999 unique control zone codes.

G. [omit] DMX512 Control Input

1. Hardware – The DMX interface card shall mount completely within the system controller module. Wire connection method shall be via removable terminal block assembly intended for permanent installation.
2. Channels - The DMX512 interface shall allow 48 of the 512 possible DMX control channels to be monitored from an external DMX controller. If more than 48 channels are needed, then a second DMX interface can be added for an additional 48 channels. The Synergy system controller will not broadcast DMX control commands. If DMX command broadcasting is required the accessory SYSC BACGATE DMX device shall be required. The beginning DMX channel number shall be individually set-able for each DMX interface.
3. Take Control - Loads associated with DMX control channels shall automatically assume exclusive DMX control upon initiation of a live signal from the theatrical device. Control shall automatically relinquish to the architectural controls when the theatrical control device is switched off or the DMX control stream is otherwise interrupted.

H. Network

1. Communication - System controllers shall be capable of panel-to-panel communications over a high-speed 156Kbps, hard-wired data network or Ethernet LAN.
2. Wire - Network wire shall be twisted and shielded pair, installed in a daisy chain configuration, and rated for EIA-485 data communication. Network wire type and installation shall be per the lighting control system manufacturer's requirements without exception. For Ethernet LAN applications wire shall be Cat 5 cable.
3. Protocol - . Network protocol shall be BACnet® over ARCNET® (ANSI 878.1) token passing or BACnet IP. Systems utilizing proprietary networking schemes shall not be acceptable

I. Networked Preset Dimming Control Stations

1. Capacity – Preset control stations shall provide 6 presets, master raise/lower, individual raise/lower, and OFF control for 4, 8, 12, or 16 control channels as indicated from the front of the control station.
2. Finish - Faceplates shall attach to mounting frame without visible screws and, when in place, shall provide a clean architectural appearance. Full-length piano hinge shall allow faceplate to fold down flat against wall when open. Faceplate finish shall be brushed stainless steel or as otherwise directed by the architect.
3. Presets – Control stations shall be capable of storing and recalling a total of 16 presets, each with fade time set-able as 5, 10, 15, 30, 45 seconds or 1, 5, 10, 30, 60 minutes..
4. Level Indication - Each channel shall have an associated 10 segment LED bar graph which shall indicate the intensity of the lighting.
5. Master - Master raise/lower function shall adjust intensity of all control channels simultaneously. Channels set as non-dim shall be excluded from master raise/lower operation.
6. Exclusion from Presets – It shall be possible to individually exclude channels from saved presets.
7. Tamper Proofing – Provide a hidden switch on each control station to disable the preset save function to prevent unauthorized or accidental overwriting of scenes.

J. Networked Switch Control Stations

1. Finish – Faceplates shall attach to the mounting frame without visible screws and, when in place, shall provide a clean architectural appearance. Faceplate finish shall be brushed stainless steel or as otherwise directed by the architect.
2. Buttons – Stations shall support up nine programmable buttons per station with associated status LED indicators. Each button shall be individually programmable for function and load controlled. Stations shall support the following button function types:
 - a.) ON
 - b.) OFF
 - c.) Raise
 - d.) Lower
 - e.) Maintained contact ON/OFF
 - f.) Alternate action ON/OFF
 - g.) Preset recall
 - h.) Room assignment partition control
3. IR Remote Receiver – Provide network switch control stations with an infrared receiver for wireless remote control. The function of each IR receiver shall be programmable and provide the following functions as a minimum:
 - a.) Preset recall
 - b.) Preset raise/lower
 - c.) Channel raise/lower
 - d.) ON/OFF
 - e.) Saving of presets with fade times
4. External Input/Output – Where indicated, provide network switch control stations with remote input and output capability for localized control functions. Local input and output control functions shall be network visible to the System Controller and to other BACnet building systems. Provide the following input and output capabilities:
 - a.) Switched Input - contact closure from an occupancy sensor or other device.
 - b.) Analog Input - 0- 10 VDC variable input from a photocell or other device.
 - c.) Two (2) Switched Outputs – 24V active high outputs that can switch the lighting load through a SensorSwitch power pack.
 - d.) Two (2) Analog Outputs – 0- 10 VDC control signal outputs for control of dimmable fluorescent or LED lighting equipped with four wire dimming ballast. Where localized fluorescent/LED dimming is associated with photocell input for daylighting applications, provide circuitry within the station to automatically adjust the dimmed light level based the amount of ambient light present. Raise/lower buttons on the station shall provide manual dimming override and establishment of the user set point for the daylight dimming function. The user set point shall also be adjustable via network command.

K. Networked Touch Screen Control Station

1. 3.5" color screen with configurable color schemes
2. Resistive touch screen interface is compatible with gloves and prosthetic limbs.
3. Capacity – Provides up to 16 Presets and 32 channels, with number of presets and channels configurable via the SYSW CONFIG software or SYSC MLS / MLX controller.
4. Finish – No visible screws. Provides a clean architectural appearance.
5. Presets – Capable of storing and recalling a maximum of 16 presets, each with fade time set-able as 0, 5, 10, 15, 30 and 45 seconds, or 1, 5, 10, 30 and 60 minutes.
6. Preset lighting levels can be modified and saved from the SYGS station.
7. Adjustable channel intensity using raise/lower buttons.
8. Level Indication - Each channel provides an associated bar graph which indicates the intensity of the lighting in 1% increments.
9. Master - Master raise/lower function adjusts intensity of all dimmed control channels simultaneously.
10. User defined alphanumeric labels for all channel and preset buttons. Labels may be edited in the SYSW CONFIG software or on the SYGS station.
11. Password protection options for multiple levels of access.
12. Customizable 'logo screen' provides ability for customers to display their own logo or other picture on the station screen when not in use.

- L. Control Station LAN Network – Control stations shall be connected to the system via a four wire digital communication bus network wire. The system shall support one control station LAN for each system controller. Each control station LAN shall support a maximum of sixty stations.

2.3 FIRMWARE FEATURES

- A. Open Protocol Networking - To insure interoperability with other building systems, the lighting control panels shall communicate using the BACnet® (ASHRAE 135- 1995) communication standard. As a minimum, all relays, dimmers, switches, groups and analog inputs shall be represented as standard BACnet objects and shall support read/write services. Systems requiring a gateway device for BACnet communications shall provide at least one BACnet gateway point for each lighting control relay, dimmer, switch input and analog input on the project. It shall be the sole responsibility of the lighting control system supplier to map all proprietary lighting control points through the gateway and supply complete written documentation cross referencing the lighting zones to the BACnet points. This documentation shall clearly indicate which BACnet properties and services are provided by the gateway and which properties and services are actually supported by the proprietary lighting control devices to which the gateway is connected. All lighting control devices conforming to the BACnet protocol shall have a Protocol Implementation Conformance Statement (PICS) that identifies all of the portions of BACnet that are implemented.
- B. Groups - It shall be possible to associate output relays and dimmers into logical control zone groups. Groups shall be assign-able to schedule events, switch inputs, analog inputs, control station channel, presets, DMX output, or telephone override. It shall not be necessary to program functions or schedules individually for each output. Groups shall be network visible to other building systems as standard BACnet objects.
- C. Astronomic Clock - The system clock shall of the astronomical type and be capable of calculating the correct time for sunrise and sunset at the installed location. It shall be possible to set control functions to occur at or up to 99 minutes before or after sunrise or sunset.
- D. Daylight Savings Time - The system shall automatically adjust for daylight savings time. It shall be possible to disable this function.
- E. Schedules - The system shall support up to 99 unique lighting control schedules. The quantity of time schedule events contained in the schedules shall be limited only by the available system memory and shall be dynamically allocated to the schedules such as to not limit the capacity of any single schedule.
- F. Schedule Assignment - Unique schedules may be assigned to each day of the week facilitating a rotating Monday through Sunday weekly operating scenario. A unique holiday schedule shall automatically supercede assigned weekday schedules based on a list of holiday dates. Additionally, schedules may be assigned to specific calendar dates. A schedule assigned to a calendar date shall have priority over a schedule assigned to a Monday through Sunday upon which the calendar date occurs such that only one schedule runs on any given day.
- G. Overrides - It shall be possible to override schedule operation and force outputs to an ON or OFF state. Overrides shall be initiated from a variety of system sources including switch inputs, analog inputs, telephone interface, modem, or network. Four types of override shall be available:
 - 1. Priority Normal - Under normal conditions, a group can be overridden ON or OFF by any available input source programmed to control the group. The group will remain in the overridden condition until changed by a schedule event or by another override source.
 - 2. Priority ON - The priority ON override shall force the group ON and not allow further control until the priority ON override is released by the source. In the event of overlap, priority On shall take precedence over priority OFF.
 - 3. Priority OFF – The priority Off override shall force the group OFF and not allow further control until the priority Off override is released by the source.
 - 4. Priority Low – The priority low condition shall allow layering of control strategies to optimize operation. Switches or other inputs set to low priority shall be subservient to normal priority overrides or schedules.
- H. Inter-Panel Control - Each system controller input and output shall include provision to annunciate actuation over the network making events available for use by all controllers connected to the network. This function shall be set-able via the UIP on the system controller and not require the use of a personal computer for inter-panel operation over the network.

- I. Flash to Find - It shall be possible to set any output to continuously flash on and off to facilitate easy location of undocumented loads. The flash to find function shall automatically cancel after two minutes.
- J. Status - Each system controller shall be capable of displaying the current real time status of all inputs and outputs associated with the controller.
 - 1. Input Status – The current state of each input shall be displayed as ON or OFF for switch inputs or as a value for analog inputs.
 - 2. Output Status – The current state of each output shall be displayed as ON or OFF for relay outputs or as a percentage value for dimmed outputs.
 - 3. Network Status – The network status display shall indicate that the system controller is actively communicating on the local input/output bus and the network by displaying network message traffic expressed as a percentage of capacity. This display shall also indicate the currently available system RAM and flash disk memory.
- K. Logging - The system controller shall automatically retain a record of system control events and run times and shall make this information available to the user via the UIP on the system controller.
 - 1. Event Log - The system shall automatically log in memory key actions performed by the system controller. Each log entry shall be time and date stamped. It shall be possible to view or print the event log via the UIP or PC software. A minimum of 2000 system events shall be saved before the system begins to overwrite the oldest data. Logged actions shall include but not be limited to:
 - a.) Power up
 - b.) Power down
 - c.) Input change of state
 - d.) Output change of state
 - e.) Manual override
 - f.) Network event
 - g.) New script
 - h.) Alarms
 - 2. Relay Run Time - A cumulative “ON” time record shall be accumulated for each output. It shall be possible to view and reset the run-time for each output via the UIP or PC software.
 - 3. Relay Starts - A counter shall track the quantity of starts for each output. It shall be possible to view or reset the number of starts for each output from the UIP or PC software.
- L. Script File - All system parameters and user programming shall be stored within the system controller in the form of an editable text file. It shall be possible to upload and download the file between the system controller and a personal computer.
- M. Script Logic - The system controller logic shall support the creation of customized logical control scenarios. Scenarios shall be created off line using the optional Windows® based configuration software package. As a minimum, the system shall understand and process “basic” IF, AND, OR, THEN, ELSE, = (equal), < (less than), and > (greater than) logical statements. Commands and operations to be tested and/or acted upon shall include as a minimum: DAY, DATE, TIME, INPUT, OUTPUT, TIMER, INC COUNTER # (increment counter #), DEC COUNTER (decrement counter #), and RESET COUNTER.
- N. Room Partition Control – It shall be possible to configure the system to accommodate areas where movable partitions are used to sub-divide a large room into several smaller rooms. The system shall provide for a dimensional array of possible room combination scenarios making possible the re-mapping of the channel to preset relationships in situations where the architectural relationship of the lighting changes with the reconfiguration of the room. It shall be possible to provide a unique set of presets for each possible room combine scenario. Systems that simply overlap the channels of combined rooms in a one to one relationship are not acceptable.

2.4 CONFIGURATION SOFTWARE

- A. Provide PC software for off-line programming and editing of lighting control panel script files. The application shall run on any personal computer using the Windows XP/Vista/Windows 7 32bit operating system and shall support the BACnet file transfer services allowing co-installation and network operation with other BACnet building automation workstations.

- B. It shall be possible to upload, edit, and download user program and log data through a direct connection to the lighting control system network or remotely through the use of a telephone modem.
- C. The configuration software shall have the ability to "learn" the hardware components that are present in the system and automatically configure a script file using default values which may then be edited by the user.
- D. The system shall support the simultaneous use of multiple personal computers.
- E. The application shall be BACnet compliant and designed to co-reside on a PC workstation running other BACnet building control applications.
- F. The configuration software shall utilize a local database to store all system parameters. The programming database shall be capable of being Emailed to the lighting control manufacturer for review, editing and technical support, then Emailed back to the customer for upload into the lighting control system.

PART 3. EXECUTION

3.01 EQUIPMENT INSTALLATION AND DOCUMENTATION

- A. Installation - The control system shall be installed and connected as shown on the plans and as directed by the manufacturer. The contractor shall complete all electrical connections to all control circuits, network terminations, RS-232 connections, sensors and override wiring.
- B. Documentation - The contractor shall provide accurate "as built" drawings to the owner indicating the correct and latest program in each controller. The "as-built drawings" shall clearly indicate the lighting control panel identification, the load controlled by each relay, and the device connected to each input.
- C. Operation and Service Manuals – Provide operation and service manuals for all system components as indicated in the General Provisions.

3.02 PRODUCT SUPPORT AND SERVICE

- A. System Start-up
Provide a factory authorized technician to verify the installation, test the system, and train the owner on proper operation and maintenance of the system. Before requesting start-up services, the installing contractor shall verify that:
 - 1. The control system has been fully installed in accordance with manufacturer's installation instructions.
 - 2. Phone lines have been checked for dial tone.
 - 3. Low voltage wiring for overrides and sensors is completed.
 - 4. Accurate "as-built" load schedules have been prepared for each lighting control panel.
 - 5. Proper notification of the impending start-up has been provided to the owner's representative.A Start-up Request form must be completed by the contractor and submitted to the Lighting Control Manufacturer prior to scheduling a Start-up.
- B. Factory Support
Factory telephone support shall be available at no cost to the owner for the life of the system. Factory assistance shall consist of assistance in solving programming or other application issues pertaining to the control equipment. The factory shall provide a toll-free number for technical support.

3.03 WARRANTY

Manufacturer shall provide a three (3) limited warranty on the lighting control system and software.

END

SECTION 16521 - EXTERIOR LIGHTING

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. Exterior luminaires with lamps and ballasts, but not mounted on exterior surfaces of buildings.
 - 2. Luminaire-mounted photoelectric switches.
- B. Related Sections include the following:
 - 1. Division 2 Section "Lighting Poles and Standards" for poles and other support structures and for requirements of resistance to wind **and ice** loads.
 - 2. Division 16 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 SUBMITTALS

- A. Product Data: For each luminaire, arranged in the order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of fixture, including dimensions and verification of indicated parameters.
 - 2. Luminaire dimensions, effective projected area, details of attaching luminaires, accessories, and installation and construction details.
 - 3. Luminaire materials.
 - 4. Photoelectric relays.
 - 5. Fluorescent and high-intensity-discharge ballasts.
 - 6. Fluorescent and high-intensity-discharge lamps.
 - 7. Electrical and energy-efficiency data for ballasts.
- B. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.
- C. Wiring Diagrams: Power, signal, and control wiring.
- D. Coordination Drawings: Mounting and connection details, drawn to scale, for exterior luminaires with requirements specified in Division 2 Section "Lighting Poles and Standards."

- E. Samples for Verification: For exterior luminaires designated for sample submission in the Exterior Luminaire Schedule.
 - 1. Lamps: Specified units installed.
 - 2. Ballast: 120-V models of specified ballast types.
 - 3. Finishes: For each finished metal used in support components.
- F. Source quality-control test reports.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For luminaires to include in maintenance manuals.
- I. Warranties: Special warranties specified in this Section.

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. FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.
- C. Comply with IEEE C2, "National Electrical Safety Code."
- D. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate exterior luminaires with mounting and wind load requirements in Division 2 Section "Lighting Poles and Standards."

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace luminaires or components of luminaires and lamps that fail in materials or workmanship; corrode; or fade, stain, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
 - 1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
 - a. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
 - b. Warranty Period for Color Retention: Five years from date of Substantial Completion.

2. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.

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. Glass and Plastic Lenses, Covers, and Other Optical Parts: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 3. Ballasts: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 4. Globes and Guards: 10 for every 20 of each type and rating installed. Furnish at least one of each type.

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. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 LUMINAIRES, GENERAL

- A. Complying with UL 1598 and listed for installation in wet locations.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. 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. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. 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.
- J. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

2.3 EXTERIOR LUMINAIRES

A. Luminaire E101.00, E401.00

- 1. Products:
 - a. Hydrel
 - b. Lithonia
 - c. Winline
- 2. Nominal Luminaire Dimensions:
- 3. Lamps:
- 4. Ballast Types and Features: Electronic
- 5. Lens:
- 6. Reflector:
- 7. Focusing and Aiming Provisions: <
- 8. IESNA Lateral Distribution Class:
- 9. IESNA Cutoff Category:
- 10. Nominal Beam Spread for Floodlights:
- 11. Photometric Performance of Installed Units:
 - a. Spot Intensity: Minimum initial horizontal illumination at grade is <Insert fc (lx)> at a point <Insert location of test point>.
 - b. Average Intensity: Minimum average initial horizontal illumination at grade in the illuminated area is <Insert fc (lx)>.
 - c. Uniformity: For a spacing between adjacent fixtures in parallel rows of <Insert fc (lx)>, fixture to fixture and row to row, the maximum-to-minimum initial horizontal point illumination between any pair of adjacent lighting units, including those in parallel rows, is not greater than <Insert ratio>.

d. ~~Cutoff: Maximum initial horizontal illumination does not exceed <Insert fc (lx)> at a point <Insert location of test point>.~~

12. Minimum ballast factor, calculated as the ratio of lamp lumen output on a particular ballast as compared to that lamp's lumen output on a reference ballast under NEMA test conditions, is <Insert value>.

13. Minimum luminaire efficacy rating, calculated according to NEMA LE 5, NEMA LE 5A, or NEMA LE 5B, is: <Insert value>.

2.4 PHOTOELECTRIC RELAYS

- A. UL 773 or UL 773A listed, factory mounted to the luminaire.
- B. Contact Relays: Single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay.[Contacts shall have directional lens in front of photocell to prevent fixed light sources to cause turnoff.]
 - 1. Relay with locking-type receptacle shall comply with NEMA C136.10.
 - 2. Adjustable window slide for adjusting on-off set points.

2.5 FLUORESCENT LAMP BALLASTS

- A. Ballasts shall be suitable for low-temperature environments.
 - 1. Temperatures 0 Deg F and Higher: Electronic or electromagnetic type rated for 0 deg F (minus 17 deg C) starting temperature.
 - 2. Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic type designed for use with high-output lamps.
 - 3. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
- B. Ballasts for compact lamps shall be suitable for cold-weather starting and shall include the following:
 - 1. Power Factor: 90 percent, minimum.
 - 2. Ballast-Coil Temperature: 65 deg C, maximum.
 - 3. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.

2.6 HIGH-INTENSITY-DISCHARGE LAMP BALLASTS

- A. General: Comply with NEMA C82.4 and UL 1029. Shall include the following features, unless otherwise indicated:
 - 1. Type: Constant-wattage autotransformer or regulating high-power-factor type.
 - 2. Minimum Starting Temperature: for single-lamp ballasts.
 - 3. Normal Ambient Operating Temperature: 104 deg F .
 - 4. Open-circuit operation will not reduce average life.
 - 5. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

- B. Auxiliary, Instant-On, Quartz System: Automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. Automatically turns quartz lamp off when high-intensity-discharge lamp reaches approximately 60 percent light output.
- C. High-Pressure-Sodium Ballasts: Solid-state igniter/starter with an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.
 - 1. Instant Restrike Device: Solid-state potted module, mounted inside high-pressure-sodium fixture and compatible with high-pressure-sodium lamps, ballasts, and sockets up to 150 W.
 - a. Restrike Range: 105- to 130-V ac.
 - b. Maximum Voltage: 250-V peak or 150-V ac RMS.
 - 2. Single-Lamp Ballasts: Minimum starting temperature of minus 40 deg C.
 - 3. Open-circuit operation will not reduce average life.

2.7 FLUORESCENT LAMPS (omit)

- A. Compact Fluorescent Lamps: CRI 80 (minimum), color temperature, averaged rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.
 - 1. T4, Double-Twin Tube: Rated 18 W, 1200 initial lumens (minimum).
 - 2. T4, Double-Twin Tube: Rated 26 W, 1800 initial lumens (minimum).

2.8 HIGH-INTENSITY-DISCHARGE LAMPS(omit)

- A. High-Pressure-Sodium Lamps: NEMA C78.42, wattage and burning position as scheduled, CRI 21 (minimum), color temperature [1900] <Insert value>, and average rated life of 24,000 hours.
- B. Low-Pressure-Sodium Lamps: NEMA C78.41.
- C. Metal-Halide Lamps: ANSI C78.1372, wattage and burning position as scheduled, CRI 65 (minimum), and color temperature [4000] <Insert value>.

2.9 FACTORY FINISHES

- A. Field Painting Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match process and color of pole or support materials specified in Division 2 Section "Lighting Poles and Standards."
- C. Factory-Painted Finish for Steel luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Interior Surfaces: Apply one coat of bituminous paint on interior of pole, or otherwise treat to prevent corrosion.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.
 - b. Color: Match Architect's sample of Existing color.
 - c. Color: As selected by Architect from manufacturer's full range.

D. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: -Medium bronze.
5. Gold Anodic Finish: AA-M32C22A43 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, impregnated color coating 0.018 mm or thicker) complying with AAMA 611.

2.10 SOURCE QUALITY CONTROL

- A. Provide services of a qualified, independent testing and inspecting agency to factory test luminaires with ballasts and lamps; certify results for isofootcandle curves, zonal lumen, average and minimum ratios, and electrical and energy-efficiency data for ballasts.
- B. Factory test fixtures with ballasts and lamps; certify results for isofootcandle curves, zonal lumen, average and minimum ratios, and electrical and energy-efficiency data for ballasts.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lamps in each fixture.
- B. Luminaire Attachment: Fasten to indicated structural supports.
- C. Adjust luminaires that require field adjustment or aiming.

3.2 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.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
 - 1. IESNA LM-5.
 - 2. IESNA LM-50.
 - 3. IESNA LM-52.
 - 4. IESNA LM-64.
 - 5. IESNA LM-72.
- C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 16521