

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 13 POOL GENERAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Project administrative requirements that relate to Division 13 11 Pools.

1.2 RELATED DOCUMENTS

- A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.
- B. The following contain requirements that relate in Division 13 11:
 - 1. Mechanical/Electrical/Equipment Coordination: General Conditions, Supplementary General Conditions and Division 01 General Requirements
 - 2. Earth Work and Pool Excavation: Division 31
 - 3. Concrete Deck Work: Division 03
 - 4. Mechanical: Plumbing Systems - Division 22, HVAC Systems and Equipment - Division 23
 - 5. Electrical: Division 26
- C. Applicable requirements of the following Codes and Standards apply to Work in Division 13 11:
 - 1. Association of Pool and Spa Professionals (APSP)
 - a. Minimum Standard for Public Swimming Pools
 - 2. National Electrical Code (NEC)
 - 3. National Sanitation Foundation (NSF): Seal of Approval Program
 - 4. American Society for Testing and Materials (ASTM): Specifications referenced herein.
 - 5. Governmental Health and Building Codes
 - 6. ADA Accessibility Guidelines for Buildings and Facilities
 - 7. American National Standards Institute

1.3 REFERENCES

- A. Refer to individual Division 13 11 sections.

1.4 DESCRIPTION OF WORK

- A. Work of Division 13 11 includes, but is not limited to, the following:
 - 1. Layout of all pool(s) and pool related work required under Division 13 11.
 - 2. Project benchmarks and control points.
 - 3. Excavation and stone fill as required for pool tank structure and pipe trenching. Refer to Division 01 and 31 for special conditions.
 - 4. Pool vessels, as detailed on Contract Drawings and Shop Drawings.
 - 5. Pool mechanical systems, including piping, recirculation system, filtration system, activity mechanical systems and water chemical treatment system.
 - 6. Heating system for swimming pool. Coordinate venting and interlocking for pool heater(s) with HVAC Contractor.
 - 7. Waterslide and water activity mechanical systems including all piping.
 - 8. Pool subsurface water monitoring system – includes perforated piping (with silt sleeve) under pool floor slab and riser pipe to deck elevation.
 - 9. Interior pool finishes.
 - 10. Pool deck equipment and accessory equipment shown and/or specified, including required anchors embedded within the pool deck and coordination with Deck Contractor.
 - 11. Coordination of all electrical interlocks for pool and pool related equipment.
 - 12. Miscellaneous pool testing, safety and control equipment.
 - 13. Low voltage wiring for pool and pool related equipment is installed and connected by the Swimming Pool Contractor unless required otherwise by code. Where code requires that low voltage wiring is installed by a licensed electrical contractor, low voltage wiring is specified in Electrical Documents.
- B. Definitions

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1. The term "pool" as used in Division 13 11 shall refer to the following:
 - a. Pool A - Multi-purpose pool: Combination zero-depth entry/leisure, volleyball, Aqua Zip'N, and climbing wall.
 - b. Pool B - Spa pool
 2. The term "concrete" as used in Division 13 11 refers to concrete for swimming pool construction only.
 3. The term "Architect/Engineer" as used in Division 13 11 refers to the swimming pool designer only.
 4. The term "Contractor" as used in Division 13 11 refers to the swimming pool contractor only.
 5. The term "Low Voltage Wiring" as used in Division 13 11 includes wiring $\leq 24V$. All Low Voltage Wiring is Provided with the Equipment. Low voltage wiring is shown in Low Voltage Wiring Diagram included in the pool drawings except where specified by Electrical Consultant.
 6. The term "Control Wiring" as used in Division 13 11 refers to connections from individual equipment components to the Building Management System (BMS).
 - C. Applicable Code Permit and Inspection Responsibilities.
 1. State and/or County Health Department permit fees by Owner.
 2. Local Departments of Health inspection fees by Contractor.
 3. Other permits/fees required paid by Contractor.
 4. Scheduling of Required Inspections – Contractor
 5. Documentation and Submission of accepted modifications to approved plans to Permit Authorities – Contractor.
 - D. Related Work Not in Division 13 11 Specified Elsewhere
 1. Pool deck construction, including finishes, sealants, and drains.
 2. Potable water or fresh water: Fresh water connection to auto fill and wastewater connections (see Contract Drawings).
 3. Pool electrical work: Electrical connections shall be by the General Construction Contract Electrical Sub-Contractor. The Pool Contractor shall provide the filter pumps, motors, solenoids, relays, water level probes (with housing), motorized valves, etc., as shown on Contract Drawings and required by pool systems equipment manufacturer. The Electrical Contractor shall install, and wire electrical equipment furnished by the Pool Contractor and shall provide motor starters and disconnect switches as indicated or required by Codes. The Electrical Contractor shall provide grounding and bonding per NEC Article 680.
 4. Control Wiring for all electrical and HVAC equipment shall be by the control system sub-contractor.
 5. Heating system for pools, heater by the Pool Contractor; venting and controls by Division 23.
 6. Surge Tank Ventilation System
 - a. All surge tank equipment shall be purchased and installed by the Pool Contractor.
 - b. All surge tank ventilation and plumbing shall be purchased and installed by the Mechanical Contractor.
 - c. All plumbing shall be Schedule 40 PVC.
 - d. Exhaust fan shall be of non-corrosive materials, Plastec 20 model PLA 20, or equal.
 - e. Pool Contractor to coordinate surge tank penetrations with Mechanical Contractor.
 - f. The Electrical Contractor shall provide all wiring, bonding, and grounding per NEC Article 680.
- 1.5 QUALITY ASSURANCE
- A. Qualifications of Pool Contractor:

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1. Work of Division 13 11 shall be performed by a Pool Contractor who has a minimum of five (5) projects with a proven five (5) year record of competence and experience in the construction of similar facilities of this size and complexity.
 2. Pool Contractor prequalification is required prior to bid. This must be received by the Architect fourteen (14) days prior to the bid date on the appropriate AIA form. (AIA A305)
 3. Pool Contractor shall meet all Local and State Certifications and License requirements prior to bidding. Copies of the required Certificates and Licenses shall be made available upon request.
- B. Performance Criteria: Certain sections of Division 13 11 contain performance criteria rather than product descriptions. It shall be the obligation of the Pool Contractor to ensure that all criteria are satisfied and the burden of proof of conformance shall rest with the Pool Contractor. The Architect/Engineer shall require complete calculations, past performance records and, if required, inspection trips of similar facilities to substantiate conformance with these criteria. The Architect/Engineer shall be sole judge of conformance, and the Pool Contractor is cautioned that he will be required to provide a finished product meeting all stated criteria and meeting or exceeding Department of Public Health requirements.
- C. All work of Division 13 11 shall be performed by the qualified Pool Contractor or a Subcontractor to the qualified Pool Contractor unless otherwise pre-approved in writing by the Architect/Engineer. A representative of the Pool Contractor shall oversee work subcontracted by the Pool Contractor.
- D. The following shall be performed during construction of the project.
1. Refer to General Conditions, Division 01, and other Division 13 11 sections for further requirements.

1.6 SUBMITTALS

- A. Submittals Required
1. Refer to General Conditions, Division 01, and individual Division 13 11 sections for number required.
 2. The Contractor shall submit for approval to the Architect/Engineer complete lists, including descriptions, catalogs, product cut sheets, etc., and where applicable dimensioned shop drawings of all material, fixtures, and equipment to be furnished and installed as part of Division 13 11.
 3. Submittals shall adequately and completely describe the equipment, including where necessary or requested complete construction and installation dimensions, complete capacity and performance data, all accessories and auxiliary equipment and all pertinent details of manufacture.
 - a. Submittals shall be provided in Adobe PDF electronic file format via email file size (10 MB max.). Create PDFs at native size and right-side up; illegible, partial, unlabeled, or unorganized submittal sections will be returned rejected. Contractor shall make their own copies from the original returned by the Architect.
- B. Product Data: Provide manufacturer's/installer's written installation instructions.
- C. Shop Drawings
1. The drawings accompanying this Specification are diagrammatic in nature and show the general arrangement of all equipment, piping, ductwork, services, etc. Because of the small scale of the drawings, it is not possible to show all offsets, fittings and accessories that may be required. The Contractor shall carefully investigate the structural and finish conditions of his work and shall arrange such work; accordingly, furnishing all fittings, pipe and accessories that may be required to meet such conditions. Where conditions necessitate a rearrangement, the Contractor shall obtain the Architect/Engineer's approval.
 2. Shop drawings for equipment shall be submitted, and Engineer's review of shop drawing shall be obtained before proceeding with fabrication. Shop drawings shall not be "doctored" reproductions of Architect/Engineer's drawings.

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- D. Samples: Submit samples of materials, finishes, and trim as requested by the Architect/Engineer.
- E. Schedule of Values
 - 1. Provide Architect/Engineer with a copy of the Schedule of Values developed for this project relevant to Division 13 11 for approval.
- F. Valve Charts: Submit two (2) copies of valve charts for each piping system, consisting of Isometric Drawings or piping layouts showing and identifying each valve and describing its function to the Architect/Engineer for approval.
 - 1. Upon completion of the Work, one (1) copy of each chart sealed to rigid backboard with clear lacquer placed under glass and framed, shall be hung in a conspicuous location in the equipment room.
- G. Furnish to the Architect/Engineer the following:
 - 1. Refer to individual Division 13 11 sections for additional requirements.
 - 2. Submittals
 - a. Shotcrete Nozzle Man Qualifications and Certifications
 - b. Pool Finish Experience/Qualification Requirements
 - c. Concrete Mix Design
 - d. Non-shrink Grouts
 - e. PVC and Pre-formed Plastic Adhesive Waterstop
 - f. Expansion/Construction Joint Materials
 - g. Caulking/Sealants
 - h. Pumps and Strainers
 - i. Heater(s)
 - j. Chemical Controller(s)
 - k. Chemical Feeders
 - l. Bulk Chemical Storage Tanks
 - m. Valves
 - n. Gauges
 - o. Flow Meters
 - p. Thermometers
 - q. Pool Water Test Kit
 - r. Inlets
 - s. Grating
 - t. Pre-fabricated Submerged Outlets
 - u. Under Water Pool Lighting
 - v. Deck Equipment
 - w. Safety Equipment
 - x. Maintenance Equipment
 - y. Piping Materials (pipe, fittings, solvents, cements)
 - z. Wall Sleeves and Seals for Piping
 - aa. Tile Setting Materials and Joint Fillers
 - 3. Shop Drawings
 - a. Reinforcing Steel
 - b. Water Activities
 - c. Filters
 - d. Stainless Steel Gutter
 - e. Precast Pool Coping Stone
 - f. UV Disinfection System
 - g. Concrete Pump Pit & Surge Tank Penetration Drawings
 - 4. Test Results
 - a. Water Treatment Analysis
 - b. Compaction
 - c. Piping Pressure Testing
 - 5. Samples

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- a. Special Aggregate – Factory and Field Applied
- b. Tile
- c. Gratings
- 6. Guarantees/Warranties
 - a. Standard 1-Year
 - b. Standard 5-Year on Quartz Aggregate Finish
 - c. Standard 2-Year on Pool Finish Application
 - d. Special Equipment – Standard Manufacturer's Warranty
 - e. Future 3-Days of Instruction and Operational Checkout
- 7. Close Out Documents
 - a. & M Manuals
 - b. Record Drawings
 - c. Owner's Certification of Instruction
 - d. Extra Materials

1.7 SUBSTITUTIONS

- A. Refer to General Requirements and Division 01.
- B. Along with the Shop Drawings, the Contractor shall submit, in duplicate, a certificate properly attested, stating the material, equipment, and construction comply with the requirements of the Contract Documents, for all equipment and materials proposed as a Substitute for the specified equipment and materials.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Refer to General Requirements and Division 01 of the Specifications for additional requirements.
- B. Deliver all materials and equipment to the work site in original packages, fully identified with manufacturer's label. Store off ground and protect from weather with a suitable covering.
- C. Protect plastic pipe from exposure to chemicals (aromatic hydrocarbons, halogenated hydrocarbons and other esters and ketones) that might attack the material. Protect all pipes from mechanical damage and long exposure to sunlight during storage.

1.9 WARRANTIES

- A. Warranty: Provide one (1) year warranty covering all pool workmanship, materials, and equipment. Refer to General Requirements and Division 01 of the Specifications for additional requirements.
- B. All standard manufacturer's warranties shall apply to all equipment and products provided by this Contractor.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 EQUIPMENT BASES AND SUPPORTS

- A. Provide for major equipment, reinforced concrete housekeeping bases poured directly on structural floor slabs (or as required by equipment manufacturer) 4 inches thick minimum; unless noted otherwise on plans, extended 4 inches beyond machinery bedplates. Provide templates, anchor bolts, vibration isolators, and accessories required for mounting and anchoring equipment. Anchorage system shall be in accordance with the equipment manufacturer's specifications and local code requirements. Consult with equipment manufacturer for length and installation of anchor bolts.

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3.2 CLEAN UP AND PROTECTION

- A. After work of Division 13 11 has been completed, cleanup work areas and remove all equipment, excess materials, and debris. Protect pool from damage until substantial completion. Remove and replace equipment and finishes that are chipped, cracked, abraded, improperly adhered, or otherwise damaged.
- B. At turnover to Owner, Contractor shall be responsible for, but not limited to, the following:
 - 1. Vacuuming and cleaning all pool floors, steps, and walls.
 - 2. Cleaning all depth marker tiles, pool tile and gutter grating.
 - 3. Cleaning and waxing of all pool deck equipment, water features and stainless-steel products per Manufacturer's instructions.
 - 4. See also Division 01 Specification requirements.

END OF SECTION 13 11 13

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SECTION 13 11 14 POOL START-UP, MAINTENANCE & OPERATIONS TRAINING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pool start-up and chemical balancing of water.
- B. Training of the Owner's personnel in pool operations procedures.

1.2 RELATED DOCUMENTS

- A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.3 DESCRIPTION OF WORK

- A. Water treatment and balancing.
- B. Operations and maintenance instruction and manuals.

1.4 SUBMITTALS

- A. Operations and Maintenance (O&M) Manual
 - 1. Pool Contractor shall deliver to the Architect/Engineer water sample location, analysis test results, SI calculation, and chemical adjustment calculations per Part 3.03.
 - 2. Pool Contractor shall deliver to the Architect/Engineer, bound together in a three-ring binder a complete manual, four (4) complete sets of operating and maintenance instructions for the swimming pool structure(s), finishes, and all component equipment. O&M Manual shall include, but is not limited to, the following:
 - a. Table of contents.
 - b. All equipment cut sheets.
 - c. Accurate parts lists.
 - d. Pool start-up, emptying, and winterization instructions.
 - e. Pool equipment commissioning certifications.
 - f. Pool and equipment operation and maintenance training certifications.
 - g. Pool cleaning instructions.
 - h. Pool maintenance requirements, divided into the following:
 - 1) Daily
 - 2) Weekly
 - 3) Monthly
 - 4) Seasonally
 - 5) Annually
 - i. Narrative on the pool operation through all sequences.
 - j. A DVD of complete start-up and shut-down procedures and training session.
 - k. Trouble shooting information and procedures.
 - l. A schematic of piping as installed.
 - m. Valve charts for each piping system, consisting of isometric drawings or piping layouts showing and identifying each valve and describing its function.
 - n. Copy of Measurement Certification of Permanent Racing Course
 - o. Record Drawings
 - p. Warranties

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PART 2 - MATERIALS

2.1 NOT USED

PART 3 - EXECUTION

3.1 EQUIPMENT START-UP & COMMISSIONING

- A. Provide pool equipment start-up and commissioning services. See individual pool equipment specification sections and provide services in accordance with all specification requirements. Provide Equipment Commissioning Certifications. Certifications to include date/s of commissioning activities, a summary of the commissioning work performed, signature of commissioning agent/s, and a Certification statement that equipment has been properly installed and commissioned per the manufacturer's requirements. Include copies of all equipment Commissioning Certifications in the Owner's Operation and Maintenance Manual, and as a Submittal to the Engineer/Architect.

3.2 OPERATIONS & MAINTENANCE INSTRUCTION

- A. Provide an experienced swimming pool operator-instructor (NSPF Certified Pool Operator, or equivalent certification) for a period of not less than three (3) days (two (2) full days operations and start-up, and one (1) full day shut-down assistance) after the pool has been filled and initially placed into operation.
 - 1. During this period, the Owner's designated representative(s) shall be thoroughly instructed in all phases of pool and pool equipment operation and maintenance (O&M).
 - 2. At a minimum, the swimming pool training and O&M Manuals must include the following:
 - a. General pool operations,
 - b. Pool materials and deck equipment maintenance,
 - c. Pool fill and operating water level
 - d. Pool/Equipment start-up, shut-down, and emptying procedures.
 - e. Circulation pumping, pipe, fittings, valves, and ancillary equipment,
 - f. Filtration equipment,
 - g. Heating/cooling equipment,
 - h. Chemical treatment & monitoring systems,
 - i. Slide and water features
 - 3. Equipment training must be provided by the certified swimming pool operator-instructor and qualified equipment manufacturer representatives. See individual Specification sections for pool materials/equipment training and O&M requirements.
- B. Contractor shall obtain written certification from the Owner's designated representative acknowledging that all O&M instructions/training and materials have been provided. Certification shall include the detailed listing of equipment above with training completion and delivery dates, instructor contact information, and Owner representative's signatures.
- C. Include the cost of three (3) additional days of instruction and operational checkout/verification by an experienced swimming pool operator-instructor during the first year's operation. Written reports of each of these three (3) visits outlining the pool's operation, competence and performance of the pool's operating personnel and other pertinent comments shall be submitted to the Owner and Architect/Engineer within one week after each visit.
- D. Provide a DVD documenting training and operational requirements, including start-up, and emptying procedures.
- E. In addition to initial pool instruction listed, the Pool Contractor shall provide the Owner with unit price for complete start-up and pool closing services, including all labor and materials required.

3.3 WATER TREATMENT AND BALANCING

- A. Obtain a chemical analysis of the source/pool make-up water supply from a location as close as possible to the actual pool autofill. Conduct laboratory testing for the following parameters:
 - 1. Total Alkalinity [Parts per Million (ppm)]

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2. pH
 3. Calcium Hardness [ppm]
 4. Free Chlorine [ppm] & Combined Chlorine [ppm]
 5. Total Dissolved Solids (TDS) [ppm]
 6. Iron (Must test to a lower detectable limit of ≤ 0.05 ppm)
 7. Manganese (Must test to a lower detectable limit of ≤ 0.01 ppm)
 8. Copper (Must test to a lower detectable limit of ≤ 0.1 ppm)
- B. The following are ideal ranges for the water analysis test results. If results fall outside these ranges the Contractor shall make chemical adjustments to the water during the pool filling process until values within the ideal ranges are obtained.
1. Total Alkalinity: 80-100 ppm (for high pH disinfectants) 100-120 ppm (for low pH disinfectants)
 2. pH: 7.4-7.6
 3. Calcium Hardness: 200-400 ppm (Pools), 150-250 ppm (Spas)
 4. Free Chlorine: 2.0-4.0 ppm & Combined Chlorine: 0.0-0.2 ppm
 5. Total Dissolved Solids: Acceptable Start-up Range is not applicable (Maintain future TDS levels to within 1200 ppm above the start-up measurement)
 6. Temperature: Ideal Range is ± 2 degrees F from the desired pool operating water temperature.
 7. Iron: ≤ 0.05 ppm
 8. Manganese: ≤ 0.01 ppm
 9. Copper: ≤ 0.1 ppm
- C. Contractor shall calculate the Langlier Saturation Index (LSI) using values from the water analysis. The formula for LSI is shown below. Calculations may be made easier using through use of Orenda Technologies Mobil App, or a similar calculator. The LSI values shall fall within an acceptable "balanced" range of -0.3 to +0.3. If the LSI is outside this range OR test values are outside the ideal range listed above, the Pool Contractor shall prepare to add chemicals to the pool water volume as required until all parameters are within the ideal ranges previously listed, and the LSI is considered "balanced", Contractor is responsible for calculating required chemical additions and for adding all adjustment chemicals up until the time of project completion. Owner is responsible for providing the chemicals.

LSI Equation:

$(\text{pH}) + (\text{Temperature } ^\circ\text{F}) + (\text{Calcium Hardness}) + [(\text{Total Alkalinity}) - (\text{CYA correction factor @ current pH})] - (\text{TDS factor}) = \text{LSI}$

Equivalent Factors - Langelier Saturation Index (LSI)

Temperature (°F)	Temperature Factor	Calcium Hardness (PPM)	Calcium Hardness Factor	Alkalinity (PPM)	Alkalinity Factor	Cyanuric Acid (if present)	Cyanurate Correction Factor	Total Dissolved Solids	TDS Factor
32	0.0	5	0.3	5	0.7	pH	Factor	< 1000 ppm	12.10
37	0.1	25	1.0	25	1.4	7.0	0.23	1000 ppm	12.19
46	0.2	50	1.3	50	1.7	7.2	0.27	2000 ppm	12.29
53	0.3	75	1.5	75	1.9	7.4	0.31	3000 ppm	12.35
60	0.4	100	1.6	100	2.0	7.6	0.33	4000 ppm	12.41
66	0.5	150	1.8	150	2.2	7.8	0.35		
76	0.6	200	1.9	200	2.3	8.0	0.36		
84	0.7	300	2.1	300	2.5	Note: Only use if CYA is used in your pool. Only applies to >7.0pH. If so, select correction factor based on pool pH.		Note: most calculators assume 12.1 for under 1000ppm, or 12.2 for anything over 1000.	
94	0.8	400	2.2	500	2.6				
105	0.9	800	2.5	800	2.9				

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- D. Contractor shall provide a submittal to the Engineer/Architect after receiving the water analysis. Submittal shall include the following:
 - 1. Water sample location and analysis test results,
 - 2. SI Calculation,
 - 3. Chemical adjustment calculations indicating the following:
 - a. Pool Volume
 - b. Chemical Parameters requiring adjustment
 - c. Chemicals required to make the adjustments
 - d. Calculations showing amounts of each chemical addition that is required
- E. Contractor shall provide list of required balancing chemicals with quantities to the Owner for Owner purchase immediately after receiving the approved submittal from the Engineer/Architect.
- F. The Owner shall be responsible for payment of water required to fill each pool one time for leak testing and a second time for the final pool start-up process. The Contractor shall be responsible for payment of any additional water and chemicals required due to draining and refilling of pools as needed for pool or pool piping repairs.
- G. Contractor shall make chemical adjustments to the pool water during the pool startup process based on calculations provided in the approved submittal. It is critical to keep the pool water clean and balanced during the initial fill and while the pool plaster finish is curing. Follow all recommendations of the National Pool Plasterers Council for initial adjustments required during the plaster cure time. See additional requirements in Pool Finish Specification Section/s.
- H. Stabilize pool water to within a range of 5 to 15 ppm maximum of cyanuric acid.
- I. Heat pool water to within 5 degrees Fahrenheit of the desired pool operating temperature. Once this temperature is attained, the Pool Contractor shall enter the chemical controller settings for all chemical parameters. Do not enter chemical controller settings prior to reaching the desired pool operating temperature range.

END OF SECTION 13 11 14

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SECTION 13 11 18 POOL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-Place Concrete to be used for pool floor and wall construction and related structures including surge/collector/balance tanks.
2. Shotcrete alternate to pool wall construction only if Contractor's qualifications have been pre-approved by Architect/Engineer.
3. Admixtures.
4. Curing and Treatment Requirements.
5. Formwork, shoring, bracing, and anchorage.
6. Concrete reinforcement and accessories.

B. Related Sections:

1. Applicable provisions of Division 01 – General Requirements shall govern all work under this Section

1.2 REFERENCES

A. Incorporated Guides and References:

1. American Concrete Institute (ACI):
 - a. ACI 302.1R – Guide for Concrete Floor and Slab Construction.
 - b. ACI 304R – Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - c. ACI 304.2R - Placing Concrete by Pumping Methods.
 - d. ACI 305R - Hot Weather Concreting.
 - e. ACI 309R – Guide for the Consolidation of Concrete.
 - f. ACI 347 – Guide to Formwork for Concrete.
 - g. ACI SP-66 – ACI Detailing Manual.
2. Concrete Reinforcing Steel Institute (CRSI):
 - a. CRSI Manual of Standard Practice
 - b. CRSI 63 – Recommended Practice for Placing Reinforcing Bars.
3. National Electric Code (NEC):
 - a. Article 680 – Swimming Pools, Fountains, and Similar Installations.

B. Specifications & Standards:

1. American Concrete Institute (ACI):
 - a. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials.
 - b. ACI 301 - Specifications for Structural Concrete.
 - c. ACI 305.1 – Specification for Hot Weather Concreting.
 - d. ACI 306.1 – Standard Specification for Cold Weather Concreting.
 - e. ACI 308.1 – Specification for Curing Concrete.
 - f. ACI 315 - Details and Detailing of Concrete Reinforcement.
 - g. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
 - h. ACI 350.1 – Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures
 - i. ACI 506.2 – Specification for Shotcrete
2. ASTM International (ASTM):
 - a. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - b. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - c. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - d. ASTM C33 – Standard Specification for Concrete Aggregates.
 - e. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

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- f. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
- g. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete
- h. ASTM C150 – Standard Specification for Portland Cement.
- i. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete.
- j. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete.
- k. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- l. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
- m. ASTM C321 – Standard Test Method for Bond Strength of Chemical-Resistant Mortars.
- n. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
- o. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Concrete.
- p. ASTM C672 – Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals
- q. ASTM C1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
- r. ASTM D4541 – Standard Test Methods for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- s. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.
- 3. Corps of Engineers:
 - a. CRD C-527 - Corps of Engineers Specification for Polyvinylchloride Water Stop.
- 4. NSF International (NSF)
 - a. NSF/ANSI Standard 61 – Drinking Water System Components

1.3 SUBMITTALS

- A. Submit proposed mix design of each class of concrete to Engineer/Architect not later than 10 days after Notice to Proceed or twenty-one (21) days prior to the first concrete placement, whichever comes first.
- B. Submit shop drawings of reinforcing steel under provisions of Division 01 – General Requirements.
 - 1. Initial submittal of reinforcement shop drawings shall be complete. No partial submittals will be accepted.
 - 2. Indicate reinforcement sizes, spacing, locations and quantities of reinforcing steel, bending and cutting schedules, splicing, supporting and spacing devices. Include additional reinforcement for opening through concrete structures.
 - 3. Reinforcement placement shop drawings shall conform to ACI SP-66 providing full wall elevations.
- C. Material Certificates: For each of the following, signed by the manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Waterstops.
 - 4. Non-shrink grouts.
 - 5. Expansion Joint Materials.
 - 6. Sealants.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates.
 - 2. Concrete Testing
 - 3. Compaction
- E. Shotcrete Nozzleman Qualifications.
- F. Pool Finish Experience/Qualification Requirements.

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1.4 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301, 305.1, and 306.1.
- B. Maintain copy of ACI 301 on site.
- C. Qualifications of Pool Contractor
 - 1. Work of this Section shall be performed by a Contractor who has a proven record of competence and experience in the construction of similar facilities of this size and complexity for not less than five (5) years. Contractors shall have an established record of reliability.
- D. Qualifications of Nozzleman and Gunman
 - 1. Except when shotcrete is applied under a fully automated process, the quality of shotcrete depends largely on the skill of nozzleman and gunman, and the Contractor shall satisfy the Architect/Engineer that the nozzleman has had a minimum of two years' continuous experience on shotcreting of this type of work, and that the gunman has handled the gun for a period of at least six months. The nozzleman shall show proof of good quality successful shotcreting work similar to that required for this project. Experience gained on shotcrete and ditch construction will not be considered as experience for qualifying the nozzleman.
- E. Concrete Testing: The following tests shall be performed during construction of the project. Refer to General Conditions and Division 01 for further requirements.
 - 1. Tests to measure slump, entrained air content and compressive strength shall be conducted by independent testing laboratory employed by the Contractor unless noted otherwise in front-end specifications.
 - a. Provide minimum of two 6 by 12 in. cylinders or three 4 by 8 in. cylinders per 150 cubic yard or fraction thereof for each class of concrete poured each day. Comply with ACI 318 (samples secured - ASTM C172, cylinders prepared and cured - ASTM C31, and tested - ASTM C39). Identify samples moist cure at 70 degrees F for five (5) days and ship samples to laboratory.
 - 2. Slump and Air Content Tests
 - a. Perform on concrete from same batch as sampled for strength tests and whenever there is consistency of concrete. Slump tests shall be made in accordance with ASTM C143. Air content tests shall be made in accordance with ASTM C231. If measured slump or air content falls outside specified limits, check shall be made immediately on another portion of same sample. In event of second failure, concrete shall not be used in Work.
 - 3. Compliance
 - a. Average of any three (3) consecutive strength tests for each class of concrete shall be equal to or greater than specified strength, and no individual test shall fall more than 500 psi below specified strength.
 - b. When tests results are below specified requirements or when tests of field cured cylinders indicate deficiencies in protection and curing, Architect/Engineer may require additional tests in accordance with ACI 318.
- F. Wet Mix Process Cylinder Sample
 - 1. Where automated wet mix equipment is used, shotcrete cylinders shall be taken from the mixer or ready-mix truck and tested in accordance with the requirements specified in this Section. Wet mix processes shall only be used with approved automated equipment.
- G. Pools, surge tanks, and gutters shall have a water tightness performed per ACI 350.1. Documentation of testing and results shall be submitted for review. Refer to Water Tightness Test section of this specification.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of local, state and federal rules and regulations applicable to Work and Project location.

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1.6 ENVIRONMENTAL REQUIREMENTS

- A. Cold Weather Concreting
 - 1. Placement and curing of concrete where (1) average daily temperature for three consecutive days is less than 40 degrees F, and (2) air temperature is not greater than 50 degrees F for more than one-half of a 24-hour period from midnight to midnight shall be in accordance with ACI 306.1.
- B. Hot Weather Concreting
 - 1. Placement and curing of concrete subject to a combination of (1) rising air temperature (generally greater than 75 degrees F) and (2) wind and low relative humidity shall be in accordance with ACI 305.1.
 - 2. Contractor shall provide plan for minimizing exposure of concrete to adverse conditions due to combinations of high air temperature, direct sunlight, drying winds, and high concrete temperature.
 - 3. Protect concrete from rapid temperature drop.
 - 4. Pre-wet subgrade and forms.

1.7 WARRANTIES

- A. Special 2-Year on Concrete Structure: The Pool Contractor shall guarantee for two (2) years repair of the concrete pool structure.

PART 2 - PRODUCTS

2.1 SUBGRADE, SUBBASE AND BACKFILL MATERIALS

- A. Pool Subgrade:
 - 1. In-situ soils meeting the Project Geotechnical Report requirements for materials and preparation.
 - 2. Subgrade soils must meet the soil parameters for pool structural design as stated in the Pool Structural Drawings for:
 - a. Net allowable soil bearing capacity in pounds per square foot (PSF),
 - b. Stated equivalent fluid pressure in pounds per square foot per foot (PSF/FT),
 - c. Ground water elevation
 - 3. Pool subgrade materials shall be free of large rocks, organic matter, and other deleterious substances.
- B. Filter Fabric:
 - 1. MIRAFL 140N: Nonwoven polypropylene geotextile barrier, 4.8 oz/yd², by Tencate Geosynthetics.
- C. Pool Subbase & Backfill Materials:
 - 1. Existing subsoil materials shall not be used for pool subbase.
 - 2. ASTM D 2487 Class IA Manufactured Aggregate:
 - a. Aggregate containing little or no fines (clear), including angular, crushed stone or rock, crushed slag, cinders, or shell.
 - b. Gradation: Open graded, clean: < = 10% Passing No.4 sieve, < 5% Passing No. 200 sieve.
 - c. Pool Subbase: ¾" to 1" nominal sized aggregate.
 - d. Pool backfill: ¾" nominal sized aggregate.

2.2 FORM MATERIALS

- A. Plywood Forms: Douglas Fir or Spruce-Pine-Fir species: Sound, undamaged sheets with clean true edges, exterior glue, facing material to provide finish specified.
- B. Lumber: Douglas Fir or Spruce species; construction grade or better; with grade stamp clearly visible.
- C. Preformed Steel Wall Forms: Minimum 16 gage thick, Vertically and horizontally matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and surface appearance.

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- D. Tubular Column Type: Round, spirally wound laminated fiber material; inside surface treated with release agent.
- E. Form Ties for Exposed Surfaces: Plastic cone snap ties with 1-inch outside diameter by 1-inch (nominal) long cones, with no metal within 1-inch of concrete face after removal;
 - 1. Manufacturers:
 - a. [Advance Concrete Formwork, Inc.](#)
 - b. [Dayton Superior.](#)
 - c. [Symons - A Dayton Superior Company.](#)
 - d. [Williams Form Engineering Corporation.](#)
 - e. Substitutions: As approved by Engineer/Architect.

2.3 SHOTCRETE

- A. Mix Design
 - 1. Wet-mix design only. Dry mix, mixed at the nozzle, shall not be allowed.
 - 2. A proven mix design shall be used for all Shotcrete applications.
 - 3. In addition to cylinders, testing of shotcrete shall be done per ACI 506.2.
- B. Rebound
 - 1. Rebound materials shall not be reused in any form for shotcrete work and shall never be worked into the construction by the nozzleman.

2.4 REINFORCING STEEL

- A. Reinforcing Steel: ASTM A615, 60 ksi yield grade carbon steel deformed bars; uncoated, finish.
- B. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete. Supports shall have a minimum 2" concrete cover on waterside of pool concrete.

2.5 CONCRETE MATERIALS

- A. Cementitious Materials
 - 1. Portland Cement: ASTM C150, gray color, Type I except as specified below.
 - 2. Fly Ash: ASTM C618, Class C.
 - 3. Limit cement replacement to 20%.
- B. Fine and Coarse Aggregates: ASTM C33.
- C. Water: ASTM C1602, clean and not detrimental to concrete.
- D. Admixtures
 - 1. Admixtures to be used in the concrete mixture shall be submitted to the Engineer for approval as part of the mixture proportions.
 - 2. Admixtures containing intentionally-added chlorides, sulfides, or nitrides are not permitted.
 - 3. Admixtures shall be certified to NSF/ANSI 61.
 - 4. Air-Entraining Admixture: ASTM C260.
 - 5. Water Reducing Admixture: ASTM C494, Type A.
 - 6. Retarding Admixture: ASTM C494, Type B or Type D.
 - 7. Accelerating Admixture: ASTM C494, Type C or Type E.
 - 8. High-Range Water-Reducing Admixture: ASTM C494, Type F.
 - 9. Workability-Retaining Admixture: ASTM C494, Type S.
 - 10. Shrinkage-Reducing Admixture: ASTM C494, Type S.
 - 11. Crystalline Waterproofing Admixture: ASTM C494, Type S.
 - 12. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations.
 - 13. Admixtures permitted shall be supplied by a single manufacturer for project.
 - 14. Approved Manufacturers:
 - a. Axim Italcementi Group.

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- b. Master Builders Solutions
 - c. Grace Construction Products.
 - d. The Euclid Chemical Company.
 - e. Xypex
15. Substitutions: As approved by Engineer/Architect.

2.6 ACCESSORIES

A. Pool Concrete PVC Waterstop

1. Center bulb type, as shown on Drawings, extruded from an elastomeric plastic compound, the basic resin of which shall be polyvinyl chloride (PVC). The size shall be as shown. Specific gravity shall be approximately 1.37, and the Shore durometer Type A hardness approximately 80. No reclaimed PVC shall be used in the compound. Meet the performance requirements of CRD C-572.
2. Waterstop shall have a constant thickness from the edge of the bulb to the outside edge. All waterstops shall have a number of parallel ribs or protrusions on each side of the center of the strip. Corrugated type or tapered waterstops are not acceptable. The minimum weight per foot for waterstop shall be 1.62 pounds for 3/8-inch by 6-inch and 2.30 pounds for 3/8-inch by 9-inch.
3. Manufacturers and suppliers who have provided samples meeting the specified geometry and who have the specified waterstop readily available are listed below. Other products shall not be used without prior review and acceptance by the Architect/Engineer.
 - a. Sika Greenstreak Waterstops, P.O. Box 7139, St. Louis, Missouri 63177, phone: (314) 225-9400 or fax: (314) 225-9854. Style 717 for the 6-inch by 3/8-inch and Style 735 for the 9-inch by 3/8-inch.
 - b. BoMetals, Inc., 141 Hammond Street, Carrollton, GA. Phone 770-832-2000 or fax (770-832-2095. Style RCB638NT for the 6-inch by 3/8" and style RCB938NT for the 9-inch by 3/8".
 - c. Paul Murphy Plastics Company, Wirestop Waterstop, 15301 Eleven Mile Road, Roseville, Michigan, 48066, phone 800-544-2200 fax 586-774-9146. Style CR-6380 for the 6-inch x 3/8" and Style CR-9380 for the 9-inch by 3/8".

B. Pool Concrete Compressible Waterstop

1. Use as illustrated in drawing details for the following:
 - a. Sealing non-moving cold joints and construction joints between structural elements against penetration of water from wet-face of structure with less than 30-foot hydrostatic head.
 - b. Sealing pool piping penetrations against water penetration from wet-face of structure with less than 30-foot hydrostatic head.
2. Product Description: The product shall be a 0.59" x 0.39" compressible hydrophilic sponge rubber strip composed of vulcanized rubber and urethane polymer as the hydrophilic agent.
3. Product & Manufacturer:
 - a. Adeka KBA-1510FP waterstop, manufactured by Adeka Corporation and distributed by OCM, Inc., Chicago, IL. USA.
 - b. Website: www.adeka.com
 - c. Physical & Swelling Property Requirements: The product shall at a minimum meet the physical properties as shown in the official Adeka literature as follows.
 - d. Expansion Pressure: The product shall not produce more than 0.03MPa (4.35 psi) expansion pressure when fully hydrated.
 - e. Tensile Strength: At least 0.78 MPa (113 psi),
 - f. % Elongation: No greater than 350% when fully hydrated.
 - g. Volume (thickness) % Change: No greater than 30% volume change or increase in thickness when fully hydrated.
 - h. Alternative Products:

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- 1) General: Drawing documents have been completed using the specified Adeka waterstop product as a basis of design. Alternative compressible waterstops shall not be used without approval from Engineer/Architect. Considerations such as concrete coverage requirements and wall thicknesses must be considered when substituting alternative products. Contractor will be responsible for any structural changes required due to alternate product concrete coverage requirements.
 - 2) Product Requirements: Compressible waterstop alternatives may not contain bentonite materials and may not have swelling properties that exceed the specified product.
 - 3) Acceptable Alternative: An acceptable alternative may be Synko-Flex SF302 Preformed Plastic Adhesive Waterstop with Synko-Flex SF311 primer or equal, but it must be approved prior to use. Manufacturer: Henry Company, Houston, TX. Website: <http://henry.com>
- C. Non-Shrink Grout: Premixed compound with non-metallic aggregate, cement, water reducing and plasticizing agents; capable of minimum compressive strength of 2400 psi.
1. Upcon High Flow, the Upco Company, Cleveland, Ohio; MasterFlow 713, Master Builders Solutions, Cleveland, Ohio; Duragrout, L & M Construction Chemicals, Inc., Omaha, Nebraska.
- D. Joint Materials:
1. Waterstop: See Pool Concrete PVC Waterstop.
 2. Expansion Joint Dowel Sleeves: PVC or molded plastic sleeve with end cap/plug. Size sleeve to allow movement of dowel.
 3. Pre-molded Expansion Joint Filler: Multicellular, closed cell, flexible polyethylene plastic foam as manufactured by Dow Chemical Co., Midland, MI. Ethafoam expanded polyethylene closed-cell foam, W.R. Meadows, Elgin, IL, Ceramar or a pre-approved equal.
 4. Backer Rod Joint Backing Material: Closed cell, polyethylene, flexible, rope-like foam joint backing material. Material shall be fully compatible with polysulfide sealant and for use in swimming pools. Product shall be Kool-Rod as Manufactured by W.R. Meadows, Elgin, IL, or pre-approved equal.
 5. Gun Grade Sealant: Two-part polysulfide sealant and primer certified by Manufacturer as suitable for use in pools including submerged locations. "Deck-O-Seal Gun Grade" and "P/G" solvent based primer as manufactured by W.R. Meadows or equal. Color shall be white.
- 2.7 CURING AND TREATMENT MATERIALS
- A. Water: Potable and clean.
 - B. Burlap shall be clean, evenly woven, free of encrusted concrete or other contaminating materials, and shall be reasonably free of cuts, tears, broken or missing areas.
 - C. Polyethylene Film: ASTM C171, 6 mil thick, clear.
 - D. Curing Paper: ASTM C171;
 1. Manufacturers:
 - a. Fortifiber – Orange Label Sisalkraft 280.
 - b. Substitutions: As approved by Engineer.
- 2.8 CONCRETE MIXTURE
- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture of field test data, or both, according to ACI 301.
 - B. Mix concrete in accordance with ASTM C94.
 - C. Concrete mix designs shall be designed and submitted in accordance with Division 01 and included as part of cost of this Work.

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- D. Mix designs shall be prepared by a qualified agency acceptable to Engineer/Architect. Electronic copies of mix designs shall be submitted for Engineer/Architect's review prior to placing any concrete.
- E. Mix design shall indicate brands, types, and quantities of admixtures included, compressive strength, slump, sieve analysis for fine and coarse aggregate, quantities of all ingredients, type and brand of cement, source of aggregate, whether fine aggregate is natural or manufactured.
- F. Design of mix shall assure placing and finishing characteristics that meet Project requirements.
- G. Mix designs contained in the Schedule of Mixes may be modified and submitted to Engineer for approval, by use of mid or high range water reducing admixtures to control slumps required for pumping of concrete. Strength, placing and finishing requirements shall be maintained.
- H. Concrete mixtures shall be designed to have low shrinkage characteristics and designed to minimize slab curling.
- I. Initial and final set times of concrete mix designs shall be coordinated between the contractor and concrete supplier.

2.9 SCHEDULE OF MIXES

- A. Pool Structures: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 4500 psi.
 - 2. Maximum Aggregate Size: 1 inch.
 - 3. Maximum Slump (Inch): 3
 - 4. Air Entrainment: 6 percent air content is required with an acceptable air content of plus or minus 1.5 percent. Required for pool structures subject to freeze/thaw cycles.
 - 5. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 6. Additional admixtures may be required as indicated on Structural Drawings.
- B. Surge Tanks (Walls and Floor): Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 4500.
 - 2. Maximum Aggregate Size: 1- inch.
 - 3. Air Entrainment: 6 percent air content is required with an acceptable air content of plus or minus 1.5 percent. Required for tanks subject to freeze/thaw.
 - 4. MasterLife 300D or Xypex C-500 admixture: Provide dosage per manufacturer's recommendations.
- C. Shotcrete: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Wet-mix design only. Dry mix, mixed at the nozzle, shall not be allowed.
 - 3. Maximum Aggregate Size: 3/8 - inch.
 - 4. Air Entrainment: 6 percent air content is required with an acceptable air content of plus or minus 1.5 percent. Required for pool structures subject to freeze/thaw cycles.
 - 5. Additional admixtures may be required as indicated on Structural Drawings.

PART 3 - EXECUTION

3.1 SUBGRADE, SUBBASE AND BACKFILL PLACEMENT

- A. Prepare pool subbase using in-situ soils in compliance with the Project Geotechnical Report placement methods and testing requirements. Materials shall be graded to proper elevations, free of large rocks, organic matter, and other deleterious substances.
- B. Place geotextile barrier below entire pool and up the sides of the pool walls separating the subbase aggregates and pool backfill aggregates from the subgrade and remaining backfill or in-situ soils to prevent mitigation of fines.
- C. Place pool subbase & backfill aggregate materials in 6" compacted lifts to minimize void spaces and eliminate potential future settlement. Compact materials using walk-behind plate compactors properly sized and operated to prevent damage to pool pipes.

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3.2 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance per ACI 117.
- C. Verify lines, levels, and measurement before proceeding with formwork.
- D. Earth forms are not permitted.
- E. Align form joints.
- F. Do not apply form release agent where concrete surfaces receive special finishes or applied coatings which may be affected by agent.
- G. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

3.3 REINFORCEMENT

- A. Place, support, and secure reinforcement against displacement.
- B. Locate reinforcing splices as shown on Drawings.
- C. Place reinforcing steel in conformance with the information on the drawings and CRSI 63 and CRSI, except as modified herein. Minimum length of splices shall be as shown in table on drawings. Tie splices with 18-gauge annealed wire as specified in the referenced CRSI standard. All tie wires shall be "made tight" for electrical bonding purposes, as required by NEC, Article 680.

3.4 WATERSTOP

- A. PVC Waterstop
 - 1. Split formwork is generally required for slab-to-slab, slab-to-wall and wall-to-wall joints where ribbed style waterstops are used. The centerline of the waterstop should be aligned with the center of the joint. The split form shall firmly hold the waterstop in position to prevent misalignment of waterstop during concrete placement. Secure waterstop with hog rings or integral wire loops prior to concrete placement. Loop tie wires through the hog ring/wire loops and tie off to adjacent reinforcing steel to prevent displacement of the waterstop during concrete placement. Fasteners through the body of the waterstop are not permitted.
 - 2. Lapping of the waterstop is not permitted. PVC waterstop may be butt spliced in the field with Teflon coated, thermostatically controlled splicing iron. Direct exposure to a flame is not permitted. Factory fabricated fittings are recommended for ells, tees and crosses.
 - a. The following defects at splices will not be acceptable:
 - 1) Use of adhesives, solvents, or free lap joints
 - 2) Misalignment of center bulb greater than 1/16"
 - 3) Misalignment that reduces waterstop cross section area more than 15%.
 - 4) Bond failure at joint, deeper than 1/16" or 15% of material thickness.
 - 5) Combination misalignment and bond failure with net reduction of waterstop cross-section area greater than 15%.
 - 6) Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 1/2" in 10 feet.
 - 7) Visible porosity in the weld joint, including pinholes
 - 8) Charred or burnt material
 - 9) Bubbles or inadequate bonding detectable with a penknife
 - 10) Visible signs of splice separation when cooled splices are bent at a sharp angle.
 - 11) Edge welding
 - 3. Thoroughly consolidate the concrete around the waterstop to prevent voids or honeycombing next to the waterstop. Maintain adequate clearance between reinforcing steel and the waterstop. Typical clearance should be twice the maximum aggregate size.

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Maintain continuity of the entire waterstop system. Properly store PVC waterstops prior to installation to prevent UV degradation.

B. Compressible Waterstop – Adeka KBA-1510FP

1. Non-moving Joint Installation:
 - a. Consult manufacturer and follow all recommended installation instructions.
 - b. Allow concrete to cure a minimum of 24 hours.
 - c. Concrete must be dry and free from form oils, release agents, curing compounds, laitance and other dirt or debris prior installation. Use a wire brush to remove contaminants prior to installation of waterstop.
 - d. Use butyl tape to attach KBA-1510FP to a dry and clean substrate. The butyl tape comes in a 3/4" X 1/8" X 82-foot roll (1 roll per roll of KBA-1510FP). Press the butyl strip onto the substrate and remove the release paper. Press the KBA-1510FP firmly onto the butyl tape.
 - e. Check for any gaps between the product and the substrate. If gaps are present, fill in using Adeka P-201 applied to the side of the strip. Use P-201 on corner joints and on side-by-side splice joints.
 - f. Once installed, keep the product covered, clean, and dry prior to concrete placement. For best results, place the waterstop product immediately before pouring concrete. Check to make sure the waterstop is firmly adhered before placing concrete.
 - g. During concrete placement, assure that the concrete is well consolidated around the waterstop at all locations with no voids or gaps.
2. Penetration Installation:
 - a. Consult manufacturer and follow all recommended installation instructions.
 - b. Pipe must be dry and free from form oils, release agents, curing compounds, laitance, and other dirt or debris prior to installation.
 - c. Press the butyl strip onto the clean pipe completely around the pipe diameter and remove the release paper. Press the KBA-1510FP firmly onto the butyl tape. Tightly butt strip ends together with 1" overlap or side lap.
 - d. Once installed, keep the product covered, clean, and dry prior to concrete placement. For best results, place the waterstop product immediately before pouring concrete. Check to make sure the waterstop is firmly adhered before placing concrete.
 - e. During concrete placement assure that the concrete is well consolidated around the waterstop at all locations with no voids or gaps.
3. Alternative Products Installation:
 - a. Drawing documents have been completed using the specified Adeka waterstop product as a basis of design. Alternative flexible adhesive waterstops shall not be used without approval from Engineer/Architect. See Section 2 for additional information.
 - b. If Synko-Flex has been approved during the submittal process, the following installation requirements shall be met, as well as all manufacturer's installation instructions.
 - 1) Allow concrete to cure a minimum of 24 hours before priming with Synko-Flex primer.
 - 2) Concrete must be dry and free from form oils, release agents, curing compounds, laitance and other dirt or debris prior to priming. Use a wire brush to remove contaminants prior to installation of primer.
 - 3) Apply Synko-Flex SF311 primer.
 - 4) Apply Synko-Flex SF302 Preformed Plastic Adhesive Waterstop over primed areas. Place Synko-Flex to primed areas at an approximately 5/8" thickness and approximately 1 1/2" width.
 - 5) Tightly butt strips together with 1" overlap or side lap.

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3.5 PLACING CONCRETE

- A. Notify Engineer/Architect a minimum of 48 hours prior to commencement of concreting operations.
- B. Failure to notify Engineer/Architect may result in rejection of concrete placed without observation.
- C. Place concrete in accordance with ACI 301.
- D. Place pumped concrete in accordance with ACI 304.2R. Line coating mix to initiate pumping shall not be used in pour but shall be wasted.
- E. Ensure reinforcement and embedded items are not disturbed during concrete placement.
- F. Concrete with excessive honeycomb or embedded debris shall be rejected and replaced at no cost to OWNER.
- G. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures and mechanical injury.
- H. Placing During Hot Weather:
 - 1. Place concrete during hot weather conditions in accordance with ACI 305.1.
- I. Placing During Cold Weather:
 - 1. Place concrete during cold weather conditions in accordance with ACI 306.1.
- J. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.6 POOL WALL SHOTCRETE

- A. Wet Mix Process
 - 1. The delivery equipment shall be of an approved design and size that has given satisfactory results in similar previous work.
 - 2. The equipment must be capable of discharging mixed material into the hose under close control, and it must be able to deliver a continuous smooth stream of uniformly mixed material at the proper velocity to the discharge nozzle, free from slugs of any kind.
 - 3. The nozzle shall be of a design and size that will ensure a smooth and uninterrupted flow of materials.
 - 4. Delivery equipment shall be thoroughly cleaned at the end of each shift.
- B. Surface Preparation
 - 1. Verify forms are true to line and dimensions, adequately braced against vibration, and constructed to permit escape of air and rebound during gunning operations.
 - 2. Do not place shotcrete on any surface which is frozen, spongy, or where there is free standing water.
- C. Alignment Control
 - 1. Provide alignment wires to establish thickness and plane surface.
 - 2. Install alignment wires at corners and offsets not established by form work.
 - 3. Verify alignment wires are tight, true to line, and placed to allow further tightening.
- D. Application
 - 1. Ensure correct placement of reinforcement. Ensure sufficient clearance around reinforcement to permit complete encasement.
 - 2. Allow easy access to shotcrete surfaces for screeding and finishing, permitting uninterrupted application.
 - 3. Determine operating procedures for placement in close quarters, extended distances, or around unusual obstructions where placement velocities and mix consistency must be adjusted.
 - 4. In shotcreting walls, begin application at bottom. Ensure work does not sag.
 - 5. Hold nozzle as perpendicular to surface as work will permit, to secure maximum compaction with minimum rebound.
 - 6. Follow routine that will fill and completely encase reinforcement, using maximum layer thickness.
 - 7. Build up layers by making several passes of nozzle over work area. Completely encase reinforcement with first layer.

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8. After initial set, remove excess material outside of forms and alignment lines.
 9. Allow each layer of shotcrete to take initial set before applying succeeding layers.
 10. Remove laitance that has taken final set, by sandblasting. Clean with air-water jet.
 11. Sound work with hammer for voids. Cut out voids and replace with succeeding layers.
 12. Keep rebound, and other loose or porous material out of new construction.
 13. Remove rebound that does not fall clear to work. Discard salvaged rebound.
 14. Remove trapped rebound at construction and expansion joints.
 - E. Protection of adjacent surfaces
 1. Contractor shall take every possible precaution to protect adjacent concrete surfaces, equipment, etc., from being damaged by overshooting concrete. Overshot concrete and rebound materials deposited shall be removed at the Contractor's expense.
- 3.7 EXPANSION & CONTROL JOINTS
- A. All control and expansion joints require PVC waterstop.
 - B. Installation of Joint Filler: At locations where joint sealant is to be applied, the pre-molded joint filler shall be installed in the joint accurately as detailed. Precut the pre-molded expansion joint filler to the required depth. Filler material shall be of sufficient width to completely fill the joint and shall be accurately cut to butt tightly against the waterstop and the side forms. Attach filler material to concrete with a bonding agent. Bonding agent shall be approved in writing by the joint sealant and joint filler manufacturer for compatibility.
 - C. Concrete shall be thoroughly vibrated along the joint form to produce a dense, smooth surface. Surface irregularities along the joint sealant cavity, due to improper concrete consolidation or faulty form removal, shall be repaired with an approved compound compatible with the joint sealant in a manner that is satisfactory to the sealant manufacturer.
 - D. All expansion and control joints require gun grade sealant. Cavities for joint sealant shall be formed with precut or pre-molded joint filler that can be removed as needed for sealant. Circular backer rod shall be used in joints as detailed to provide accurate shape for sealant.
- 3.8 CONSTRUCTION JOINTS
- A. Construction joints shall be located as required for the contractor's scheduling, means and methods.
 - B. All construction joints require waterstop.
 - C. Contractor shall provide a submittal showing construction joint locations and detailing for review and approval.
- 3.9 CURING AND TREATMENT
- A. Curing shall begin promptly to prevent drying of concrete. Curing shall continue for seven (7) days after placing.
 - B. Provide a moist cure for a full seven (7) days in accordance with ACI 308.1. Keep concrete slabs and walls continuously wet for a 7-day period. Intermittent wetting is not acceptable. Material shall completely cover the concrete surface and shall be weighted down to prevent shifting due to wind or other factors.
- 3.10 REPAIR OF VERTICAL SURFACE DEFECTS
- A. Upon stripping of forms, vertical surfaces shall be inspected for defects caused by surface air voids, honeycombing, form tie holes, peeling, and fins.
 - B. Surface air voids shall be repaired with a unit packaged mixture of sand and cement mixed on job site with water and a unit of acrylic. Mixture shall be brushed uniformly on to surface and into voids. Where surface is to be exposed, surface finish of repair shall match adjacent surface.
 - C. Honeycombed and other defective concrete shall be removed down to sound concrete and patched to match adjacent surfaces. Cut edges perpendicular to surface at least 1 inch deep – no feathered edges allowed.

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1. Areas not subject to water shall be repaired similar to surface air voids as indicated above. A bonding agent shall be used prior to filling the holes. Patches shall be kept moist for a minimum of 7 days.
2. Areas subject to water shall be moist for a period of 24 hours prior to patching. Holes shall be filled with non-shrink grout and cured per recommendations by manufacturer. Concrete surface shall be prepared per recommendations by manufacturer.
- D. Form tie holes shall be filled with non-shrink grout. Surface of concrete to prepared per recommendations by manufacturer. Grout shall be cured per recommendations by manufacturer.

3.11 FINISHING

- A. Floor slabs shall not vary from level or true plane more than ¼ inch in 10 feet when measured with a straightedge. Floor slabs shall receive a broom finish to accommodate special aggregate mechanical bonding requirements.
- B. After removal of forms and repair of defects, surfaces of concrete shall be given finishes specified below.
- C. Rough Form Finish: Surface left with texture imparted by forms; form facing material not specified; tie holes and defects shall be patched; all fins shall be chipped or rubbed off. The surface shall be finished in such a way that will leave the surface for the substrate rough, coarse, and porous enough to ensure that subsequent application of the cementitious surface coating can achieve a good mechanical bond to the substrate similar to a broom finish.
- D. Tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of formed surface.
- E. Final finish on formed surfaces shall continue uniformly across unformed surfaces.

3.12 WATER TIGHTNESS TEST

- A. General
 1. This test applies to the pool, the surge tank, and the gutter system. A water tightness test shall be completed on each pool, surge tank and gutter system, independently of each other, prior to the application of the pool finish.
 2. The cost of the water shall be allocated as outlined in Specifications Section 13 11 14, Part 3, 3.02, F.
 3. Contractor shall include and itemize these requirements in the overall construction schedule.
 4. The Owner may elect to waive leak test requirements if schedule becomes a critical factor. Only the Owner may waive these requirements. If the Owner elects to waive these requirements the Contractor is still responsible for providing leak-free structures, and at a minimum, all specified applicable warranties shall apply.
- B. Water Tightness Test Procedure
 1. Preparation
 - a. Visually examine the concrete structure and joints for potential leakage prior to fill. Contractor shall repair areas of potential leakage prior to fill.
 - b. Allow the concrete structure to cure a minimum of 28 days, or as required to gain sufficient strength to withstand the test load, prior to initiating test.
 - c. Securely seal all inlets/outlets and penetrations prior to fill.
 - d. The test shall not be scheduled when the weather forecast indicates the water surface could freeze before the test is completed.
 2. Fill
 - a. Fill the pool with potable water from an approved water source, and then isolate the pool, the surge tank, and the gutter system. The water tightness test and measurement documentation shall begin after the test structure has been filled for a minimum of three (3) days to allow the concrete to absorb water and minimize absorption effects during the testing period.

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- b. Fill each structure to the design maximum liquid level or 4 inches below any fixed overflow level.
 - c. After the initial fill, remove ground water to a level below the bottom of the structure main drain or floor slab (below lowest concrete plane) utilizing the pool observation tube, the pool de-watering system, or the construction dewatering system. This shall be completed prior to the start of the water tightness test and maintained for the duration of the test.
 - d. For elevated pools with secondary containment structure, the secondary containment structure shall be monitored for the presence of water for the duration of the test. Groundwater elevation is not a factor in these pools.
3. Evaporation/Precipitation Measurement Procedure
 - a. Partially fill a floating, restrained, calibrated (known volume and surface area), open container (hereafter "container" or "control container") with water and allow this container to float within the filled structure during the testing period. This will be used to measure total evaporation and precipitation.
 - b. Mark and measure the change in container's water level. If the container water level has gone down (evaporation), this change shall be subtracted from each structure's water loss measurement. If the container water level has risen (rain), this change shall be added to each structure's water loss measurement.
4. Measurement
 - a. Conduct all measurements with the Architect or Owner's representative present and document all measurements on the table below.
 - b. Provide an as-built drawing or sketch the pool, surge tank, and gutter identifying measurement locations and the evaporation control container's location.
 - c. The water surface elevation shall be recorded to within 1/16 of an inch, measured from a fixed point on the structure above the water surface.
 - d. Average multiple sample locations for structures exposed to wind.
 - e. Repeat and record the measurements for a total of three (3) consecutive days.

Measurement Times	Pool Measurements	Gutter System Measurements	Surge Tank Measurements	Control Container Measurements
12 Hrs.				
24 Hrs.				
36 Hrs.				
48 Hrs.				
60 Hrs.				
72 Hrs.				

5. Water Leakage
 - a. Calculate water leakage as follows:
Leakage [Gallons] = [7.481 x Structure Surface Area (SF)] x [Structure Loss Measurement* (FT) – Control Container Measurement (FT)].
 - Structure loss measurement is a generic term referring to Pool Measurement, Gutter System Measurement or Surge Tank Measurement independently. Calculate the leakage from the pool, gutter, and surge tank independently.
 - b. Add the measurements for two consecutive 12-hour periods to obtain the total daily loss due to leakage.
 - c. Record Daily losses due to leakage for Day #1, #2, and #3 in the table below.

Total Daily Loss Due To Leakage	Pool Leakage	Gutter Leakage	Surge Tank Leakage
Day 1			
Day 2			

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Day 3			
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6. Submittal
 - a. Provide test location as-built/sketch, measurement tables, and Water Leakage calculations to Engineer in the form of a submittal for review and records.
7. Allowable Loss from Leakage
 - a. The allowable leakage rate for an unlined, open concrete structure (i.e. backfilled pool, gutter, and surge tank) shall not exceed 0.1 percent of the total water volume in a 24-hour period. (Example: $0.001 \times 200,000\text{-gallon pool} = 200$ gallons per 24-hour period.)
 - b. Elevated pools and gutters with a secondary containment vessel shall have no measurable loss; the drop in the water surface shall not exceed 1/8" over the three-day test period when adjusted for evaporation and precipitation.
8. Repair and Retest
 - a. If the leakage volume calculated exceeds the "allowable loss" in section 7, Contractor shall locate and identify leakage points, repair the structure and provide documentation on the location of repaired areas.
 - b. After proper curing of all repair work, re-test the water tightness of structure following the procedure specified in this section.

END OF SECTION 13 11 18

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SECTION 13 11 20 POOL PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe, pipe fittings, connections, wall penetrations.

1.2 RELATED DOCUMENTS

- A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.3 REFERENCES/PIPE – FITTING REQUIREMENTS

- A. The following latest edition reference specifications, guides, and standards shall become part of this Specification as if herein written. If provisions conflict, the more stringent provisions shall apply.
 - 1. ANSI/ASTM D2564 - Solvent Cements and ASTM F656 – Primers for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings
 - 2. ASTM D2855 – Practice for Making Solvent Cemented Joints with PVC Pipe and Fittings
 - 3. ANSI/ASTM D1785 – Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Schedules 40, 80 and 120, NSF Seal for Potable Water
 - 4. ASTM D2466 – PVC Plastic Pipe Fittings, Schedule 40, Injection Molded, Sizes Through 12", NSF Listed. As manufactured by Spears Manufacturing Company, "or approved equal".
 - 5. ASTM D2467 – Socket Type PVC Plastic Pipe Fittings, Schedule 80, Injection Molded, Sizes through 12", NSF Listed. As manufactured by Spears Manufacturing Company, "or approved equal".
 - 6. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - 7. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 8. ASTM D-1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (Modified Proctor Maximum Dry Density)
 - 9. ASTM F679 – PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings, Bell Gasketed Joints, Sizes 18" Through 36". As manufactured by J-M Manufacturing Co., Inc. "Perma-Loc", "or approved equal".
 - 10. ASTM B88 – Seamless Copper Water Tube
 - 11. Eslon Engineering Manual for Plastic Piping Systems
 - 12. ASTM D2563 – Fabricated, Fiberglass Wrapped PVC Pipe Fittings 12", 14", and above, Schedule 40 or 80 manufactured from PVC pipe conforming to ASTM D1785 and compliant to the most recent publication of the "Spears General Specification for Standard Fabricated Fittings (FAB-7-702)". Butt-fusion welded fabricated fittings are not acceptable. All fittings shall be certified for potable water service by NSF. As manufactured by Spears Manufacturing Company or "approved equal"
 - 13. CLASS 150 - All plastic pipe flanges shall be Class 150 and of the same schedule as the associated pipe with neoprene gaskets where required.

1.4 QUALITY ASSURANCE

- A. Qualifications of Pool Contractor
 - 1. Work of this Section shall be performed by a Contractor who has a proven record of competence and experience in the construction of similar facilities of this size and complexity for not less than 5 years. Contractors shall have an established record of reliability.
- B. The following tests shall be performed during construction of the project. Refer to General Conditions and Division 01 for further requirements.
 - 1. Testing and Flushing of Piping

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- a. Contractor shall be responsible for discovering leaks and making necessary repairs.
 - 1) Pressure piping and suction piping: After the piece is laid, the joints completed and the trench partially backfilled, leaving joints exposed for examination, subject new lines to a hydrostatic pressure of not less than 50 pounds per square inch. Joints shall remain watertight under this pressure for a period of two (2) hours. All air must be expelled from pipes prior to testing.
 - 2) Gravity lines: A water test shall be applied to all gravity drain piping systems, either in their entirety or in sections. All openings shall be tightly plugged and each system filled with water and tested with at least a 10 foot head of water (4.3 psi). The water shall be kept in the system, or in the portion under test, for at least fifteen (15) minutes before the inspection starts. System shall be watertight at all joints.
 - 3) Leaks shall be repaired and tested repeatedly until leakage or infiltration is approved.
- b. Provide test results to the Architect/Engineer before covering with concrete.

1.5 SUBMITTALS

- A. Refer to General Requirements and Division 01.
- B. Product Data: For each type of manufactured material and product indicated.
- C. Provide Shop Drawings showing all pipe penetration locations through concrete pump pit walls and concrete surge tank walls. Include dimensioned location of pipe penetrations in plan and elevation view, pipe sizes, sleeve sizes, link-seal sizes, and sleeve and link-seal material/product information.
- D. Provide a submittal including system drain valves and location of drain valves for Owner's use during pool shutdown and/or pool winterizing.

1.6 SUBSTITUTIONS

- A. Refer to General Requirements and Division 01.

PART 2 - PRODUCTS

2.1 PIPE BEDDING & BACKFILL MATERIALS

- A. Pipe Trench Foundation/Subbase: In-situ soils meeting the Project Geotechnical Report requirements for preparation. Trench base materials shall be free of large rocks, organic matter, and other deleterious substances.
- B. Pipe Trench Embedment Zone (bedding, haunching, initial backfill):
 - 1. Existing subsoil materials shall not be used for pipe bedding.
 - 2. Condition 1: ASTM D 2487 Class 1A Aggregate.
 - a. Manufactured aggregates containing little or no fines including angular, crushed stone or rock, crushed slag, cinders, or shell.
 - b. Open graded, clean: $\leq 10\%$ Passing No.4 sieve, $< 5\%$ Passing No. 200 sieve
 - c. Maximum pipe diameters $\geq 6"$: Maximum aggregate size $\leq 1.5"$.
 - d. Maximum pipe diameters $< 6"$: Maximum aggregate size $3/4"$.
 - e. Where conditions may cause migration of fines into the trench from adjacent soil (and loss of pipe support) apply Condition 2 and use Class 1B Aggregate. Alternatively, include the addition of a filter fabric between the trench and Class 1A aggregate to prevent migration of fines into the embedment zone.
 - 3. Condition 2: ASTM D 2487 Class 1B Aggregate.
 - a. Use where conditions may cause migration of fines from adjacent soil and loss of pipe support. Process materials as required to obtain gradation which will minimize migration of adjacent materials.

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- b. Manufactured processed aggregates; angular, crushed stone (or other Class IA materials) and stone/sand mixtures with gradations selected to minimize migration of adjacent soils.
 - c. Dense graded, clean: $\leq 50\%$ Passing No.4 sieve, $< 5\%$ Passing No. 200 sieve
 - d. Maximum pipe diameters $\geq 6"$: Maximum aggregate size $\leq 1.5"$.
 - e. Maximum pipe diameters $< 6"$: Maximum aggregate size $3/4"$.
 - C. Final Pipe Trench Backfill: Use on-site existing soils meeting the Project Geotechnical Report requirements for backfill materials. Final trench backfill may not include organic material, clay, topsoil, or other deleterious substances. The source and suitability of all proposed off-site fill shall be confirmed by the Project Geotechnical Engineer prior to bringing material on site.
- 2.2 PIPE & FITTINGS
 - A. Refer to Section 1.03 for pipe and fitting requirements.
 - B. Refer to pipe schedule(s) on drawings for size and type.
- 2.3 THREAD TAPE
 - A. Teflon 2
- 2.4 SOLVENT CEMENTS AND PRIMERS
 - A. PVC pipe shall be installed using solvent weld materials including primers, cleaners, and cements. All solvent weld materials, methods, and applicator tools shall conform to all ASTM Standards for solvent cements used for plastic pipe installations.
 - B. Manufacturer: IPS Corporation, Weld-On Product Line
- 2.5 WALL SLEEVES
 - A. Pipes penetrating all watertight walls shall use "Century Line" thermoplastic wall sleeves in combination with "Link Seals" having stainless steel service designation. As manufactured by Thunderline Corporation, or the Metraflex Company, "or approved equal".
- 2.6 NON-SHRINK GROUT
 - A. Upcon High Flow, The Upco Company, Cleveland, Ohio; Masterflow 713, The Master Builder Company, Cleveland, Ohio; Duragrout, L & M Construction Chemicals, Inc., Omaha, Nebraska.
- 2.7 PIPE SIGNAGE
 - A. Brady, B-946, custom legend, self-sticking markers, and arrows or equal.

PART 3 - EXECUTION

- 3.1 PIPE INSTALLATION
 - A. Pool Pipe Trench Excavation
 - 1. General:
 - a. Excavation for all pool systems and related piping shall comply with the following:
 - 1) Division 31 Earthwork Specifications for buried utilities.
 - 2) Project Geotechnical Report requirements for pipe trench preparation, backfilling, and engineered fill.
 - 3) Current OSHA criteria and regulations.
 - b. See pool pipe plans for additional piping details, notes/requirements, pipe routing, material types and sizes.
 - 2. Pipe Trench Requirements: Excavate pool piping trenches to proper depths for pool operations, required pipe slopes, and a minimum final cover plus backfill depth of 36-inches. Trench widths shall be minimized as indicated in the Pool Drawings "Typical Pool Pipe Trench Detail" and as required for proper compaction. Maintain a clear trench width of 6 to 12-inches beyond the nearest pipe wall. Maintain a minimum of 6-inches between

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each adjacent pipe. Protect the soils adjacent to the trench to maintain an undisturbed condition for optimal pipe support.

3. Pipe Trench Foundation/Subbase: The trench bottom shall be smooth and free from large dirt clods, frozen material, and stones greater than 1.5-inches in diameter. A subbase is necessary only when native subgrade soils are unstable. For such conditions, over excavate the subgrade soils and place a layer of supportive engineered fill material as the trench subbase. Compact subbase materials to provide a firm foundation for the subsequent pipe embedment materials. Match the compaction effort specified in the Final Backfill layer of the pipe trench.

B. Pool Pipe Bedding & Backfill

1. Embedment Zone: Controlled placement of pipe trench materials is required in the embedment zone for pipe performance and to minimize deflection. Schedule inspections prior to the backfilling as needed, however backfilling the embedment zone should follow pipe assembly as closely as possible to protect the pipe from falling debris, minimize the possibility of flooding an open trench and avoiding shifting pipe. See Part 2 PRODUCTS for material specifications and assure selected embedment zone materials are free from dirt clods, clay, frozen materials, and rocks greater than 1.5-inches in diameter. Place materials in six-inch lifts in the following three subzones:
 - a. Bedding: Place six inches of supportive, compacted bedding materials beneath the pool piping to provide uniform longitudinal support under the pipe, prevent low spots, and to set piping to the proper grade. Do not use blocking of any type to bring the pipe to grade. If the native trench soil is comprised of fine grain soils and migration of those soils into the bedding material is anticipated, a well-graded bedding material without voids or a fabric barrier should be used to avoid compromising the trench backfill materials. Consult the Geotechnical Report for specific recommendations.
 - b. Haunching: Haunching is required from the bottom of the pipe to the centerline of the pipe ("springline"). To provide resistance to pipe deflection compaction of the haunching zone is required prior to placement and compaction of the initial and final backfill. Place the haunching materials by hand to give effective support of the pipe. Compact materials using shovel slicing and/or firmly tamping the materials under the pipe haunches, around the pipe, up to the spring-line of the pipe and out to the trench walls. If automatic tampers are used, avoid contacting and damaging the pipe. Control haunching to avoid vertical and horizontal displacement of the pipe from proper alignment.
 - c. Initial Backfill: The initial backfill extends from the pipe springline to a point above the top of the pipe. Place the initial backfill in 6-inch maximum loose lifts to a 12-inch minimum depth of cover above the pipe. Using small handheld or walk behind vibratory plate tampers, compact the initial backfill zone to a level no higher than $\frac{3}{4}$ of the pipe diameter, taking care not to contact the pipe/s. Do not compact the initial backfill layer directly above the pipe.
2. Final Backfill: This zone extends from the top of the initial backfill to the top of the trench and up to final grade. Adjust final grades as required to allow for landscaping, flatwork, or roadwork materials if applicable. Place materials for this zone using materials and compaction efforts in accordance with the Geotechnical Report and/or Division 31 Specification requirements. If those requirements are not provided, place materials in accordance with the following:
 - a. +/- 2% of the optimum moisture content
 - b. 12-inch maximum lifts, as measured in loose thickness.
 - c. Uniformly compact each lift to a minimum of 95 percent of the material's ASTM D-1557 Modified Proctor Maximum Dry Density, prior to placement of subsequent lifts.
 - d. Place each subsequent lift and compact in a similar manner until achieving proposed finished grades.
 - e. Final cover plus backfill materials shall measure a minimum of 36-inches above the top of the pipe/s unless noted otherwise on the plans or details.

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C. Piping Placement and Use

1. Base Bid shall be on pipe materials shown. See the PL Drawings and associated schedules for required pipe material types.
2. All material transitions shall be above-grade, flange to flange connections and include ribbed EPDM type rubber gaskets. Below-grade materials transitions will not be allowed.
3. Piping must be laid on a grade so it will drain completely by gravity. In all instances where gravity drainage is not provided, the contractor shall install drain valves so that all lines can be drained completely. Shop drawings will be required on any such installation.
4. No installation shall be made that will provide a cross connection or inter-connection between distribution supply for drinking purposes and the swimming pool that will permit a backflow of water into the potable water supply. Pipe openings shall be closed with caps or plugs during installation. Equipment and pool fittings shall be tightly covered and protected against dirt, water and chemical or mechanical injury. At the completion of work the fittings, materials and equipment shall be thoroughly clean and adjusted for proper operation.
5. All gutter lines shall drain by gravity to the surge tank.
6. All above grade outdoor piping shall be painted, in accordance with the manufacturer's recommendations, to protect against ultraviolet degradation.

D. PVC Pipe

1. Cut all pipe with mechanical cutter without damage to pipe.
2. Placing and laying: Inspect pipe for defects before installation. Clean the interior of pipe thoroughly of foreign matter and keep clean during laying operation. Pipe shall not be laid in water or when trench conditions are unstable. Water shall be kept out of the trench until the pipe is installed. When Work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth or other substance will enter the pipes or fittings.
3. Threaded joints: After cutting and before threading, the pipe shall be reamed and shall have burrs removed. Screw joints shall be made with graphite or inert filler and oil or with an approved graphite compound applied to male threads only. Threads shall be full-cut and not more than 3 threads on the pipe remained exposed. Use Teflon II tape on the male threads of all threaded pipe joints. Caulking of threaded joints to stop or prevent leaks will not be permitted. Unions shall be provided where required for disconnection of exposed piping. Unions will be permitted only where access is provided.
4. All PVC pipe connections shall be flanged or solvent welded.
5. Solvent welded joints shall be made in accordance with the manufacturer's printed instructions and the following minimum standards:
 - a. All fittings shall fit easily on the pipe before applying cement. The outer surface area of pipe and inner wall of fitting shall be dry and clean. Cleaner is to be applied to the outer surface of the pipe and to the inner surface of the fitting. Cement is to be applied to the outer surface of the pipe, or on the male section of fittings only. When the outside surface area of the pipe is satisfactorily covered with cement allow ten (10) seconds open time to lapse before inserting pipe end into fittings. After full insertion of pipe into fitting, turn fitting about the pipe end approximately 1/8 to 1/4 of a turn. Wipe off excess cement at the joint in a neat cove bead. Follow manufacturer's instructions on solvents. Remove all debris, including, containers, brushes, applicators and other items from premises, dispose of properly. Burying of debris on site is not permitted.
 - b. In addition to the requirements outlined above, the solvent weld process for pipe sizes of 6" diameter and larger includes additional requirements outlined below. As pipe diameter increases, so does the difficulty in installing it. Follow all of the solvent weld manufacturer's recommendations for larger diameter pipe.
 - 1) The installer shall use proper size applicators to ensure enough cement is applied to fill the larger gap that exists between the pipe and fittings.
 - 2) Use the applicable cement for the size of pipe and fittings being installed.

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- 3) End of pipe must be cut square and chamfered (beveled).
 - 4) Provide adequate crew size to properly handle and fit pipe installations.
 - 5) It is important in large diameter joining that the primer and cement be applied simultaneously to the pipe and fittings. Apply a second, full layer of cement to the pipe. Pipe must be bottomed into the fitting.
 - 6) Large diameter pipe and fittings require longer set and cure times. Prefabricate as many joints as possible. If pipe is to be buried, fabricate as many joints as possible above ground, after joints have cured, carefully lower into trench.
 - c. All joints shall remain completely undisturbed for a minimum of 10 minutes from time of jointing the pipe and fitting. If necessary, to apply pressure to a newly made joint, limit to 10% of rated pipe pressure, during the first 24 hours after the joint has been made.
 - d. Make provisions for expansion and contraction by way of swing joints or snaking.
 - e. Protect plastic pipe from exposure to aromatic hydrocarbons, halogenated hydrocarbons, and most of esters and ketones that attack the material. Protect all pipe from mechanical damage and long exposure to sunlight during storage.
 - f. PVC welding is not allowed without prior approval of the Architect/Engineer.
- E. Field Coordination
1. It is the Contractor's responsibility to provide piping by means that account for all necessary coordination, including, but not limited to: water stops, oversize sleeves, pipe supports, valves and other attachments, over-excavations required for fusion machinery or other equipment, etc.
 2. Provide pipe extensions and temporary caps necessary for pressure testing requirements.
 3. Contractor is required to provide coordination and adequate protection as needed to all external services (i.e., ducts, pipes, cables) that run throughout the project site. Plumbing shall be located and placed to prevent damage during and after construction from traffic loads above.
- F. Overhead piping in mechanical room/pool room shall be run such that a minimum head clearance of 7'-0" is observed to all piping, pipe fittings and pipe hangers/supports. Piping runs shall not create path obstruction or a tripping hazard.
- G. Pipe Identification
1. Provide identification on all piping located in mechanical equipment, chlorine, acid rooms, heater courts, etc.
 2. All piping in Mechanical Room to be labeled with description of line and arrows indicating direction of flow.
 3. Mark at least once on each line and at 5 ft. intervals minimum. Consult Health Department Code for minimum marking requirements.
 4. Color code per Health Department requirements. If code does not identify color coding requirements consult Architect/Engineer.
- 3.2 SLEEVES AND WALL PENETRATIONS
- A. Patch exterior side of wall penetrations with non-shrink grout. Other methods of water tightness shall be pre-approved by the Architect/Engineer.

END OF SECTION 13 11 20

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SECTION 13 11 23 POOL PIPE SUPPORTS

PART 1 - GENERAL

- 1.1 SECTION INCLUDES
 - A. Pipe Hangers & Supports.
- 1.2 RELATED DOCUMENTS
 - A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.
- 1.3 SUBMITTALS
 - A. Refer to General Requirements and Division 01.
 - B. Product data including manufacturer's specifications, installation instructions.
 - C. Shop Drawings showing type and locations.
- 1.4 SUBSTITUTIONS
 - A. Refer to General Requirements and Division 01.
- 1.5 DELIVERY, STORAGE AND HANDLING
 - A. Refer to General Requirements and Division 01.

PART 2 - PRODUCTS

- 2.1 MATERIALS
 - A. Hangers and Supports
 - 1. General
 - a. All hangers, pipe supports, threaded rod, hardware, etc. shall be hot-dipped galvanized steel, ASTM A123, or type 304 stainless steel or better grade.
 - b. All piping connections and support hardware inside surge tanks and gutters shall be stainless steel.
 - 2. Strut
 - a. Minimum height 1 5/8", minimum width 1 5/8", minimum thickness 12-gauge material.
 - b. Finish shall be hot-dipped galvanized steel, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.
 - 3. Strut Clamps
 - a. Pipe sizes 1/2" thru 12", two-piece clamps with clamping bolt and nut. Pipe sizes 14" and larger, provide "U" bolts, nuts and washers.
 - b. Finish shall be hot-dipped galvanized steel, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.
 - 4. Strut Accessories
 - a. Flat plate fittings, corner braces, post bases, etc. Finish shall be hot-dipped galvanized steel, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.
 - 5. Wedge Anchors
 - a. One-piece assembly, 3/8" minimum body diameter.
 - b. Grade 2, hot-dipped galvanized steel anchors and clips, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.
 - 6. Beam Clamps
 - a. Steel "C" clamp type with locknut.
 - b. Finish shall be hot-dipped galvanized, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.
 - 7. Support Components

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- a. All threaded rod, threaded rod couplings, nuts, washers, etc. Finish shall be hot-dipped galvanized, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.
- 8. Exposed/cut Ends: All galvanized channel supports or other metallic pipe support hardware that is cut shall be field treated to cold galvanize over all exposed/compromised areas with a 95% zinc rich paint to a 1.0 to 3.0 mil thickness.
- B. Locations
 - 1. In the Pool/Waterpark/Natatorium Room: All piping supports, connections and support hardware shall be type 304 stainless steel or better grade, ASTM A240.
 - 2. Inside Surge/Collector Tanks & Gutters: All piping supports, connections and support hardware shall be type 304 stainless steel or better grade, ASTM A240.
 - 3. In the Pool Mechanical Room: All piping supports, connections and support hardware shall be hot-dipped galvanized, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.
 - 4. Pump Support Pads: All pump equipment pad support channels and anchor hardware shall be type 304 stainless steel or better grade, ASTM A240.
 - 5. Pool Chemical Rooms: All piping supports, connections and support hardware shall be fiberglass or type 304 stainless steel or better grade, ASTM A240.
 - 6. Exterior Locations: All piping supports, connections and support hardware installed outside and exposed shall be hot-dipped galvanized, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.

PART 3 - EXECUTION

3.1 GENERAL

- A. All mechanical room piping must be properly supported using the schedule indicated on the drawings as a guideline for maximum allowable spacing between supports.
- B. It shall be the contractor's responsibility to properly support piping at all valves, pumps, equipment, overhead areas, and changes in direction.
- C. All piping must be supported laterally as well as vertically hung.
- D. Ring, clevis, roller, and J hook type hangers are not acceptable.
- E. Exposed/cut Ends: All galvanized channel supports or other metallic pipe support hardware that is cut shall be field treated to cold galvanize over all exposed/compromised areas with a 95% zinc rich paint to a 1.0 to 3.0 mil thickness.
- F. Comply with manufacturer's written instructions.

END OF SECTION 13 11 23

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 24 POOL VALVES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Butterfly Valves
- B. Ball Valves
- C. Check Valves
- D. Expansion Joint/Flexible Connector
- E. Modulating Float Valves
- F. Modulating Electrical Main Drain Valves
- G. Submerged Service Operators
- H. Valve Operator Extension
- I. Drainage Valves
- J. Reducers

1.2 RELATED DOCUMENTS

- A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.3 REFERENCES

- A. The following latest edition reference specifications, guides and standards shall become part of this Specification as if herein written. If provisions conflict, the more stringent provisions shall apply.
 - 1. ANSI – American National Standards Institute
 - 2. ASTM – American Society of Testing Materials

1.4 SUBMITTALS

- A. Refer to General Requirements and Division 01.
- B. Submit Shop Drawings, clearly indicating make, model, location, type, size, pressure rating, and type of service.
- C. Valve charts
 - 1. Submit two copies of valve charts for each piping system, consisting of isometric Drawings, or piping layouts showing and identifying each valve and describing its function to the Architect/Engineer for approval.
 - 2. Upon completion of the Work, one copy of each valve chart sealed to rigid backboard with clear lacquer, placed under glass and framed, shall be hung in a conspicuous location in the equipment room.

1.5 SUBSTITUTIONS

- A. Refer to General Requirements and Division 01.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to General Requirements and Division 01.

1.7 WARRANTIES

- A. Standard Manufacturer's Warranty

PART 2 - PRODUCTS

2.1 GENERAL

- A. Cast Iron valves 3" and larger shall have an epoxy coated body on all interior and exterior surfaces, ductile iron-nylon II coated disc, one piece 416 stainless steel shaft with Buna-N or EPDM seat minimum, 150 PSI rating, or cast aluminum ASTM S12A housing and fully coated

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 24 POOL VALVES

with Rilsan on all interior and exterior surfaces. Internal components include EPDM resilient lining, Rilsan coated ductile iron disc and T304 stainless steel shaft. 150 psi rating.

- B. Cast Aluminum valves 3" and larger shall have an ASTM S12A body and coated with Rilsan on all interior and exterior surfaces. Internal components include Buna-N or EPDM resilient lining and seat, Rilsan coated ductile iron disc and T304 stainless steel shaft. 150 psi rating.
- C. Thermoplastic valves 3" and larger shall be constructed from PVC Type 1 Cell Classification 12454 or CPVC type 4 cell classification 23447. Thermoplastic valves shall include PVC disc with solid type 316L stainless steel shaft with Buna-N or EPDM seat pressure rated to 150 psi @ 73 degrees Fahrenheit.

2.2 BUTTERFLY VALVES

- A. Butterfly valves 3" - 12" shall be wafer or lug bodies and shall be suitable for use between ANSI 125 and 150 lb. Flanges.
- B. Bodies of the flangeless design shall be provided with at least two bolt guides to center the valve in the pipeline.
- C. All valves shall be as manufactured by Bray Valve (713) 894-5454, Dominion or equal.
- D. All bolts and, nuts and washers shall be corrosion resistant hot-dipped galvanized, ASTM A123 or type 304 stainless steel with plated washers to be used when secured to PVC flanges.

2.3 UV LAMP STRAINER VALVE

- A. EZ Strainer 4" to 12" butterfly type valve with stainless steel strainer disc and shaft, case aluminum Rilsan (nylon) coated valve housing, with manual locking valve handle as manufactured by Neptune Benson. Install on downstream side of UV lamp per UV installation details.

2.4 BALL VALVES

- A. PVC True Union Ball Valves, Ipex, Asahi, Spears or equal.

2.5 CHECK VALVES

- A. ½" thru 2 ½" shall be PVC body, true union, ball type, seal material EPDM as manufactured by Ipex, Asahi Spears or equal as indicated on Contract Drawings.
- B. 3" thru 20" diameter check valves:
 - 1. Type: Split disc wafer style
 - 2. Valve Body: Ductile or cast iron with an epoxy painted exterior
 - 3. Lining: Fully lined with a Buna N elastomer
 - 4. Shaft: 316 stainless steel shaft and shaft plug
 - 5. Plates: 316 stainless steel (3" – 12") or Aluminum Bronze (14"+)
 - 6. Spring & Plate Travel Stop: 316 stainless steel
 - 7. Manufacturer: Center Line Series 800 as manufactured by CRANE ChemPharma & Energy, or Model CVXXK Series by Metraflex, or approved equal.

2.6 EXPANSION JOINT/FLEXIBLE CONNECTOR (where required)

- A. Shall be the Metrasphere, Style R with EPDM body and threaded bolt holes, Model #MSREE Series manufactured by Metraflex, as indicated on drawings. Install with a control unit assembly (tie rods) from flange to flange per manufacturer's instructions to minimize expansion joint damage caused by excessive motion.

2.7 MODULATING FLOAT VALVES

- A. Float operated modulating valve shall be designed for submerged service.
- B. The housing body shall be fabricated using Sch. 80 PVC pipe with Sch. 80 PVC van stone flanges. The internal wafer shall be 12 gauge T304L material and positioned with 1/8" (+1/16") clearance around the perimeter. The body shall also incorporate an interior stop plate constructed of PVC to define that allowable range of arm motion. Close fitting Delrin bushings

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 24 POOL VALVES

shall be included on the shaft penetration of the body to provide a seal against water loss and air entrance.

- C. The valve shaft shall be T304L material 1" in diameter. Float arms shall securely fasten to shaft using T316SS nuts with washers to provide adjustability. Arms shall be ½" diameter all thread rod T316SS with length as required. Valve sizes 14" – 20" shall have ¾" square tubing for arms.
- D. Ball floats shall be constructed of T304L stainless steel and be 7" in diameter with internal weighting. Floats shall also be adjustable using T316SS nuts with washers as previously described. Provide one (1)/two (2) float arms as shown on the drawings. Valve sizes 14" – 20" shall have 12" diameter cylindrical floats.
- E. The float arms shall be hinged to allow for vertical operation. A 12 gauge T304L bracket shall be provided as a guide to maintain the vertical float positions.

2.8 MODULATING ELECTRONIC MAIN DRAIN VALVES

- A. The modulating electronic main drain valves shall be assembled and installed as specified in the Contract Drawings. The purpose of the valve is to use the surge tank and/or balance tank water level as a means of electronically adjusting and controlling the flow from the pool main drain plumbing.
- B. Provide and install equipment as detailed in the Contract Drawings and as follows:
 - 1. The surge tank sensor and transmitter (Basis of Design): Shall be a BECSys, Model SLS continuous level sensor, or equal with the following characteristics:
 - a. Piezoresistive pressure measurement of the water column.
 - b. Automatically adjusts for changes in atmospheric pressure.
 - c. Factory calibrated.
 - d. Field configurable sensor length.
 - e. Solid-state; no moving parts that can wear out over time.
 - f. Installation options for wall mount and stand pipe glass configurations.
 - 2. Digital Processor (Basis of Design): Is internal with the BECSys 7 Chemical Controller or approved equal (see pool mechanical and main drain detail on PL drawings). Program settings as shown on detail per the manufacturer's instructions. The controller shall continuously monitor, display and data log surge tank level with 10 mm (0.4") resolution or better. The controller shall also use the surge tank level to control a water makeup valve to maintain water level (Autofill) and/or control a main drain modulating valve.
 - 3. Valve: One (1) butterfly valve. Valve shall be one pipe size smaller than the main drain pipe.
 - a. See "Butterfly Valves" within this specification section for additional valve material and manufacturer requirements.
 - 4. Valve Positioner:
 - a. DHC-100 digital positioner, electronic actuator with manual over-ride wheel operator, and battery back-up.
 - b. Positioner: Pushbutton calibration to plus/minus 0.1 degree within a 90-degree quadrant. See detail for range of positions. Fail position (loss of command/signal) shall be 100% closed.
 - c. Electronic Actuator: Provide Series 92 Quarter master Protek Failsafe electric actuator with rechargeable battery pack and low battery indicator. Voltage: Available in 115/230VAC and 12/24VDC, 0.2 to 4.0 amp draw.
 - d. Manufacturer: Asahi America, Inc., www.asahi-america.com; or equal.

2.9 SUBMERGED SERVICE OPERATORS

- A. Use only approved service operators for the valve requiring underwater operation in the surge tank or in manhole used for pool draining.

2.10 VALVE OPERATOR EXTENSION

- A. Extensions shall be stainless steel and by same manufacturer as the valve manufacturer.

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 24 POOL VALVES

2.11 DRAINAGE VALVES

- A. Provide min. 3/4" True Union Ball valve on all piping at such a location to allow complete drainage of system.

2.12 REDUCERS

- A. Use Eccentric reducers on pump suction lines only and concentric reducers on pump discharge lines only.
- B. Stainless steel body and flanges, T304 materials, ANSI 125# rated flanges.
- C. Use Neptune Benson, 15-CNS/15ECS series "or equal".
- D. Provide valves of same manufacturer throughout where possible and practical.
- E. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.

2.13 VALVE LABELS

- A. Provide and install 2" round, 1/16" thick, multi-layered valve tags with contrasting lettering with non-corrosive beaded tie on all valves. All labels shall be labeled in accordance with the valve chart per Section 13 11 14.

PART 3 - EXECUTION

3.1 VALVE CONNECTIONS

- A. Provide valves suitable for connection to adjoining piping.
- B. Valve size shall be the same as the pipe size.

3.2 VALVE USE

- A. Pipe sizes 3" - 14" – Butterfly
- B. Miscellaneous valves 1/2" – 2-1/2" - PVC True Union Ball Valves
- C. All chemical lines and equipment - PVC True Union Ball Valves

3.3 VALVE OPERATORS

- A. All butterfly valves shall have gear operators and chain operators as required unless drawings indicate otherwise. Chain operators shall be required on all gear operators located 7'-0" or higher above finished floor.
- B. Provide extension lengths as necessary to operate submerged or below surface valves and the appropriate valve box access cover.

END OF SECTION 13 11 24

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 25 POOL CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pumps
 - 1. Flooded Suction
 - 2. Self-Priming Thermoplastic
- B. Pump Accessories
 - 1. Pump Strainers
 - 2. Gauges
 - 3. Flow meters

1.2 RELATED DOCUMENTS

- A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.3 REFERENCES

- A. The following latest edition reference specifications, guides, and standards shall become part of this Specification as if herein written. If provisions conflict, the more stringent provisions shall apply.
 - 1. Hydraulic Institute Standards
 - 2. Institute of Electrical and Electronics Engineers Standards (IEEE)
 - 3. National Electrical Manufacturers Association Standards (NEMA)
 - 4. Occupational Safety and Health Administration Rules and Regulations (OSHA)
 - 5. National Sanitary Foundation (NSF)
 - 6. American Society for Testing and Materials Standards (ASTM)
 - 7. American Iron and Steel Institute (AISI)
 - 8. American National Standards Institute (ANSI)
 - 9. ASTM A48 – Standard Specification for Gray Iron Castings
 - 10. ASTM B584 – Standard Specification for Copper Alloy Sand Castings for General Applications
 - 11. AISI 1045
 - 12. ASTM B62 – Standard Specification for Composition Bronze or Ounce Metal Castings

1.4 DESCRIPTION OF WORK

- A. The pumping units shall be installed in accordance with the instructions of the manufacturer and as shown on the drawings by the Architect/Engineer.
- B. Pump capacity, horsepower, TDH (Total Dynamic Head), speed, suction and discharge diameters, type, and other requirements shall be as shown on the drawings and shall comply with the requirements as specified herein.
- C. The General Conditions shall apply to this Section as fully as if repeated herein.

1.5 QUALITY ASSURANCE

- A. To assure a properly integrated and compatible system, the Equipment Manufacturer shall assume full responsibility for the warranty and proper operation of the pumps and/or accessory equipment.
- B. Acceptable Products and Manufacturer: As listed on the contract documents or included herein or, an Engineer approved equal product and manufacturer.
- C. All pumps and strainers shall be NSF50 certified as provided, including required coatings, and shall be labeled as such on the serial number identification tag.

1.6 SUBMITTALS

- A. Refer to General Requirements and Division 01.

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 25 POOL CENTRIFUGAL PUMPS

- B. Submit complete motor and pump data together with shop drawings for the driven machine. All material is to be collated in a card stock binder, with pockets for large drawings, and with index. This data shall be prepared by the motor and/or pump manufacturer and shall include:
 - 1. Pump manufacturer and model number, name of motor manufacturer, type of pump and motor with dimensioned drawings.
 - 2. Characteristic curves at full load motor speed showing flow, TDH, efficiency, horsepower, and NPSH required. For all VFD applications include a family of performance curves, separate of the full load motor speed curve, for speeds of 105%, 100%, 89%, 83%, 66%, and 50% of the scheduled RPM.
 - 3. Nominal motor horsepower, speed at full load, frame size, enclosure construction, winding insulation class and treatment, temperature rise at nominal horsepower, service factor, voltage rating (indicate if dual voltage), number of phases, frequency rating, full-load amperes at nominal horsepower for application voltage, starting code letter, or locked rotor KVA or amperes.
 - 4. Complete pump description plus material list including casings, impellers, seals, shaft, bearing frame, motor mounts, guards, base plate, exterior coating type and mill thickness.
 - 5. Installation Instruction and Operation and Maintenance Manuals shall include recommended protection and maintenance required for storage prior to putting pumps in service and may be submitted any time before shipment of the pumps.
- 1.7 SUBSTITUTIONS
 - A. Refer to General Requirements and Division 01.
- 1.8 DELIVERY, STORAGE, AND HANDLING
 - A. Refer to General Requirements and Division 01.
- 1.9 WARRANTIES
 - A. Manufacturer's standard pump warranty. Warranty on mechanical seals covering 100% of the cost on all parts and labor extending over the same time period as the standard pump warranty.
 - B. Flooded Suction Pumps
 - 1. Pump failure of any pump component directly attributable to materials and/or workmanship within one (1) year after substantial completion shall be repaired or replaced by the pump manufacturer at no cost to the Owner.
 - 2. Motor failure of any motor component directly attributable to materials and/or workmanship within three (3) years after substantial completion shall be repaired or replaced by the pump manufacturer at no cost to the Owner.
 - C. Self-priming, integral strainer pumps shall be provided with a minimum one-year warranty covering failure of any pump/motor/strainer component directly attributable to materials and/or workmanship.

PART 2 - PRODUCTS

- 2.1 END SUCTION, CENTRIFUGAL PUMPS
 - A. General
 - 1. Pump performance shall be optimized with provision of variable speed drives where designated in the drawings.
 - 2. Operational Pump Characteristics
 - a. Engineer has the right to reject any pump with a pump curve having a design point operating efficiency more than 5% below the operating efficiency of the scheduled pump provided on the drawings.
 - 3. Furnish and install horizontal close-coupled end suction centrifugal pumps as specified on the Contract Drawings or as pre-approved by the Architect/Engineer.
 - B. Materials of Construction:
 - 1. Flooded Suction Pumps

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 25 POOL CENTRIFUGAL PUMPS

- a. Pump internal materials shall be as follows:
 - 1) Casing – Ductile Iron (ASTM A536)
 - 2) Impeller – 316 Stainless Steel
 - 3) Shaft – 316 Stainless Steel
 - 4) Shaft Sleeve – 316 Stainless Steel
- b. Coating: All internal cast iron wetted parts shall be sandblasted and coated per the coating manufacturer's recommendations with Scotchkote 134 or equal product.
- c. Casing
 - 1) The casing will be of the end suction design with tangential discharge outlet. For suction piping diameters of 2" or greater, the suction and discharge shall be bolt through flanged connections. Flange connections shall be ANSI 125# rated with NPT gauge tapings.
 - 2) The casing shall have tapped and plugged holes for priming and draining. The casing bore shall be large enough to allow "back pullout" of the impeller without disturbing the casing or suction and discharge piping. The casing shall be supported by casing feet to avoid pipe strain.
- d. Impeller: The impeller shall be of the enclosed type, vacuum cast in one piece. It shall be finished all over, the exterior being turned and the interior being finished smooth and cleaned of all burrs, trimmings and irregularities. The impeller shall be dynamically balanced. The impeller will be keyed to the shaft, and fastened with 316 stainless steel washers, gasket and cap screw.
- e. Mechanical Seal: Shaft sealing shall be accomplished by means of a John Crane Type 21 or equal mechanical seal with solid silicone carbide face/primary ring; solid silicone carbide seat/mating ring; 316 stainless drive band, retainer and spring; and Buna-N elastomers.
- f. Shaft: The impeller shall be direct coupled to the 316SS motor shaft. The motor shaft shall be machined to provide a key way and drilled and tapped to accept the impeller fastener. Stub shafts are not acceptable.
- g. Shaft Sleeve: The pump shaft shall be fitted with a 316SS shaft sleeve to minimize shaft wear. The sleeve shall be sealed to the impeller hub by an O-ring and shall be positively driven by a pin to the key way. The use of adhesive compounds to fasten the sleeve to the shaft shall not be accepted.
- h. Pump / motor must mount on the same plane and preserve back-pull-out design. 304SS MOTORIZER shall be supplied when pump mounting feet and motor feet do not align.
- i. Pump nameplate shall be engraved via computer on 316SS data plate.
- j. Motor
 - 1) The motor shall be a NEMA-JM configuration motor meeting current NEMA Premium Efficiency Standards and shall be totally enclosed fan cooled (TEFC). NEMA –JP configurations shall only be used on large pumps (Aurora 6x8x13.5 & 8x10x13.5) only.
 - 2) The motor shall have a service factor of a least 1.15. The service factor is reserved for variations in voltage and frequency.
 - 3) Motor must be rated for use with a Variable Frequency Drive and meet the NEMA MG1 Standard, Part 30.
 - 4) Motors shall have 316SS shaft
 - 5) Motors must achieve 15:1 constant torque turndown.
 - 6) Motors shall come equipped with internal shaft grounding brush.
 - 7) Motors Frames 326 and below shall have removable feet to achieve F1, F2, & F3 field convertible conduit box position.
 - 8) Motor Conduit box shall have NPT threaded entry
 - 9) The motor shall have a sufficient horsepower rating to operate the pump at any point on the pump's head capacity curve at full load speed (60 Hz) regardless of selected operating speed without overloading the nameplate

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 25 POOL CENTRIFUGAL PUMPS

horsepower rating of the motor, regardless of service factor. Vendor shall confirm that motor current does not exceed allowable full load amperage at reduced frequency. Vendor shall verify scheduled horsepower meets above requirements. In no case shall the horsepower be less than indicated on the Drawings without specific approval from the Engineer.

- 10) Electrical requirements including phase, frequency, and voltage are indicated on the Drawings.
2. Self-Priming Thermoplastic Pumps
 - a. Pump internal materials shall be as follows:
 - 1) Casing – Thermoplastic Resin
 - 2) Impeller – Thermoplastic Resin
 - 3) Case Wear Ring – Bronze (ASTM B505)
 - 4) Shaft – Hardened Steel (AISI 1045) or Stainless Steel (ASTM A895)
 - 5) Shaft Seal – Ceramic and carbon seal faces, with stainless steel, brass, and Buna N materials in the bellows portion.
 - b. Impeller: The impeller shall be of the enclosed type, molded in one piece. The impeller will be secured to the shaft by means of a stainless-steel key and locking screw into the end of the motor shaft.
 - c. Case Wearing Ring: The pump casing shall be fitted with a diffuser. The diffuser has a bronze case wear ring to minimize abrasive and corrosive wear to the casing. The case wear ring shall be of the radial type, press fitted into the diffuser.
 - d. Shaft: The impeller shall be direct coupled to the motor shaft.
 - e. Shaft Seal: The pump shaft shall be fitted with a shaft seal to minimize shaft wear. The shaft seal shall be Ceramic and carbon seal faces, with stainless steel, brass, and Buna N materials in the bellows portion.
 - f. Motor
 - 1) The motor shall be a premium efficiency motor meeting current NEMA Standards and shall be totally enclosed fan cooled (TEFC).
 - 2) The motor must be rated for use with a Variable Frequency Drive and meet the NEMA MG1 Standard, Part 30.
 - 3) The motor shall have a sufficient horsepower rating to operate the pump at any point on the pump's head capacity curve at full load speed (60 Hz) regardless of selected operating speed without overloading the nameplate horsepower rating of the motor, regardless of service factor. Vendor shall confirm that motor current does not exceed allowable full load amperage at reduced frequency. Vendor shall verify scheduled horsepower meets above requirements. In no case shall the horsepower be less than indicated on the Drawings without specific approval from the Engineer.
 - 4) Electrical requirements including phase, frequency, and voltage are indicated on the Drawings.
 - g. For pumps indicated on the contract documents to be provided with an integral VFD:
 - 1) Drive shall be UL 60730 Compliant.
 - 2) Provide manufacturer's standard control panel and communication cable.
 - 3) Control panel shall include an alarm LED and error message to alert the user of malfunctions.
 - 4) VFD shall include a programmable priming mode with automatic detection of prime for easy start-up and automatic detection of loss of prime.

2.2 PUMP ACCESSORIES

A. Pump Strainers

1. All Horizontal Pumps
 - a. Unless the pump has an integral hair and lint strainer, supply and install strainers equal to those indicated on the Contract Documents.
 - b. Provide each strainer with two strainer baskets.

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 25 POOL CENTRIFUGAL PUMPS

- B. Gauges
 - 1. Provide compound gauges where called for on Drawings and as required by Code.
 - 2. Compound gauges shall be Liquid Filled, 30 Hg to 60 PSI with gauge cock and snubber as manufactured by Weksler, Marsh, Winters or equal.
- C. Flowmeters
 - 1. Provide flow meters where called for on the Drawings and as required by Code on main lines and on branch lines of flow ranges indicated.
 - 2. Flowmeters shall be as specified on the contract documents or approved equal.
 - 3. Transmitter shall have an operating voltage of 12-24VDC and meet appropriate CE, CSA & UL standards. Reading accuracy must be within +/- 0.5% of reading at 25oC. Device shall meet NEMA 4X & IP65.
- D. Pump Labels
 - 1. Provide corrosion-resistant, permanent pump labels with contrasting lettering.
 - 2. Label shall include pump ID from contract drawings and a description. (e.g. "P1A Lap Pool Filtration Pump")

PART 3 - EXECUTION

3.1 PUMP INSTALLATION

- A. The pumping units shall be installed in accordance with the instructions of the manufacturer and as shown on the drawings by the Pool Engineer.
- B. Ensure that the pumps and motors are properly supported and aligned with no pipe strain transmitted to the pump casing.
- C. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations.
- D. Permanently affix pump label to the pump.

3.2 ACCESSORY INSTALLATION

- A. Install accessories as shown on the contract documents and in accordance with manufacturer's instructions.
- B. Strainers shall be supported on a concrete housekeeping pad and provided with sufficient space for maintenance.
- C. Gauges shall be positioned to be read adjacent to the pump or from above, where pumps are in a pump pit.
- D. Field mount the flowmeter and flow meter transmitter as located and shown on the pool plans. Mount transmitter at 4-5 feet above the floor utilizing the 3-8050 universal mounting kit.
- E. Permanently affix pump label to the pump in an easily visible location.

3.3 FACTORY TRAINED REPRESENTATIVE

- A. Provide a factory-trained representative for the purpose of supervising installation, start-up, final field acceptance testing, and providing instruction to the owner's operating personnel in the proper operation and maintenance of the equipment in this section.
- B. Contractor and factory-trained representative shall verify pump flow aligns with the pump curve and calibrate flowmeter as required.

END OF SECTION 13 11 25

DIVISION 13 - SPECIAL CONSTRUCTION

**SECTION 13 11 25
POOL CENTRIFUGAL PUMPS**

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DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 26 POOL PUMP VFD

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Includes:
 - 1. Furnish all labor, materials, tools, and equipment, as indicated, in accord with provisions of Contract Documents.
 - 2. Completely coordinate with work of all other trades.
 - 3. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation shall be furnished and installed as part of this work.
- B. General:
 - 1. See Section 26 0001 for General Electrical Requirements.
 - 2. See Division 1 for General Requirements.
 - 3. Coordinate all requirements with Contractor providing equipment including but not limited to contacts bypass and controls.

1.2 RELATED WORK

- A. Section 26 05 26 – Grounding and Bonding
- B. Section 26 05 53 – Electrical Identification
- C. Section 26 28 13 – Fuses
- D. Section 26 28 16 – Enclosed Switches

1.3 REFERENCE STANDARDS

- A. ANSI/IEEE 519 Guide for Harmonic Control and Reactive Compensation of Static Power Converters.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 01, General Conditions of the Contract, and Section 26 0001.
- B. Include physical, electrical, and performance characteristics of each variable frequency drive and associated components, including dimensions; weight; input and output performance; voltage, phase, current and overcurrent characteristics; installation instructions; protective features; wiring and block diagrams indicating specified options; electrical noise attenuation equipment where required to meet the criteria specified; line side voltage notch wave form and line side current harmonics; certified efficiency versus load and speed curves; and required operating environment.

1.5 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Submit operation and maintenance data under provisions of Section 26 0001 and Division 01.
- B. Instructions to include recommended maintenance procedures, maintenance schedules, recommended spare parts list, and vendor name for those parts.

1.6 EQUIPMENT STARTUP AND AGENCY TRAINING

- A. Provide the services of a factory trained and certified technician to approve the installation; start-up, test, and adjust for proper operation; and instruct and train the Agency's representative in the operation and maintenance of the unit(s). Upon completion of the equipment startup, submit a complete manufacturer's field report, including startup and test log, signed by the factory trained technician. Coordinate with other Contractors as required. The startup shall be completed within ten (10) working days from the startup date.

1.7 WARRANTY

- A. The warranty shall be for a period of 36 months applied from the date of project Substantial Completion, but not to exceed 42 months from shipment. Further, the warranty shall include all

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 26 POOL PUMP VFD

parts, labor, travel time, administrative costs, overhead, travel expenses, technical support and any and all other costs to provide the warranty service.

1.8 COORDINATION

- A. All line voltage power wiring to equipment, factory mounted control panels, to motor control centers, to and from disconnect switches, and to individually mounted starters, and from starter to motors, shall be provided by the Electrical Contractor.
- B. Vendor/Contractor that specifies "starters by Electrical Contractor" shall furnish project specific wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Contractor and indicated to be wired by the Electrical Contractor. In addition, furnish complete sets of wiring diagrams for Owner's bound maintenance manual.
- C. All line, or low voltage, wiring which is not indicated on the drawings, or specified, but necessary to complete the installation, shall be provided by this Division.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. ABB 580 Series
- B. Alternate manufacturer's requests shall be submitted in writing to the Engineer for approval at least 20 working days prior to bid. A compliance list point by point to this specification shall be provided. Factory authorized local support for service for warranty shall be identified.

2.2 DESIGN AND CONSTRUCTION

- A. The unit shall be variable torque, modular design for control of the motors and rated at the motor full load nameplate amps.
- B. The unit shall be UL 61800-5-1 listed, solid state, micro processor-based with a pulse width modulated (PWM) output wave form (none others are acceptable).
- C. The VFD shall employ a full wave bridge rectifier, to prevent line notching, with dual DC bus chokes, capacitors to minimize the ripple of the rectified voltage to maintain near constant DC voltage. Insulated gate bipolar transistors (IGBT's) shall be employed as the output switching device.
- D. Control circuitry shall be plug-in, plug-out modular basis with a corrosion resistant coating on printed circuit boards.
- E. Units to be suitable for an operating environment from 0°C to 40°C temperature and humidity up to 95% non-condensing. The VFD shall be rated to Class 3S2 Pollution degree 2 according to IEC/EN 61800-5-1. The entire VFD package shall be UL listed at 100KA SCCR.
- F. Electrically and physically isolate control circuitry and conductors from power circuitry and power conductors. Control conductors and power conductors shall not be run in the same conduit.
- G. The unit enclosure shall be UL Type 12 (IP55) enclosure for the application minimum. All components shall be factory assembled and tested prior to leaving the manufacturing facility.
- H. Include the following operating and monitoring devices mounted on the front cover:
 - 1. Fused disconnect switch with door interlocked handle and lock-open padlocking provisions (VFDs with no bypass).
 - 2. Operating mode selector switch marked "hand-off-auto". Manual speed adjustment via keypad, mounted on the door.
 - 3. Manual bypass selector switch to select power through drive or bypass where indicated on drawings. A main door interlocked, thermal magnetic circuit breaker (pad lockable, door interlocked) and VFD exclusive fuses on all drives with bypass
 - 4. Pilot light marked "RUN".
- I. Provide a manual bypass circuit and bypass starter to transfer from variable frequency drive operation to bypass operation where indicated on drawings. When no bypass is required, a door interlocked, padlockable disconnect and fast acting fuses are to be provided.
- J. Provide partitioning within drive enclosure to separate and isolate bypass section from variable frequency drive section and to house bypass wiring, contactors, relays, and manual bypass circuit

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so that devices within the converter/inverter compartment are able to be serviced without electrical danger to the service technician.

- K. Starters shall have provisions for additional control requirements such as, but not limited to inputs and outputs for connection to external relays and equipment where required.

2.3 PERFORMANCE REQUIREMENTS

- A. Units shall be suitable for input power of electrical system as scheduled on the drawings $\pm 10\%$ to 15% , 3 phase, 60 Hertz nominal. The VFD shall operate with line voltage $+30\%$ and -35% . All faults shall be selectable for manual or auto restart. The VFD shall detect when a motor disconnect is open and disable the VFD.
- B. Provide minimum 5% line reactor in each AC phase on the input side or 5% dual DC bus reactors to reduce harmonic voltage distortion. Limit line noise, as measured at the point of common coupling, to a voltage factor of 5% or less as defined in IEEE-519, latest edition. If the distortion is greater than that allowed by IEEE-519, latest edition, the line reactor shall be changed in size to ensure compliance. The supplier of the VFD shall provide distortion calculations to be used for setup and analysis.
- C. Use a current limiting control device to limit output current to 110% continuous for one minute; also refer to Protection Features in this section. Full load output current available from drive shall not be less than motor nameplate amperage. The full load amp rating of the VFD shall not be less than the values indicated in the NEC Table 430-150.
- D. Output power shall be suitable for driving standard NEMA B design, three phase alternating current induction motors at full rated speed with capability of 10:1 turndown.
- E. Additional performance capabilities to include the following:
 - 1. Ride through a momentary power outage of 15 cycles.
 - 2. Short circuit and ground fault output protection (power applied only and running).
 - 3. Start into a rotating load without damage to drive components or motor.
 - 4. Capable of automatic restart into a rotating load after a preset, adjustable time delay following a power outage.
 - 5. Programmable time delay following a run command.
 - 6. Input power factor: Min 0.95 throughout the speed range.
 - 7. VFD's shall have a UL listed Short Circuit Withstand Rating of 65,000 AIC.
 - 8. Minimum efficiency: 95% at 100% speed, 85% at 50% speed.

2.4 CONTROL FEATURES

- A. Use control circuits compatible with input signal from control system in the automatic mode and from manual speed control in the manual mode. Vary motor speed in response to the input control signal. Include components necessary to accept the signal from the control system in the form that it is sent. Coordinate with Vendor/Contractor supplying control system and or motor.
- B. Include the following additional control features:
 - 1. Hand-Off-Automatic (HOA) selector switch to select local or remote start/stop and speed control.
 - 2. Analog input, selectable 0-10v or 4-20 mA, for automatic control from a compatible control system. Include an RS-485 port with BACnet protocol. The drive shall be BTL Listed to Revision 14 or later. Use of non-BTL Listed drives are not acceptable. The VFD shall also include a certified PROFINET communication port. Local speed control at the VFD.
 - 3. Local speed control at the VFD.
 - 4. Adjustable acceleration and deceleration rate so that the time period from start to full speed and from full speed to stop can be field adjusted.
 - 5. Adjustable minimum and maximum speed settings for both automatic and manual modes of operation.
 - 6. Three (3) sets of programmable form "C" contacts for remote indication of variable frequency drive condition. Note: default programming to be set for "Drive Run & Fault".
 - 7. Illuminated display keypad. VFD that use codes are not acceptable.
 - 8. External Fault indicator in English that is programmable (i.e. "motor disconnect open").

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9. One (1) input for a N.O. dry contact type input for a 2-wire remote start/stop.
10. One (1) input for a N.C. dry contact type input for external faults: (freezestats, fire alarm, smokes, etc). This input shall be factory wired to prevent both the VFD and bypass starter operation when external fault is present.
11. Jumpered terminals for remote "Emergency Stop" controls.
12. Provide Safe Torque Off circuit according to EN 61800-5-2: 2016, IEC 61508 Parts 1-2:2010, ISO 13849-1:2015, ISO 13849-2:2012, IEC 62061:2015 SIL 3/PL shall be provided in the base VFD.
13. The VFD shall accept a N.O. dry contact that will change the control from a speed follower signal to a PID control. Actual flow and set point shall be displayed on two lines of the keypad. The flow shall be labeled GPM.

2.5 PROTECTION FEATURES

- A. Use electronic protection circuitry in the power circuits to provide an orderly shutdown of the drive without blowing fuses or tripping circuit breakers and prevent component loss under the following abnormal conditions:
 1. Activation of any safety device.
 2. Instantaneous overcurrent and/or over voltage of output.
 3. Power line overvoltage and undervoltage protection.
 4. Phase loss.
 5. Single and three phase short circuiting.
 6. Ground faults.
 7. Control circuit malfunction.
 8. Over temperature.
 9. Output current over limit.
- B. Provide the following additional protective features:
 1. Input transient overvoltage protection up to 3000 volts per ANSI 37.90A; Coordinated AC transient surge protection system consisting of 4 MOVs (phase-to-phase and phase-to-ground), a capacitor clamp, and internal chokes. The MOVs shall comply to UL 1449 4th Edition;
 2. DC bus fusing or other electronic controls which limit the rate of rise of the DC bus current and de-energizes the drive at a predetermined current level;
 3. Where a control transformer is part of the assembly, provide using for the control circuit transformer;
 4. Grounded control chassis; and
 5. Devices and/or control circuitry to ensure that the variable frequency drive and bypass starter are not both energized and driving motor simultaneously.
 6. Motor heating function to prevent condensation build up in the motor. Motor heating adjustment, via parameter, shall be in "Watts."
- C. Provide the following additional protective features:
 1. Coordinated AC transient surge protection system consisting of 4 MOVs (phase-to-phase and phase-to-ground), a capacitor clamp, and internal chokes. The MOVs shall comply with UL 1449 4th Edition. Drives that do not include coordinated AC transient surge protection shall include an external TVSS/SPD (Transient Voltage Surge Suppressor/Surge Protection Device).

2.6 DIAGNOSTICS

- A. Provide an English character display (no error codes) with indicators for the following:
 1. Phase Loss
 2. Ground Fault
 3. Over Current
 4. Over Voltage
 5. Under Voltage

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6. Over Temperature
 7. Overload
 8. DC Buss Status
 - B. Keypad to have Bluetooth interface with a free phone app that has all the functions the keypad does. There shall be a built-in time clock in the control panel with 10-year battery backup. The calendar and timeclock can be used for programmed start/stop and other functions. Bluetooth connectivity shall allow uploading, downloading, and emailing of parameters.
- 2.7 QUALITY ASSURANCE TESTS
- A. Use a factory heat stress test to verify proper operation of all functions and components under full load. Each VFD shall be tested on a motor load. Test results to be provided.
 - B. Field performance test of variable frequency drives to determine compliance with this specification will be performed at the owner's discretion and may include any specified feature, including operation of protective devices through a simulated fault. Contractor will pay for initial testing. Should drive be found deficient by this testing, drive manufacturer will be required to make any and all changes necessary to bring unit(s) into compliance with the specified performance and demonstrate this performance by retesting. Cost of changes and retest will be by this contractor.
 - C. Variable frequency drive manufacturer or designated representative to perform a field test of each drive, in the presence of the owner's representative, for the following items:
 1. Provide general inspection to verify proper installation;
 2. Demonstrate drive reaction to simulated power interruptions of two seconds and sixty seconds;
 3. Demonstrate adequate protection during switching from variable frequency drive operation to bypass starter operation and back again;
 4. Measure and record voltage distortion factor and line notch depth at the point of common coupling. Provide the recorded value as part of the startup report.
- 2.8 BYPASS EQUIPMENT
- A. Bypass Starters:
 1. See Equipment schedule in drawings and provide bypass starters where indicated.
 2. The bypass starters shall be across-the-line magnetic starter type. There shall be a VFD-Off-Bypass selector switch or keypad that shall be separate from the VFD keypad. The bypass shall have a separate power supply from the VFD. The bypass control circuit shall include its own H-O-A switch to run in bypass without an external run command. The bypass shall be able to operate with the VFD removed for service.
 - B. Bypass Configuration:
 1. Provide one main fused disconnect switch or circuit breaker to isolate both the drive and bypass circuit. Bypass configuration shall consist of one input drive contactor or disconnect, one output drive contactor and one output bypass contactor. The two output contactors shall be mechanically and electrically interlocked.
 - C. Provide motor overload protection in the bypass circuit.
 - D. Provide high speed fuses for the VFD (not in the bypass circuit). The VFD and bypass shall be UL listed for 100KA SCCR.
- 2.9 LINE REACTORS
- A. Line reactors shall be installed in each phase of the AC input side of the VFD and mounted within a common enclosure with the VFD.
 - B. Line reactor shall be a three-phase inductor, 5% impedance, iron core, 600V, Class H insulation, 115 degree C rise, copper windings with screw type terminal blocks.

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PART 3 – EXECUTION

3.1 VARIABLE FREQUENCY DRIVES

- A. Install where indicated on drawings and in accordance with approved submittals and manufacturer's published recommendations. Installation to be by the Division 26 contractor.
- B. Input wiring shall be installed in a separate conduit system, output wiring shall be installed in a separate conduit system and control wiring shall be installed in a separate conduit system. Do not mix input power, output power, or control wiring in a common conduit.
- C. Control signal for drive will be provided as indicated on drawings.
- D. VFD manufacturer to perform a field test of each drive and provide Owner operational and maintenance training.

3.2 REMOTE EMERGENCY STOP

- A. Factory jumper shall be removed from VFD Emergency Stop terminals. Terminals shall be wired to emergency stop pushbuttons as shown on the plans. Feature shall be programmed for Manual Reset that must occur at the VFD. VFD shall not automatically reset when emergency stop pushbuttons are reset.

END OF SECTION 13 11 26

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SECTION 13 11 32 POOL FIBERGLASS FILTERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pool Fiberglass Filters

1.2 RELATED DOCUMENTS

- A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.3 REFERENCES

- A. The following latest edition reference specifications, guides and standards shall become part of this Specification as if herein written. If provisions conflict, the more stringent provisions shall apply.
 - 1. National Sanitary Foundation (NSF)
 - 2. ASTM D-2150 – Specification for Woven Roving Glass Fabric for Polyester

1.4 DESIGN REQUIREMENTS

- A. As assurance that each item of apparatus is properly sized to perform in conjunction with each other, the Owner requires bidders to use the filter manufacturer as a single source of supply for the items of equipment as listed and described herewith.
- B. The system shall be supplied complete by the manufacturer and shall include: internals, face piping and valves, gauge panel with tubing and petcocks, sight glass, air relief connection, bottom drain connection with internal strainer.
- C. System shall be fabricated and fully assembled at the manufacturer's plant for pressure testing and dimensional verification. System shall be knocked down for shipping purposes in subassemblies for minimum field assembly. Internal manifold and lateral piping shall be factory installed and shipped in place. Loose fitted piping furnished for field assembly will not be accepted.
- D. The filter system including tank quantity, size, filter rate, capacity and model number shall match the basis of design as indicated on the drawings.

1.5 SUBMITTALS

- A. Provide detailed shop drawings of the items of equipment being provided, indicating the dimensions, material of the filter tanks, exterior face piping, internal manifolds and laterals and filter media.
- B. Provide a complete set of operating instructions, embracing the operational functions and recurring maintenance processes involved in connection with the complete filtration system.
- C. Provide all warranties relating to filter systems including valves, internal piping, face piping, controls and all standard accessories.

1.6 CERTIFICATIONS

- A. Shall bear the NSF Seal of Approval, Standard #50 for sand type filters.

1.7 QUALIFICATION STATEMENTS

- A. The equipment described herein shall be a product of a manufacturer regularly engaged in the fabrication of fiberglass pressure vessels for at least fifteen years.

1.8 WARRANTY

- A. The equipment supplier shall guarantee that the equipment to be furnished is of the correct capacity, that the various parts are designed to operate correctly and in conjunction with each other, that if the installation is made in accordance with his drawings and operated in accordance with his instructions, the system will perform the prescribed functions correctly, the water entering the pool will be clear, bright, free from suspended matter visible to the unaided

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eye, will not produce any toxic effect or impart undesirable taste, odors or colors, and will be sanitary to the satisfaction of all authorities having jurisdiction.

B. Equipment Warranties

1. Filter tanks shall carry a 15 year non-prorated warranty as regularly offered by the tank manufacturer.
2. Internal and external face piping shall carry a non-prorated 3 year warranty.
3. Valve bodies shall carry a 5 year non-prorated warranty.
4. Valve operators and system accessories including sight glass, pressure gauges and air relief valve shall carry one year warranty as provided by the product manufacturer.
5. Unless otherwise specified, workmanship is to carry a one (1) year warranty

1.9 SYSTEM STARTUP

- A.** An authorized representative of the equipment supplier shall provide the supervisory services of an Installation Engineer for at least one day to fully instruct designated personnel in the operation, care and maintenance of the filter system.

1.10 MANUFACTURER

- A.** The equipment manufacturer shall be per the basis of design as listed in the drawings equipment schedule.
- B.** Alternative manufacturers meeting the specifications within may also be accepted. Product submittal and review with approval by the Aquatics Engineer/Architect shall be required.
- C.** Equipment not meeting these specifications must be pre-approved prior to bid. Other treatment systems may be considered with Owner's approval and only if a complete set of drawings and specifications detailing such equipment as it pertains to this project are submitted for evaluation ten (10) days prior to the bid date. The submission should include a list of five (5) operating installations with names and telephone numbers of the operating personnel. The technical contents of the submittal shall include hydraulic calculations, equipment fabrication details, filter room layout in plan and elevation views, warranties, installation and operating instructions.

PART 2 - PRODUCTS

2.1 FILTERS

A. Fiberglass Filter Tank

1. The filter tank shall be suitable for 50 psi working pressure, hydrostatically tested to 75 psi and designed with a 4:1 safety factor.
2. Two saddle style bases shall be provided for tank support. Systems that incorporate stacked tanks shall include similar bases and mounting saddles for the upper vessel. Access to the tank shall be provided by a 14" x 18" manhole with a two-bolt, 4-point yoke. Manhole seal shall be complete with one piece 1/4" neoprene gasket and positioned so that internal pressure from the filter will augment the seal. Externally mounted bolt-on covers will not be accepted.
3. Drain out system shall consist of one (1) 3/4" fiberglass coupling mounted to the tank bottom. Each coupling to be fitted with a slotted PVC sand retainer. Air relief connection shall be one (1) 3/4" coupling provided on top of the tank. Bulkhead fittings will not be accepted.
4. Each filter tank shall be equipped with the necessary flanges and connections for the internal and external piping. Connections shall be comprised of 1" minimum thickness fiberglass flanges with ANSI standard 150 lb. bolt pattern. Connections requiring bolt-thru hardware will not be accepted.
5. The resin used shall be a commercial grade, premium corrosion resistant vinyl ester that has been evaluated in a laminate by test in accordance with ASTM C-581 in service comparable to the intended service and recommended for this service by the manufacturer. Other generic types of resin such as isophthalics or general purpose polyester resins shall not be acceptable.

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6. Ultraviolet absorbers shall be added to the exterior surface for improved exterior resistance.
 7. Chopped strand mat shall be constructed from commercial grade E-type glass strands bonded together using a binder. The strands shall be treated with a sizing that is chemically compatible with the resin system used. Continuous roving shall be a commercial grade of E-type glass fiber with a sizing that is chemically compatible with the resin system used.
 8. The inner surface exposed to the corrosive environment shall be followed with a layer composed of vinylester resin, reinforced only with non-continuous glass fiber strands applied to a minimum thickness of 0.100 inches. The combined thickness of the inner surface and interior layer shall be 0.110 to 0.130 inches and in no case less than 0.100 inches.
 9. The exterior laminate shall consist of filament winding and unilateral construction so as to create a modulus of elasticity to maintain no more than 0.1% strain in any direction.
 10. Resin used in these layers shall be Hetron 922 incorporating a Cobalt/MEKP cure system as recommended by the manufacturer.
- B. Filter Piping - Internal
1. The upper and lower internal distribution system shall be a horizontal header/lateral arrangement. The headers shall be Schedule 80 PVC construction, capped on one end and flanged on the other end. Lateral connections shall be spaced no more than 6" on the centers and shall be 1½" FPT connections.
 2. Underdrain laterals shall consist of 1.5" Schedule 80 PVC pipe with machined double slotted openings on 1/8" centers. Machined openings shall be designed to retain all media particles as small as 0.012 inch (0.30 mm) particle size. Molded or drilled openings or retainer screens will not be acceptable. Each lateral shall be fabricated complete with a socket cap on one end and male adapter on the other. Both fittings to be solvent welded to the slotted pipe. Laterals shall be fitted with a rubber O-ring to allow for proper positioning of the machined openings.
 3. Upper laterals shall consist of 1½" Schedule 80 PVC pipe with 1/2" wide machine slotted openings on 1 1/4" centers. Upper laterals shall be designed and sized at the factory so as to provide uniform distribution and unrestricted flow during filter and backwash cycles. Laterals shall be fitted with a rubber O-ring to allow for proper positioning of the machined openings.
 4. All hardware shall be T304L stainless steel or non-metallic.
- C. Face Piping
1. External face piping shall be Schedule 80 PVC pipe and fittings. All fittings, including 10" and 12" sizes shall be molded type. Fabricated or fiberglass wrapped fittings will not be acceptable. Flanges shall be located so as to allow for easy dismantling of face piping. All fittings shall be solvent cemented.
 2. Piping shall be drilled and tapped where necessary to accommodate gauge tubing connectors.
 3. All valves shall be constructed in accordance with the Specification 13 11 24 unless otherwise specified. All valves 3" – 12" shall be constructed with cast aluminum ASTM S12A housing and fully coated with Rilsan on all interior and exterior surfaces. Internal components include EPDM resilient lining, Rilsan coated ductile iron disc and T304 stainless steel shaft. Valves 14" and larger shall be constructed with cast iron housing epoxy coated and with nylon coated ductile iron disc.
 4. Unless otherwise specified, all nuts and bolts shall be stainless steel with stainless steel washers to be used when secured to PVC flanges.
 5. Standard accessory items shall include sight glass rated for 50 psi with polycarbonate glass, remote mounted gauge panel with two 4½" diameter pressure gauges, ¼" petcocks, ¼" poly vent tubing with PVC compression adapters.

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6. Face piping shall be fully factory assembled, knocked down and crated for shipment. The warranty of the face piping shall be provided by the filter manufacturer. Field gluing of the face piping by anyone other than the filter manufacturer will not be accepted.
7. Face piping arrangement shall be as indicated on the drawings. All backwash control valves shall be located no greater than 60" off the floor.
- D. Automatic Air Relief Valve
 1. A minimum 1" valve shall be provided to automatically and continuously release air in the filter. The valve shall be fabricated of plastic with Buna-N seals.
- E. Air Relief & Drain Plumbing
 1. An air relief plumbing kit shall be provided for each filter with two (2) True Union PVC ball valves to allow manual air relief and isolation of the automatic valve. A filter drain plumbing kit shall be provided for each filter with a single True Union PVC ball valve to allow manual draining of each filter. Air relief and drain plumbing shall be properly supported and extended to as close as possible to the nearest floor area drain without crossing any maintenance aisle/s. Valves fabricated of cast iron, bronze or stainless steel shall not be acceptable.
- F. Valve Control Assembly
 1. A mechanical linkage constructed of T304 stainless steel shall connect two valves in order to create simultaneous movement.
 2. Assembly shall be designed so that filter and backwash cycles can be accomplished by repositioning two pairs of valves.
 3. Each pair of valves shall be operated as specified with gear or electric actuation.
 4. All linkage components shall be grit blasted to a 1-2 mil profile. All linkage components shall be finish coated with minimum 3-4 mils Type 316 stainless steel paint.
- G. Gear Operators
 1. Valves shall be provided with infinite position gear operators. Gear case (body) shall be constructed of cast iron painted internally and externally for maximum protection. Enclosure shall be sealed to IP65 and maintenance free.
 2. Self-locking gearing shall be capable of holding the disc in any position with no movement up the full pressure rating of the valve. Gear operator shall provide 90° of travel with $\pm 5^\circ$ adjustment in closed position. Gear operator shall include a non-corrosive sealed indicator for remote visibility. Gear operator shall include manual adjustment capabilities.
- H. Electric Operators
 1. Electric service shall be 110 VAC unless otherwise indicated in drawings. Operator housing shall be corrosion resistant NEMA 4X (IP65). Electrical connectors shall be four-pole industrial style and meet DIN 43650 standards. Plug connection shall be gasketed and mechanically secured with a stainless steel screw. Harness assemblies from operator to control panel shall be factory fabricated. No field wiring shall be required.
 2. Drive assembly shall include hardened steel and polyamide reduction gears with permanent lubrication. Operator shall be equipped with a manual override. Operator shall have a visual position indicator.
 3. Electric drive motor minimum duty cycle rating to be 35%. Overloading protection shall be self-resetting. Limit switches shall be provided to allow adjustment of cycle. Two additional limit switch contacts shall be provided for indication or auxiliary.
- I. Automatic Controller - MFP4
 1. The automatic controller shall provide total control of the system's filtration and backwash, and provide all necessary equipment interlocks and timing mechanisms to execute the filter program.
 2. The controller shall contain at least two microprocessors that will monitor all functions of the system.
 3. The controller shall control the operation of the following functions by time or pressure differential:
 - a. Backwash: Manual or automatic; with or without security interlock for data logging

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- b. Heater cool down delay
- c. Auxiliary contacts to interlock UV lamps, chemical control, or other equipment
- d. 7 inch Hi-Res LCD Screen with Tactile Feedback Membrane
- e. Step-by-step animated graphics
- f. Last backwash display
- g. Remote Operation via browser or phone
- h. Off Site Real-Time Status
- i. Data logging of process
- j. Differential Pressure Monitoring and Bump Control
- k. Exporting of process data logs to .csv Excel™ files
- l. Modbus Communications for PLC connectivity
- m. Nema 4X / IP66 approved / UL Listed
- n. Electrical Requirements: 120VAC-1Ø-60Hz, 15 amp Circuit Protection (CP)/230VAC-1Ø-50Hz, 10 amp CP

2.2 FILTER MEDIA

- A. Each filter tank shall be provided with media as required per manufacturer's recommendations.
- B. Gravel support media of a hard coarse aggregate with a subangular grain shape with a particle size of 1/8" x 1/4" shall be used on the inside of the bottom head to the elevation where the filter media commences. The specific gravity shall not be less than 2.5. Place support media by hand to avoid damage to the underdrain system and level before the addition of the upper layer of filter media. Support gravel shall be delivered and stored in bags (approximately one cubic foot) for ease of handling and elimination of possible contamination. Concrete underfill shall not be used. Media shall be free from minerals that may precipitate onto pool surfaces.
- C. Sand shall be a carefully selected grade of hard, uniformly graded silica material. Media shall be naturally rounded particles of silica or milled angularly shaped particles of silica quartz. Sand shall have a particle size between .45 mm and .55 mm (#20). No more than 1.5% shall be allowed to pass through a #40 sieve (.0164"). Uniformity coefficient shall not exceed 1.53. Specific gravity to be not less than 2.5. Bed depth shall be placed as required by the filter manufacturer. Sand shall be delivered and stored in bags (approximately one cubic foot) for ease of handling and elimination of possible contamination. Media shall be free from minerals that may precipitate onto pool surfaces.

PART 3 - EXECUTION

3.1 FILTER SYSTEM

- A. All filter piping and valves shall be factory assembled and knocked down into sub-assemblies for shipment. The components shall be carefully packaged in a totally enclosed wooden crate to prevent damage during transport.
- B. Filters shall be installed level and anchored to the floor.
- C. Provide installation complete with factory representative training and equipment start.
- D. Pool Contractor shall deliver operating and maintenance instructions for operation, maintenance and cleaning of Filter system.
- E. Training and Start-Up
 - 1. Filter installation shall include a filter system "start-up" and "system operator training (SOT)". Start-up shall include the first-time use of the filter in recirculation mode and all system adjustments as needed for proper operation of all filter modes. SOT shall include written and verbal instructions and demonstrations required for the system operator to properly operate and maintain the filter system in all filter operating modes.
 - 2. Start-Up and SOT shall be completed by a fully trained and authorized filter manufacturer representative.
 - 3. Prior to initiating the Start-Up procedures, the contractor shall complete all equipment installation and tests as required for proper filter operations. Contractor shall obtain the "Pre-Start-Up" requirements/checklist directly from the filter manufacturer.

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POOL FIBERGLASS FILTERS**

4. Contractor shall coordinate and schedule the system start-up and training directly with the filter manufacturer and Owner.
5. SOT session shall be a minimum of one (1) day duration. Obtain written documentation with a dated signature from the system operator that training was provided to their satisfaction.

END OF SECTION 13 11 32

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 34 POOL VERTICAL FIBERGLASS FILTERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pool Vertical Fiberglass Filters

1.2 RELATED DOCUMENTS

- A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.3 REFERENCES

- A. The following latest edition reference specifications, guides and standards shall become part of this Specification as if herein written. If provisions conflict, the more stringent provisions shall apply.
 - 1. National Sanitary Foundation (NSF)

1.4 DESIGN REQUIREMENTS

- A. As assurance that each item of apparatus is properly sized to perform in conjunction with each other, the Owner requires bidders to use the filter manufacturer as a single source of supply for the items of equipment as listed and described herewith.

1.5 SUBMITTALS

- A. Provide detailed Shop Drawings of the items of equipment being provided, indicating the dimensions, material and characteristics of the filter shells, interior and exterior filter manifolds, nozzle system and filter media.
- B. Provide a typed sheet of Operating Instructions, embracing the operation functions and recurring maintenance processes involved in connection with the complete filtration system.

1.6 CERTIFICATIONS

- A. Shall bear the NSF Seal of Approval, Standard #50 for sand type filters.

1.7 QUALIFICATION STATEMENTS

- A. The equipment described herein shall be a product of a manufacturer regularly engaged in the fabrication of fiberglass pressure vessels for at least fifteen (15) years.

1.8 WARRANTY

- A. The equipment supplier shall guarantee that the equipment to be furnished is of the correct capacity, that the various parts are designed to operate correctly and in conjunction with each other, that if the installation is made in accordance with his drawings and operated in accordance with his instructions, the system will perform the prescribed functions correctly, the water entering the pool will be clear, bright, free from suspended matter visible to the unaided eye, will not produce any toxic effect or impart undesirable taste, odors or colors, and will be sanitary to the satisfaction of all authorities having jurisdiction.
- B. Provide a standard one (1) year non-prorated warrantee.

1.9 SYSTEM STARTUP

- A. An authorized representative of the equipment supplier shall provide the supervisory services of an Installation Engineer for at least 4 hours to fully instruct designated personnel in the operation, care and maintenance of the filter system.

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 34 POOL VERTICAL FIBERGLASS FILTERS

PART 2 - PRODUCTS

2.1 FILTERS

A. Fiberglass Filter Tank

1. The filter tank shall be no less diameter and length than shown on plan. It shall be suitable for 50 psi working pressure.
2. The vessel(s) shall be constructed of multi-layer fiberglass. Layers shall consist of a combination of chopped glass and woven roving in an isophthalic-polyester matrix. The vessel shall be assembled from one side shell and two domed ends which shall be joined with an adhesive and reinforced with FRP layup. Alternate construction methods shall not be acceptable.
3. Vessels shall be provided with ABS support bases. The tanks will be secured to these bases with adhesive.
4. The wetted surface shall be a standard gel coat (GC). The gel coat shall be a modified polyester gel coat equivalent to a Cook gel coat 943-AN-023 with a thickness of no less than 10 mils.
5. The external surface shall be smooth in appearance and be free of cracks or other defects. The exterior surface shall be supplied with an all-weather coating. The tank coating shall be water based acrylic emulsion paint with UV inhibitors.
6. Each filter tank shall be equipped with a bottom mounted drain out system that shall completely empty the vessel.
7. Each tank shall have an automatic and manual air release system and shall be of non-corrosive materials.
8. Each filter tank shall be equipped with the necessary flanges and connections for the internal and external piping and valves.
9. Each tank shall have one influent header fitted with sufficient distributors to properly distribute incoming flow evenly across the sand bed surface and one hub with sufficient laterals equally distributed not less than 12 inches below the filtering sand bed with a total effective slot area such that the average velocity through the slots will not exceed 6 feet per second at the design flow rate. The hub shall be fabricated of ABS and all distributors and laterals shall be replaceable. The laterals shall have "cam and ramp" ¼ turn connections and be constructed of ABS plastic with molded 'V'-groove slots. Laterals with machined or cut slots shall not be accepted. Laterals shall be threaded at right angles into the header pipe.
10. Exterior influent and effluent pipe connections shall be 2" PVC.
11. Each tank shall have an 8.5-inch diameter access manhole with molded cover, o-ring, and pressure gauge.
12. The system shall be designed for installation against a back or side wall with all servicing accessible without moving tank(s). When the system is off, the tank(s) must remain full of water and not allow water to gravity drain back to the source to prevent disturbance of the sand bed.
13. Each filter tank shall be equipped with the necessary flanges and connections for the internal and external piping and valves.

B. Multi-port and Hi Flow Valve Control Assembly (Unless Otherwise Noted in Drawings).

1. Valve assembly shall be pre-plumbed and constructed of PVC.
2. Valve shall include a six-position positive lock operation system.
3. Shall be side mounted.
4. Valve mechanism shall be designed so that the filter, drain, rinse and backwash cycles can be accomplished by repositioning one valve handle that will provide accurate positioning for tight shut off.

2.2 FILTER MEDIA

- ###### **A.**
- A sufficient quantity of #20 US sieve grade clean crystal silica sand to cover filter elements with a minimum 12-inch sand bed shall be furnished and installed into each tank and shall be free of

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limestone or clay and shall be free from minerals that may precipitate onto pool surfaces. The following is an acceptable gradation for this media:

#20 SILICA SAND

Effective size: 0.45 mm (0.018 in.)

Uniformity coefficient: 1.5

Mean diameter: 0.616 mm (0.0243 in.)

Standard deviation: 0.110 mm (0.00432 in.)

Grain Sphericity: GRTR 0.7

- B. Each filter tank shall be provided with media as required per manufacturer's recommendations.

END OF SECTION 13 11 34

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POOL VERTICAL FIBERGLASS FILTERS**

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SECTION 13 11 35 POOL ULTRAVIOLET DISINFECTION EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pool Ultraviolet Disinfection Equipment

1.2 RELATED DOCUMENTS

- A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.3 REFERENCES

- A. The following latest edition reference specifications, guides and standards shall become part of this Specification as if herein written. If provisions conflict, the more stringent provisions shall apply.
 - 1. NSF – National Sanitary Foundation
 - 2. MET – Met Laboratories, Inc.
 - 3. CSA – Canadian Standards Association
 - 4. UL – Underwriters Laboratory
 - 5. NEMA – National Electrical Manufacturers' Association
 - 6. ANSI – American National Standards Institute
 - 7. USEPA UVDGM- U.S. Environmental Protection Agency Ultraviolet Guidance Manual
 - 8. Din- German Institute of Standardization
 - 9. IP- International Electrotechnical Commission

1.4 SUBMITTALS

- A. Drawings and Instructions
 - 1. Provide detailed Shop Drawings of the items of equipment being provided, indicating the dimensions, material and characteristics.
 - 2. Provide a detailed Operations Manual, embracing the operation functions and recurring maintenance processes.

1.5 SUBSTITUTIONS

- A. Refer to General Requirements and Division 01.

1.6 QUALITY ASSURANCE

- A. All SYSTEM components shall be supplied to the CONTRACTOR by a single EQUIPMENT SUPPLIER.
- B. The EQUIPMENT SUPPLIER shall have at least twenty (20) year experience providing medium pressure UV systems to the Aquatics market.
- C. The EQUIPMENT SUPPLIER shall design, develop, manufacture and test the SYSTEM in a facility that is assessed and registered as conforming to the requirements of ISO 9001:2008 quality management system.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to General Requirements and Division 01.

1.8 WARRANTY

- A. A factory trained representative of the manufacturer shall perform all warranty work. Manufacturer to warranty Ultraviolet chamber and Spectra Control panel for a period of 5 years (see requirements) excluding lamps, quartz and seals. Medium pressure Ultraviolet bulbs shall be warranted for a period of 8,000 hours. Intermittently operated lamps (□ 1 on/off cycle per day) will be replaced free of charge should failure occur prior to 4,000 hours and replacement will be prorated between 4,000 and 8,000 hours.

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- B. Manufacturer must maintain spare or replacement parts in the USA for same day or no longer than next day delivery in North America, other areas based on expedited delivery available.
- C. A Service Agreement (twice per year maintenance) from a qualified factory certified distributor shall be provided to initiate the service to maintain the five-year warranty.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The UV System shall have a MET or equivalent (ETL, CSA, or UL) listing, be NSF-50 (2016 or later) certified including Section 14.18 (crypto inactivation), and 3rd party validated to the USEPA UVDGM 2006 Guidelines.
- B. Equipment General Description: The Ultraviolet System shall be provided in a complete package to include:
 - 1. Stainless steel chamber,
 - 2. Spectra Control System located in a NEMA 12 (IP52) rated panel,
 - 3. Medium pressure bulb(s) designed to emit wavelengths within the UVC electromagnetic spectrum,
 - 4. UV EZ Clean strainer,
 - 5. Automatic wiper system, and
 - 6. Project Commissioning by an Ultraviolet Technician certified by the manufacturer.
- C. Manufacturer: Ultraviolet Lamp/Chamber and Spectra Control Panel by Neptune Benson / Evoqua Water Technologies Ltd., or Architect/Engineer approved equal. Any deviation/exception must be provided in writing to and approved by the designer prior to the bid date.

2.2 UNIT TYPE

- A. Wafer (WF) UV Units: Ultraviolet manufacturer to offer unit capability of a horizontal or vertical installation application using state of art design and direct flow through characteristics. Direct flow will be required in order to reduce total head loss through the system. Unit shall be medium pressure system with a flow rating as scheduled in the drawings, or greater, @ a maximum of 94% UV Transmission (UVT). Chamber and Control Cabinet shall be as indicated on the drawings.

2.3 ULTRAVIOLET REACTOR/CHAMBER

- A. The unit shall be constructed of 316L stainless steel, electropolished and passivated to prevent corrosion within the harsh pool environment. Pressure drop across the unit will be minimal.
- B. The Ultraviolet chamber shall come complete with the following equipment:
 - 1. Ultraviolet intensity monitor factory calibrated to provide intensity in mW/cm² (monitors providing percentage of lamp output are not acceptable).
 - 2. Built-in alarm system to notify operator when output level drops below operator set dosing levels or the required level of 60 mJ/cm² for indoor pools and 40mJ/cm² for outdoor pools.
- C. Ultraviolet temperature control system shall be provided to maintain system integrity in the event of flow interruptions to the chamber.
- D. Ultraviolet chamber shall come complete with annealed quartz sleeve with "O" ring seals for water tightness. System shall be complete with advanced seal arrangement to reduce risk of quartz over compression on the seal face.
- E. Chambers shall be complete with ANSI 150 or DN flanges (as specified) and all ports or vents shall be threaded NPT. The Ultraviolet chamber must be capable of installation in the system so that it remains full under all conditions.
- F. Ultraviolet Reactor (Chamber) will be a validated system with third party testing to a recognized international standard such as the USEPA DGM.
- G. The ultraviolet unit must be complete with integrated brackets or feet for ease of installation in either vertical or horizontal mounting.

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- H. The Chamber shall have a sacrificial anode attached to the chamber, extending inside the chamber and be bonded to the installation bond loop.

2.4 ULTRAVIOLET LAMP

- A. Ultraviolet lamp shall be medium pressure high intensity. Each lamp shall be designed to emit continuous ultraviolet wavelengths in the range of 200nm to 400nm. This will provide optimal disinfection/inactivation of bacteria, algae, molds and viruses and destruction of the Monochloramine, Dichloramine, and Trichloramine compounds. The lamp(s) must remain unaffected by temperature variance of 0 degrees F (-17C) to 200 degrees Fahrenheit (93 degrees Celsius).
- B. The lamp system must provide a constant calculated dose of not less than 60 mj/cm2 until the end of the lamp life for indoor applications and not less than 40 mj/cm2 for outdoor disinfection and this must be based on constantly treating the full recirculating flow rate, not on a side stream treatment. The system must be equipped with infinity variable power control of the lamp intensity & dose. Power stepping is not an acceptable alternative. The lamps shall be capable of turndown to 30% of the nominal rated power.
- C. The lamp shall be connected via means of a plug connector and shall have a mechanical interlock to prevent lamp removal when lit for safety reasons.

2.5 AUTOMATIC WIPER SYSTEM

- A. An automatic cleaning system shall be provided for cleaning of quartz sleeve and Ultraviolet monitor probe. The system shall travel the entire length of the quartz sleeve twice per desired cleaning cycle. Precision molded wiper rings shall be provided to ensure thorough quartz tube cleaning and quartz tube protection.
- B. Wiper cycle shall be user selectable and adjustable within a range of 5 minutes to 24 hours depending on anticipated application and deposit build-up.
- C. Automatic Wiper system shall have the following characteristics:
 - 1. System shall utilize direct drive with square faced coupling and acme threaded shaft to prevent slippage and pin shearing. Systems utilizing shear pins or complicated gear boxes will be unacceptable.
 - 2. Wiper power supply shall be 24-volt DC for improved safety. Higher voltage not acceptable.
 - 3. System shall incorporate Direct Shaft Encoding for positional location. Systems relying on external limit switches or internally located magnets will be unacceptable.
 - 4. Wiper interval shall be operator selectable with optional override switch.
 - 5. Wiper faults are to be indicated on the control system display.
 - 6. Wiper System to utilize "Intelligent Operation" for automatic start-up commissioning.
 - a. Records wiper position at chamber ends. Position must be fixed and not dependent on a timed interval or component striking end of chamber.
 - b. Establish a travel run without setting limit adjustments to ensure system integrity and longevity.

2.6 UV STRAINER

- A. The UV system must be provided with a downstream strainer to protect against the remote possibility of lamp /quartz breakage traveling downstream.
- B. The UV strainer must be cleanable by manual action without removal from the piping system. If electrical or pneumatic automation of this valve is required, the valve control shall be integrated into each the filtration and UV control systems.

2.7 ULTRAVIOLET CONTROL SYSTEM

- A. Control cabinet shall be a SPECTRA control unit and or pre-approved equal.
- B. The cabinet shall be an epoxy coated NEMA 13 / IP54 rated cabinet. If mounted outdoors it must be a NEMA4X /IP56 rated cabinet with an integral A/C unit to protect the components from the environment.

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- C. The power must be controllable to provide full power, half power and infinite variable power based on real time interface with changes in UVT, Flow Rate or Combined Chloramines. The power panel must house the electronic ballasts required to ignite the lamps.
- D. Three levels of operation shall be provided to meet the needs of the operator and pool environment:
 - 1. Simple Control (start, stop and reset),
 - 2. Full Parameter Display, and
 - 3. Customized Operator Configuration.
- E. Modes of operation shall be password protected to secure system critical setup functions.
- F. Control system shall have clearly identifiable start, stop, and reset icons (suitable for gloved operation) with Running and Fault LCD indicators.
- G. The screen shall display the following:
 - 1. Ultraviolet Calculated Dose, derived from flow and intensity inputs
 - 2. Ultraviolet Intensity in units of % and mw/cm2
 - 3. Lamp Current
 - 4. Flow Rate. System shall accept a signal from an optional flow meter with display in units of gallons per minute (GPM) and m3/hour
 - 5. Chamber Temperature in units of deg. F and deg. C
 - 6. Operation Hour Meter
 - 7. System shall include alarm functions with simple text message display to assist in fault finding. Fault Indicators to include:
 - a. Lamp fault,
 - b. Low Ultraviolet Alarm
 - c. Temperature Alarm
 - d. Ground Fault Trip
 - e. Wiper Fault.
- H. Control system shall have a minimum of the following system interface control:
 - 1. Remote Operation
 - 2. Process Interrupt Features (from valves, flow meters)
 - 3. Low UV Dose (configurable to shut down or alarm only)
 - 4. Flow Meter Input
 - 5. Auto-Restrike
 - 6. Half to Full Power Ultraviolet Setting, with 24-hour/7-day settable timer
 - 7. Variable Power/Dose Pacing Interface
- I. Control system shall have built in data-logging capabilities to record the following information:
 - 1. Ultraviolet Intensity Required
 - 2. Ultraviolet Intensity Measured
 - 3. Lamp Current
 - 4. Chamber Temperature
 - 5. Flow Rate (if flow meter is connected))Time and Date Stamp of all alarms generated
- J. Control system must be capable of the following communications:
 - 1. Interface with a Chemical Controller that can measure Total or Combined Chloramines to maintain the proper UV dosage required during the life of the lamp.
 - 2. Interface with the Defender filtration controller.
 - 3. Operating through Ethernet or Wi Fi with a method of uploading data to a Web based portal.
 - 4. Interfacing with a SCADA system including Modbus.
- K. Electrical Requirements:
 - 1. See Drawings for scheduled units and electrical requirements. Confirm scheduled information with manufacturer prior to purchase.
 - 2. Units include the following power/voltage capability:
 - a. 208/220/230/240-Volt, single-phase for the 3" to 8" diameter UV units, 50/60 Hz
 - b. 380/400/415/440/480-Volt, three-phase for the 10" and 12" diameter units, 50/60 Hz power.

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**SECTION 13 11 35
POOL ULTRAVIOLET DISINFECTION EQUIPMENT**

PART 3 - EXECUTION

3.1 SYSTEM INSTALLATION, STARTUP & TRAINING

- A. Install in accordance with contract documents and manufacturer's instructions.
- B. All UV electrical power supply and connections shall be performed by licensed electrician in conformance with all applicable Building/Electrical Code requirements.
- C. Commissioning
 - 1. Ultraviolet Chamber and Control Panel shall be commissioned by a qualified factory trained technician to institute the Warranty.
 - 2. Final electrical and control cabling shall be connected from the control cabinet to the Ultraviolet disinfection chamber during the commissioning process.
- D. TRAINING
 - 1. System operations and maintenance instructions shall be provided during a training session to the Owner's operations personnel. All training shall be conducted by a technician trained and certified by the UV manufacturer.
 - 2. Contractor shall obtain Owner signature and date upon completion of training and include copy in the project Operations & Maintenance Manual.

END OF SECTION 13 11 35

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POOL ULTRAVIOLET DISINFECTION EQUIPMENT**

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SECTION 13 11 37 POOL CHEMICAL SYSTEMS AND CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Chemical Controller with the following sensors:
 - 1. pH Sensor
 - 2. ORP Sensor
 - 3. Temperature Sensor
 - 4. Flow Sensor
- B. Free Chlorine Sensor

1.2 RELATED DOCUMENTS

- A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.3 QUALITY ASSURANCE

- A. The controller shall carry the following product certifications:
 - 1. NSF Standard 50
 - 2. UL 61010-1

1.4 SUBMITTALS

- A. Refer to General Requirements and Division 01.
- B. Submittals required: For each type of manufactured material and product indicated. Provide Submittals indicating equipment provided, dimensions, material specifications, wiring diagrams and all accessory components including sensors.

1.5 SUBSTITUTIONS

- A. Refer to General Conditions, Division 01.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to General Conditions, Division 01.

1.7 WARRANTIES

- A. Controller shall be covered by manufacturer's 5-year warranty.
- B. ORP and pH sensors shall be covered by manufacturer's 2-year warranty.
- C. Other sensors and flow cell components shall be covered by manufacturer's 1-year warranty.
- D. Chemical feed pumps shall be covered by manufacturer's 2-year warranty.
- E. A factory trained/authorized representative shall provide training to the owner. The control system shall be provided with on-site start-up, on-site operator training, and 1-year on-site warranty service performed by a representative trained and authorized by the controller manufacturer.

PART 2 - PRODUCTS

- 2.1 All products listed as basis of design are acceptable, as are approved equivalents by project manager.

2.2 CHEMICAL CONTROLLER

- A. The water chemistry control system shall provide continuous monitoring and control of the water chemistry and related disinfection equipment.
 - 1. The controller shall continuously monitor and control pH. Chemical feed shall be configurable for manual, automatic, proportional, and on/off modes.

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2. The controller shall continuously monitor and control sanitizer based upon the ORP reading, the free chlorine sensor, or both. Chemical feed shall be configurable for either on/off or time-based proportional feed.
3. The controller shall have a programmable superchlorination function, based upon ORP or ppm superchlorination setpoint, which is triggered manually.
4. The controller shall have a programmable dechlorination function, based upon ORP or ppm dechlor setpoint, which is triggered either manually or by the completion of the superchlorination function.
5. The controller shall compute the Langelier Saturation Index and the Ryznar Saturation Index based upon sensor data and/or manual entered by the operator.
6. The controller shall continuously monitor, display, and datalog system flow, maintaining a total flow volume. A Low Flow Alarm shall be operator settable, which can be programmed to disable chemical feeds.
7. The controller shall control the boost function for a UV dosing based on real-time combined chlorine as calculated by the readings from an amperometric free chlorine and total chlorine sensor.
8. The controller shall also have a Minimum Flow Rate setting to turn off heater whenever system flow is less than this programmed minimum level. The controller shall also manage the heater on/off status based on real-time water temperature reading.
9. The controller shall continuously monitor, display, and data log pool or surge tank level. The controller shall automatically control a water makeup relay to add makeup water to maintain pool level set point based on pool or surge tank level.
- B. The standard display shall be a backlit transfective LCD that will continuously display information related to the following:
 1. All installed sensor readings
 2. Set points, with current control status
 3. All active alarms, including time activated
- C. The flow sensor shall be used to prove flow to the chemical controller to prevent dosing of chemicals during a system low flow/no flow condition.
- D. The controller shall automatically abort a Manual or Scheduled Turndown upon declining water chemistry and return to the standard programmed circulation rate to maintain optimal water quality. Declining water chemistry is signaled by any of the alarm conditions.
- E. The controller shall signal all alarm conditions with the following indicators:
 1. A bright flashing LED on the front of the controller.
 2. Each active alarm listed on the LCD display along with time activated.
 3. Email and text alarm notifications.
- F. The controller inputs are as follows:
 1. The controller shall have inputs available for pH, ORP, Temperature, free chlorine, and flow sensors.
 2. The controller shall come with a minimum of (3) fully assignable digital inputs available for items other than those listed above.
- G. The controller outputs are as follows:
 1. The controller shall have integral line or dry contact 5A solid-state relay outputs capable of switching 3A under all normal operating conditions available for Acid or Co2 feed and sanitizer feed pumps.
 2. The controller shall come with a minimum of (2) fully assignable integral line or dry contact 5A solid-state relay outputs capable of switching 3A under all normal operating conditions available for items other than those listed above.
 3. All relays must account for the effects of the temperature gradient inside the IP66 or NEMA 4X enclosure. Systems that utilize relays that are not de-rated must submit an engineering evaluation justifying the use of relays at their full, optimal-condition capacity. All solid-state relays shall have a provision for an electrical interlock with the circulation pump motor starter.

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SECTION 13 11 37 POOL CHEMICAL SYSTEMS AND CONTROLS

4. The controller shall come with a minimum of (8) separately isolated 4-20mA output signals.
 5. The controller shall be capable of expanded capabilities with optional expansion package.
 - H. Required controller safety features:
 1. The controller shall have built-in limits to the amount of time any relay control output may be forced on (i.e. in "Manual On" mode).
 2. The controller shall have programmable high and low alarm settings for pH, ORP, PPM, temperature, low flow & no flow and surge tank levels. The controller shall have a programmable lockout of sanitizer feed upon pH high or low alarm.
 3. The controller shall activate a No Flow alarm when the dedicated sample stream flow switch indicates there is insufficient flow through the sample stream. This No Flow alarm shall lockout all chemical feed control operations.
 4. The controller shall have a dedicated Emergency Off button on the front panel of the system, which immediately halts all chemical feeds and control outputs when pressed. This feature shall require entry of a security access code.
 - I. Required controller remote communication and access features:
 1. The controller shall have the ability to allow field upgrades and updates and programming as needed. Controller must be capable of being accessed via remote communication.
 2. The controller shall have a means to preserve data logs during power outages, for input level recording and events. All input levels shall be recorded and maintained for 365 days on the controller, with a sample taken every minute. The controller shall record and maintain the events over the last 365 days recording all alarms, parameter changes, user logins, and operational cycles related to all control features.
 3. The controller shall also support the following types of connection to 3rd party applications such as EMS, BMS, BAC and SCADA systems:
 - a. 1) MODBUS TCP/IP
 - b. MS/TP (RS485)
 - c. TCP/IP (Ethernet) BACnet connection
The connection shall support access to Inputs (current readings), System Information, Set Points, Alarm Points, Control Status and Alarms. Set Points and Alarm Points shall be modifiable from the 3rd party application via the selected interface.
 4. The controller shall come with an integral Wi-Fi module.
 5. The controller shall be Windows 10 compatible or include the necessary software and apps to allow for the real-time monitor/ of the following via personal computer, smartphone, or tablet device:
 - a. Auto-Polling – to allow automatic download of data logs.
 - b. Graphical Operator's Console – to display current readings, setpoints, alarm points and control status mode.
 - c. Data Logging
 - d. Email and text alarms notifications.
 6. The controller shall require security access codes.
 - J. The controller shall be housed in an IP66 or NEMA 4X polycarbonate enclosure. All high-voltage wiring shall be performed in a separate IP66 OR NEMA 4X enclosure that precludes access to the controller electronics.
- 2.3 pH SENSOR
- A. The controller shall provide a measurement of pH by utilizing a sensor with the following characteristics:
 1. 2 – 12 sensing range
 2. operating temperature range of 32-140 °F (0-60°C)
 3. operating pressure range of 0 - 60 psi (0 TO 4.1 bar)The controller shall continuously monitor, display and data log pH with minimum 0.1 resolution.

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2.4 ORP SENSOR

- A. The controller shall provide a measurement of ORP by utilizing a sensor with the following characteristics:
1. 0 to 999 mV sensing range;
 2. operating temperature range of 32- 140° F (0-60°C)
 3. operating pressure range of 0- 60 psi (0 TO 4.1bar)
- The controller shall continuously monitor, display and data log ORP with minimum 6mV resolution.

2.5 TEMPERATURE SENSOR

- A. The controller shall provide a measurement of water temperature by utilizing a sensor with the following characteristics:
1. 32 – 212°F (0 – 100°C) sensing range
 2. Operating temperature range of 32 – 212°F (0 – 100°C)
 3. Operating pressure range of 0-145 psi (0-10 bar)
- The controller shall continuously monitor, display and data log temperature with 5/9 °C (1°F) resolution.

2.6 CIRCULATION FLOW SENSOR

- A. The controller shall provide a measurement of pool circulation flow rate and volume by utilizing a flow sensor with the following characteristics:
1. paddle wheel flow sensor
 2. O-ring seal
- The controller shall continuously monitor, display and data log flow rate with 0.45 lpm (0.1 gpm) resolution.

2.7 FREE CHLORINE SENSOR

- A. The controller shall provide a measurement of free chlorine by utilizing a sensor with the following characteristics:
1. to 10.0 mg/l (ppm) measuring range
 2. 32° - 176°F (0°-80°C) operating temperature range
 3. Replaceable cleaning beads
- The sensor shall not utilize a membrane or electrolyte. Sensors utilizing a membrane and/or electrolyte, which must be replaced and/or replenished on a regular basis, shall not be considered equal. The controller shall continuously monitor, display and data log free chlorine with 0.1 mg/l resolution.

2.8 AUTO-FILL WATER LEVEL SENSOR

- A. The controller shall provide a measurement of the water level by utilizing a continuous level sensor with the following characteristics:
1. Field configurable sensor length,
 2. Installation options for wall mount and stand pipe glass configurations.
 3. 4 to 20 mA output
- The controller shall continuously monitor, display and data log the water level with 10 mm (0.4") resolution or better. The controller shall use the sensor to control a water makeup valve to maintain water level (Autofill) and/or control a main drain modulating valve.

PART 3 - EXECUTION

3.1 CHEMICAL CONTROLLER INSTALLATION

- A. Installation of the system shall be per the manufacturer's specification and no exceptions shall be allowed. A factory trained/authorized representative shall provide training to the owner. The control system shall be provided with on-site start-up, on-site operator training, and 1-year on-

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POOL CHEMICAL SYSTEMS AND CONTROLS**

site warranty service performed by a representative trained and authorized by the controller manufacturer.

- B. Provide coordination and instructional training of the chemical controller's remote use functions and alarms with Owner's designated staff and information technology personnel.
- C. Calibration of chemical controller shall be executed only after the monitored pool temperature has been established to within 4 degrees of the design temp, or as required by the manufacturer's installation instructions, if more stringent.

3.2 CHEMICAL STORAGE INSTALLATION

- A. Tank shall be hydrostatically tested at time of installation.

3.3 MANUALS

- A. Manufacturer shall supply an Installation, Operation and Maintenance Manual describing features, operating instructions, maintenance procedures and replacement parts.

END OF SECTION 13 11 37

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POOL CHEMICAL SYSTEMS AND CONTROLS**

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SECTION 13 11 40 POOL HEATING SYSTEMS

PART 1 - GENERAL

- 1.1 SECTION INCLUDES
 - A. Gas-fired Pool Heaters
- 1.2 RELATED DOCUMENTS
 - A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.
- 1.3 DESCRIPTION OF WORK
 - A. Heating system for swimming pool. Coordinate all venting, interlocking and control wiring for pool heaters with HVAC Contractor.
- 1.4 SUBMITTALS
 - A. Refer to General Requirements and Division 01.
 - B. Submittals required:
 - 1. Heaters
 - 2. Thermometers
 - 3. Printed and bound operating, installation, and service manuals
- 1.5 SUBSTITUTIONS
 - A. Refer to General Requirements and Division 01.
- 1.6 DELIVERY, STORAGE AND HANDLING
 - A. Refer to General Requirements and Division 01.
- 1.7 WARRANTIES
 - A. Standard Manufacturer's Warranty

PART 2 - PRODUCTS

- 2.1 POOL HEATERS
 - A. Provide gas fired heaters for pools, as scheduled on Contract Drawings, complete with controls.
 - B. Heaters must be A.S.M.E. Coded and labeled by manufacturer if they exceed the HLW-101 service limits; a heat input of 200,000 Btu/hr (60 kW) or a nominal water-containing capacity of 120 gal (450 L).
 - C. Heaters will not require A.S.M.E labeling if they do not exceed the HLW-101 service limits; a heat input of 200,000 Btu/hr (60 kW) nor a nominal water-containing capacity of 120 gal (450 L). However, the heater must meet HLW-700 and HLW-800 design requirements per current A.S.M.E. standards.
 - D. Provide and install per State and Local Codes, including State Boiler Code required control and safety device packages.
- 2.2 THERMOMETERS
 - A. Thermometers shall have an adjustable angle and separable 304 stainless steel socket thermowell. The insertion length shall accommodate pipe size as required by the manufacturer.
 - B. Thermometers shall be liquid filled with a 9" scale, glass window, and dual face to display both Fahrenheit and Celcius temperatures, manufactured by Weksler, Marsh, Winters or approved equal; or thermometers shall be solar powered with digital display, glass passivated thermistor and aluminum stem as manufactured by Wika or approved equal.

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POOL HEATING SYSTEMS**

PART 3 - EXECUTION

3.1 POOL HEATERS

- A. Install per manufacturer's installation instructions and recommendations, and in accordance with all applicable State and Local Codes.
- B. Furnish and install thermometers in inlet and outlet piping to heater and downstream in the blended water stream.
- C. Furnish and install a pressure relief valve for each heater and pipe to within 6" of floor.
- D. Furnish and install a flow switch per heater manufacturer's requirements.
- E. Factory authorized start-up required. Start-up form shall be included in the Operating and Maintenance Manuals and submitted separately to the Architect/Engineer.

END OF SECTION 13 11 40

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SECTION 13 11 42 PERIMETER OVERFLOW GUTTER GRATING

PART 1 - GENERAL

- A. A perimeter overflow gutter system consisting of a continuous grating covered overflow channel as shown in documents shall be installed. The gutter shall be level throughout.
- 1.1 SECTION INCLUDES
 - A. PVC Parallel grating
 - B. PVC Perpendicular grating
 - C. Polymer / High Density Polyethylene (HDPE) Grating
- 1.2 RELATED DOCUMENTS
 - A. Drawings and Contract Requirements, including General and Supplementary Conditions and Division 01 – General Requirements, apply to this Section.
 - B. Division 13 11 Pool specifications apply to this section
 - C. Division 13 11 18 Pool Concrete
 - D. Division 13 11 43 Pool Stainless Steel Gutter
- 1.3 REFERENCES
 - A. The following latest edition reference specifications, guides and standards shall become part of this Specification as if herein written. If provisions conflict, the more stringent provisions shall apply.
 - 1. ANSI – American National Standards Institute
 - 2. ASTM – American Society of Testing Materials
 - 3. NSF – National Sanitation Foundation Standard 50
 - 4. MAHC – Model Aquatic Health Code
- 1.4 SUBMITTALS
 - A. Refer to General Requirements and Division 01.
 - B. Submit Shop Drawings, clearly indicating make, model, type, and size of grating
 - C. Submit 4" x 4" samples of each of MFG. standard colors
- 1.5 SUBSTITUTIONS
 - A. Refer to General Requirements and Division 01.
- 1.6 DELIVERY, STORAGE AND HANDLING
 - A. Refer to General Requirements and Division 01.
- 1.7 WARRANTY
 - A. Manufacturer's Ten-Year Warranty, prorated after one year.
 - B. Grating installation shall be completed in accordance with all manufacturer's requirements for warranty coverage.

PART 2 - PRODUCTS

- 2.1 GENERAL
 - A. Provide perimeter overflow gutter grating type as identified and detailed in the drawings.
 - B. Perimeter overflow gutter grating shall be provided from a single manufacturer.
 - C. Materials shall meet product requirements within these specifications.
- 2.2 PARALLEL OVERFLOW GUTTER GRATING - PVC
 - A. The grating surface bars shall run parallel to the pool wall.
 - B. The grating shall be formed from molded, modular, interlocking, UV-stabilized PVC bars. The top surface of the grating bars shall be raised, water-shedding, slip-resistant and shall meet the

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IBC Classification C for Wet-Barefoot inclining platform (ramp) test for swimming pool surroundings.

- C. Grating bars shall be a minimum of 15/32" (12mm) wide and an outside depth of 1.0" (25.4mm) with a middle depth that varies, dependent on grating width and load strength requirements.
- D. Grating design shall meet ASTM D790-10 or ANSI/AS3996 Class A for covers and grates with load exceeding 10kN (2,248lb).
- E. The grating shall provide at least 37.5% open area per foot for unrestricted water flow. The space between the bars shall not exceed 3/8" (9.5mm) and shall comply with IBC child finger/toe entrapment guidelines.
- F. Grating width shall allow the insertion of the touchpad holding brackets between the grating and the gutter lip.
- G. All inside and outside corners and custom radii sections under 3-feet inside diameter (short radius section) shall be custom fabricated and strengthened by the manufacturer.
- H. Fasteners shall be SS-316, provided by the manufacturer, and installed per manufacturer instructions and as shown on drawings.
- I. Colors selected by the Architect/Owner from manufacturer's standard colors.
- J. Acceptable manufacturers:
 - 1. Daldorado LLC
 - 2. Lawson Aquatics

2.3 PERPENDICULAR OVERFLOW GUTTER GRATING - PVC

- A. The grating surface bars shall run perpendicular to the pool wall.
- B. The grating shall be formed from molded, modular, interlocking, UV-stabilized PVC bars. The top surface of the grating bars shall be raised, water-shedding, slip-resistant and shall meet the IBC Classification C for Wet-Barefoot inclining platform (ramp) test for swimming pool surroundings.
- C. Grating shall be a minimum of 15/32" (12mm) wide and an outside depth of 1.0" (25.4mm) with a middle depth that varies, dependent on grating width and load strength requirements.
- D. Grating design shall meet ASTM D790-10 or ANSI/AS3996 Class A for covers and grates with load exceeding 10kN (2,248lb).
- E. The grating shall provide at least 37.5% open area per foot for unrestricted water flow. The space between the bars shall not exceed 3/8" (9.5mm) and shall comply with IBC child finger/toe entrapment guidelines.
- F. Grating width shall allow the insertion of the touchpad holding brackets between the grating and the gutter lip.
- G. All inside and outside corners and custom radii sections under 3-feet inside diameter (short radius section) shall be custom fabricated and strengthened by the manufacturer.
- H. Fasteners shall be SS-316, provided by the manufacturer, and installed per manufacturer instructions and as shown on drawings.
- I. Colors selected by the Architect/Owner from manufacturer's standard colors.
- J. Acceptable manufacturers:
 - 1. Daldorado LLC
 - 2. Lawson Aquatics
 - 3. RenoSys

2.4 POLYMER / HDPE OVERFLOW GUTTER GRATING

- A. The grating shall be machined from a marine grade polymer or High Density Polyethylene (HDPE) sheets using 1" thick, UV- stabilized material. Material must meet or exceed ASTM D696 for Coefficient of Linear Expansion of material.
- B. The top surface of the grating shall be raised, water-shedding, slip-resistant and shall meet ASTM D2047 slip resistance (wet) with a nominal value of 0.62.
- C. Grating design shall meet ASTM D790-10 or ANSI/AS3996 Class A for covers and grates with load exceeding 10kN (2,248lb).

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- D. The grating shall include machined slots providing at least 37.5% open area per foot for unrestricted water flow. The openings shall not exceed 3/8" (9.5mm) and shall comply with IBC child finger/toe entrapment guidelines. Direction of slots may be parallel and/or perpendicular to the pool wall as indicated in drawings.
- E. Grating width shall allow the insertion of the touchpad holding brackets between the grating and the gutter lip.
- F. All inside and outside corners and custom radii sections under 3-feet inside diameter (short radius section) shall be custom fabricated and strengthened by the manufacturer.
- G. Fasteners shall be SS-316, provided by the manufacturer, and installed per manufacturer instructions and as shown on drawings.
- H. Colors selected by the Architect/Owner from manufacturer's standard colors.
- I. Acceptable manufacturers:
 - 1. Paddock Pool Equipment Company
 - 2. RenoSys
 - 3. Natare Corporation

PART 3 - EXECUTION

3.1 GENERAL

- A. Inspect project conditions prior to installation. Concrete support ledge must meet the grating manufacturer's minimum width requirements. Concrete surface shall be clean and level to allow a level grating installation. Report conditions detrimental to grating installation in writing to Architect prior to initiating installation.
- B. Install grating per manufacturer's instructions. Include manufacturer's PVC grating accessories (PVC curb angle, supports, handholds, fasteners and other accessories) as required by project conditions and/or as detailed in drawings.
- C. Installation shall not allow water flow beneath the grating and into the gutter trench. Follow manufacturer's installation methods and use manufacturer's approved sealant as required between grating and pool wall surface on the front skimming edge to assure water uniformly skims over the top skimming edge.
- D. Provide templates for corners or other conditions for shop fabrication to the manufacturer, per manufacturer's requirements. Field fabrication of corners and short radius sections is not permitted.
- E. Gap width between individual grating sections shall not exceed the specified machined opening width or width between bars. Gap width between grating and other surfaces shall not exceed 5/16" (8mm).
- F. The skimming edge elevation at the face of the pool wall shall be within 1/8" +/- of the pool static water elevation and must provide continuous skimming around the entire pool perimeter.
- G. Install manufacturer's fasteners to anchor grating. Space fasteners as indicated in drawings. Locate fasteners more frequently if required by code or manufacturer requirements.
- H. Protect grating from damage and concrete splatter. Clean grating of all dirt, debris, concrete splatter, and staining per manufacturer's instructions. Replace grating that becomes permanently marked, damaged, or stained during the construction process.

END OF SECTION 13 11 42

DIVISION 13 - SPECIAL CONSTRUCTION

**SECTION 13 11 42
PERIMETER OVERFLOW GUTTER GRATING**

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DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 43 POOL STAINLESS STEEL GUTTERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pool Stainless Steel Gutters

1.2 RELATED DOCUMENTS

- A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.3 REFERENCES

- A. The following latest edition reference specifications, guides and standards shall become part of this Specification as if herein written. If provisions conflict, the more stringent provisions shall apply.
 - 1. NSF/ANSI 50 – NSF International Standard/American National Standard
 - 2. NEC – National Electric Code
 - 3. ANSI A137.1-2012

1.4 SUBSTITUTIONS

- A. For alternate manufacturer system to be pre-qualified, the alternate Supplier shall have a minimum of 5 years of continuous experience in the manufacture and installation of continuous stainless steel gutter systems, and shall have no less than five other pools of similar scope utilizing recirculation systems manufactured by that Supplier and installed by their own personnel. Any request for approval of an alternate must be in the form of a complete set of engineering drawings, hydraulic calculations, and specifications, prepared specifically for this project and submitted to the Architect/Engineer for review. Systems that do not provide overflow skimming over the entire perimeter when the pool is in quiescence, and during all levels of bather use, are not acceptable.

1.5 DESIGN REQUIREMENTS

- A. Provide a continuous stainless steel gutter system for recirculation of pool water. The gutter system shall extend around the perimeter of the pool, as shown on the Contract Drawings, providing surface skimming, and incorporating a filtered water return line.
- B. The recirculating gutter system proposed for the swimming pool shall be designed specifically for this project and shall be fabricated and installed by an established manufacturer specializing in gutter overflow systems. All hydraulic calculations shall be provided in the shop drawings, as part of the gutter submittal.

1.6 SUBMITTALS

- A. Shop Drawings: Five copies of shop drawings and hydraulic calculations signed and sealed by an Engineer registered in the project State shall be submitted for the Architect/Engineer's approval and the State Department of Public Health approval 120 days prior to manufacture/installation of gutter.
- B. Stainless steel gutter manufacturer must provide stainless steel certificate showing type of stainless, chemical composition and finish type. Stainless certificate will show stainless steel used for manufacturing of this gutter to be purchased from a U.S. owned and U.S. located mill.

1.7 QUALIFICATION STATEMENTS

- A. The system shall be the product of a manufacturer regularly engaged in the engineering, construction and installation of swimming pool overflow gutter systems.

1.8 DELIVERY, STORAGE AND HANDLING

- A. The fabricated gutter components shall be delivered to the jobsite, unloaded by the pool construction contractor, and stored in the shallow end of the pool.

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SECTION 13 11 43 POOL STAINLESS STEEL GUTTERS

1.9 WARRANTY

- A. The Recirculating Gutter System shall be guaranteed by the manufacturer for workmanship, materials, and performance for a period of five years from date of installation. The guarantee shall include all labor and materials for replacement of any defective materials.

PART 2 - PRODUCTS

2.1 STAINLESS STEEL GUTTER

A. Manufacturers

- 1. The following are approved manufacturers:
 - a. Whitten Products Division of Hydrotech System, Cohoes, NY
 - b. Paddock Pool Equipment Co. Inc., P.O. Box 11676, Rock, SC
 - c. Neptune Benson Inc., One Bridal Avenue, West Warwick, RI 02893

B. Materials

- 1. The major components of the perimeter gutter system shall be fabricated of low maintenance, 12-gauge Type 316L (Type 304L) stainless steel with a finish equivalent to No.3 or 4., as standard to the manufacturer. Materials and methods of installation shall provide a durable and rigid installation. Exposed surface of the gutter shall be cleaned and polished to a smooth, uniform, non-corrosive finish.
- 2. Gutter grating shall be NSF 50 compliant with integral slip-resistant surface.
- 3. The gutter and gutter grating shall have a slip-resistant surface on all horizontal faces, with a minimum dynamic coefficient of friction at least equal to the requirements of ANSI A137.1-2012 of 0.42 as measured by the DCOF AcuTest.

C. Components

- 1. The gutter system shall consist of a stainless-steel drainage trough, slip-resistant overflow lip, deflector plate and pipe converter.
- 2. The system shall be provided a stainless steel filtered water return tube, sized to meet flow velocities requirements in the health code.
- 3. A grating system will be included to enclose/cover the gutter trough.
- 4. The gutter drainage channel and supply system shall be fitted with movable joints at locations to match expansion joints installed into the concrete structure. The joints shall be designed to accommodate expansion and contraction of the recirculation system without causing distortion of the channel, stress on the mounting anchors, or broken welds.
- 5. Recessed Steps
- 6. Vinyl Markings for Depth and Lanes
- 7. Dive Agitators

D. Overflow Skimming

- 1. The gutter drainage trough must be capable of continuous overflow skimming and delivery to the filter of 125% of the total recirculation flow rate. The cross-sectional area and depth of the gutter trough shall provide adequate hydraulic gradient considering the size of the pool.

E. Overflow Lip

- 1. The overflow lip of the gutter shall provide a handhold not exceeding 2-1/2 inches wide and not less than 1 inch deep or as required by Code.
- 2. The overflow lip shall be level to a tolerance of 1/8 inch (+/- 1/16") around the entire pool perimeter to provide uniform skimming of the entire pool surface.

F. Deflector Plate

- 1. For pools with freeboard greater than 1", the upper periphery of the pool gutter shall be formed as a wave deflector plate with angle of deflection providing a splash plate extending above the overflow level. The horizontal surface of this plate shall be slip-resistant at the deck.

G. Depth Markers, Target Markings

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SECTION 13 11 43 POOL STAINLESS STEEL GUTTERS

1. Pool gutter shall be complete with vinyl depth markers and target markings applied to the vertical face as required on the Drawings.
- H. Converters
 1. Gutter manufacturer shall provide gutter supply and drainage converters as required. The converters shall be incorporated into the gutter and fabricated of Type 316L (*Type 304L*) stainless steel and provide all necessary pipe stub connections for interconnection of circulation piping.
 - a. Field connections to flanged converters shall be made by means of non-corrosive hardware.
- I. Grates
 1. Gutter systems not incorporating a grate will not be acceptable.
 2. Grates shall provide a means of 100% access for trough inspection. Grating shall have a minimum 32% open area around the entire pool perimeter for fast reception of pool overflow and turbulence.
 3. Grating shall be held in place by non-corrosive tamper-proof fasteners.
 4. The grating system shall not restrict the required hydraulic flow from pool to primary channel.
 5. Grates shall be unbreakable and capable of supporting at least 450 lbs. per square foot structural bearing load when in place in gutter.
- J. Accessibility and Expansion
 1. All return tubes, fittings, inlets and rope anchors shall be 100% accessible for inspection, repair or replacement. Allowance for lineal expansion and contraction of the gutter shall be provided.
- K. Filtered Water Return Tube
 1. The filtered water return tube shall be fabricated from 12 gauge Type 316L (*304L*) stainless steel and fitted with variable sized nylon jet inlet nozzles not over 42" on center around the entire pool perimeter except in swimming lane and stair locations. Nozzles shall be grouped under floating swimming lane lines and provided in stairwells parallel to stair treads. Inlet jets shall be installed as to provide a steady and consistent stream of filtered chlorinated water on a fixed 45-degree angle directed toward the bottom of the pool. The inlet openings shall not be larger than 1/2" in diameter and the system shall provide uniform flow around the entire pool perimeter. Provide calculations indicating the rate of flow through each inlet.
- L. Racing Lane and Safety Line Anchors
 1. Anchors shall be integral to the gutter system and recessed such that no part of the anchor protrudes above any finish face of the gutter.
- M. Grouting
 1. Grout mixture shall non-shrink, non-metallic be as designed and recommended by the manufacturer and approved by the Architect/Engineer.
- N. Grounding
 1. Complete stainless steel recirculating gutter system including all appurtenances (i.e. gutter components, converters, etc.) shall be provided with grounding lugs in accordance with N.E.C., Article 680 for bonding to ground system by others.

PART 3 - EXECUTION

3.1 GUTTER INSTALLATION

A. Anchoring and Installation

1. The recirculation gutter system shall be installed with corrosion resistant anchorage spaced at a maximum of 4 feet on center around the entire pool perimeter.
2. Accurate horizontal and vertical alignment not to exceed plus or minus 1/16 inch around the entire pool perimeter.
3. All joints between stainless steel sections shall be welded. Bolted or caulked joints not accepted.

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**SECTION 13 11 43
POOL STAINLESS STEEL GUTTERS**

4. After the stainless-steel gutter system is installed and leveled on the pool walls, the gutter system installer shall complete the installation by grouting under and behind the gutters around the entire perimeter of the pool to insure a water tight seal around the entire pool perimeter.
- B. Welds
1. All seams shall be welded by the TIG process and shall result in a uniform appearance. Welds shall not be ground. All welds shall be brushed after appropriate cooling. Seams shall have a flush appearance.
 2. All horizontal welds shall be fully accessible for inspection.
- C. At the completion of the gutter system installation, the gutter installer shall clean and passivate all accessible gutter and welds, including below the grating, per manufacturer's cleaning instructions.

END OF SECTION 13 11 43

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 45 POOL RAIL GOODS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Rail Goods
 - 1. Hand rails
 - 2. Grab rails
 - 3. Ladders
 - 4. Stanchions
- B. Accessories
 - 1. Wedge Anchors
 - 2. Compression Anchors
 - 3. Escutcheons

1.2 RELATED DOCUMENTS

- A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.3 REFERENCES

1.4 DESCRIPTION OF WORK

- A. Fabrication and installation of hand rails, grab rails ladders, stanchions and accessories required for installations.

1.5 QUALITY ASSURANCE

- A. Refer to General Requirements and Division 01 of the Specifications for additional requirements.

1.6 SUBMITTALS

- A. Refer to General Requirements and Division 01.
- B. Submittals required:
 - 1. Hand Rails
 - 2. Grab Rails
 - 3. Ladders
 - 4. Therapy Rails
 - 5. Anchors
 - 6. Escutcheon Plates
 - 7. Stanchions
 - 8. Stanchion Sockets
- C. Provide care and maintenance instructions, embracing the operation functions and maintenance processes involved in connection with the complete system, including routine maintenance and cleaning. Provide information regarding maintenance practices and products which may be detrimental to the products.
- D. Printed and bound operating, installation, and service manuals.

1.7 SUBSTITUTIONS

- A. Refer to General Requirements and Division 01.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Refer to General Requirements and Division 01.

1.9 WARRANTIES

- A. Pool Equipment
 - 1. Manufacturer's Standard Warranty

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 45 POOL RAIL GOODS

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide the equipment scheduled, and any necessary fittings, anchors, and connectors as required and not provided by the manufacturer. The equipment shall be the manufacturer and model number listed or a pre-approved equal. Although unit quantities are shown, it is the installing contractor's responsibility to verify and provide actual quantities required.
- B. The following manufacturers have been pre-approved as capable of providing products meeting this specification. Note that custom material/size/finish may be required from some of the manufacturer's listed to meet these specifications.
 - 1. Spectrum Aquatic, 800-791-8056
 - 2. SR Smith LLC, 800-824-4387
 - 3. Paragon Aquatics, 888-KDI-SWIM

2.2 MATERIALS OF CONSTRUCTION

- A. Rails
 - 1. All rail products specified in this section shall be 316L stainless steel.
 - 2. All rail goods with a grip surface (handrails, grab rails, therapy bars, ladders) shall be 1.50" OD.
 - 3. Provide rail material with 0.120 wall thickness.
 - 4. The surface of the rails shall be polished to a minimum 500 grit mirror finish and passivated according to ASTM A967.
 - 5. Final coating of steel shall be per manufacturer's standard treatment procedure. All welds shall be finished, polished, and passivated to blend and match the rail finish.
- B. Stanchions (Backstroke and activity)
 - 1. All rail products specified in this section shall be 316L stainless steel.
 - 2. Shall be 1.90" OD, 0.145" wall thickness
 - 3. The surface of the stanchions shall be polished to a minimum 500 grit mirror finish and passivated according to ASTM A967.
 - 4. Final coating of steel shall be per manufacturer's standard treatment procedure.
 - 5. Stanchions shall be 4'-6" tall and provided with a 2" ring on the top surface and a 2" ring on sliding collar.
- C. Wedge Anchors
 - 1. Rail Anchors shall be corrosion resistant, sized to accept the rail dimensions specified and a minimum of 4" deep. For anchors greater than 4" deep, contractor shall verify adequate concrete thickness at the anchor points.
 - 2. Stanchion Sockets shall be corrosion resistant, minimum 6" deep and designed to accept a 1.90" OD stanchion.
- D. Escutcheon Plates
 - 1. Provide escutcheon plates for each anchor location, sized to match rail diameter.
 - 2. Shall be rail manufacturer's round, stamped 316L Stainless Steel escutcheon.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Manufacturer's Installation Instructions
 - 1. All equipment of this section shall be installed in accordance with industry standards and comply with manufacturer's installation instructions/recommendation. The contractor shall notify the engineer in writing of any discrepancies between the contract documents and the manufacturer's instruction. This notification shall include a request for clarification prior to installation.
- B. Install equipment true and level.
- C. Equipment shall be installed secure, with no "play" or movement when shaken.
- D. Rails shall be clean, free of dirt and contamination, and polished prior to turnover to owner.

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**SECTION 13 11 45
POOL RAIL GOODS**

- E. Protect Equipment from damage during installation and up to substantial completion. Repair or replace damaged parts.

END OF SECTION 13 11 45

DIVISION 13 - SPECIAL CONSTRUCTION

**SECTION 13 11 45
POOL RAIL GOODS**

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DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 46 POOL EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pool Equipment
 - 1. Pool fittings, deck, maintenance, and safety equipment.
- B. Pool Specialty Equipment
 - 1. Spray and play equipment manufactured for use in swimming pools and/or spray pads.

1.2 RELATED DOCUMENTS

- A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.3 REFERENCES

- A. Specialty Equipment
 - 1. Equipment submitted shall be designed by manufacturer to meet all federal, state, and local requirements.
 - 2. Equipment manufacturer shall meet applicable requirements of Consumer Product Safety Commission, ASTM, UL, and other applicable standards.
 - 3. Comply with ASTM F2461-09, standard practice for manufacture, construction, operation, and maintenance of aquatic play equipment.

1.4 DESCRIPTION OF WORK

- A. Refer to General Requirements and Division 01 of the Specifications for additional requirements.

1.5 QUALITY ASSURANCE

- A. Refer to General Requirements and Division 01 of the Specifications for additional requirements.

1.6 SUBMITTALS

- A. Refer to General Requirements and Division 01.
- B. Submittals required:
 - 1. Pool Fittings and Equipment
 - 2. Deck Equipment
 - 3. Safety Equipment
 - 4. Maintenance Equipment
 - 5. Pool Specialty Equipment
 - a. Provide detailed Shop Drawings of equipment being installed, including but not limited to:
 - 1) Location
 - 2) Flow rates
 - 3) Safety equipment
- C. Provide a typed sheet of Operating Instructions, embracing the operation functions and maintenance processes involved in connection with the complete system, including routine maintenance, and start-up requirements.
- D. Printed and bound operating, installation, and service manuals.

1.7 SUBSTITUTIONS

- A. Refer to General Requirements and Division 01.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Refer to General Requirements and Division 01.

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SECTION 13 11 46 POOL EQUIPMENT

- 1.9 WARRANTIES
 - A. Pool Equipment
 - 1. Manufacturer's Standard Warranty
 - A. Pool Specialty Equipment
 - 1. Manufacturer's Standard Warranty – 2-year minimum

PART 2 - PRODUCTS

- 2.1 GENERAL
 - A. Provide the equipment scheduled on the drawings, and any necessary fittings, anchors, and connectors as required and not provided by the manufacturer. The equipment shall be the manufacturer and model number listed or a pre-approved equal. Although unit quantities are shown for value engineering purpose, it is the installing contractor's responsibility to verify actual quantities required.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Manufacturer's Installation Instructions
 - 1. All equipment of this section shall be installed in accordance with industry standards and comply with manufacturer's installation instructions/recommendation. The contractor shall notify the engineer in writing of any discrepancies between the contract documents and the manufacturer's instruction. This notification shall include a request for clarification prior to installation.
 - B. Install equipment true and level.
 - C. Protect Equipment from damage during installation and up to substantial completion. Repair or replace damaged parts.

END OF SECTION 13 11 46

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 11 47 POOL PLAY EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pool Play Specialty Equipment
 - 1. Interactive spray and play equipment manufactured for use in swimming pools and/or spray pads.
 - 2. Climbable Aquatic Structures
 - 3. Above ground and flush mounted aquatic spray/play equipment.

1.2 RELATED DOCUMENTS

- A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.
- B. For waterslides, see specification section 131165.

1.3 REFERENCES

- A. Pool Play Equipment shall
 - 1. Be designed by manufacturer to meet all federal, state, and local requirements.
 - 2. Meet applicable requirements of Consumer Product Safety Commission, ASTM, UL, and other applicable standards.
 - 3. Comply with ASTM F2461, Standard Practice for Manufacture, Construction, Operation, and Maintenance of Aquatic Play Equipment
 - 4. Comply with ASTM F1487 Standard Consumer Safety Performance Specification for Playground Equipment for Public Use
 - 5. Comply with 2010 ADA Standards for Accessible Design
 - 6. ASTM A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

1.4 DESCRIPTION OF WORK

- A. Refer to General Requirements and Division 01 of the Specifications for additional requirements.

1.5 QUALITY ASSURANCE

- A. Refer to General Requirements and Division 01 of the Specifications for additional requirements.
- B. Manufacturer's Qualifications:
 - 1. Manufacturer shall have a minimum 10 years of experience in the design, engineering, manufacture, and fabrication of pool play equipment and components. The person(s) responsible for installation shall have supervised/installed a minimum of 5 (Five) installations of a similar nature and scope to the installation described herein.
 - 2. Manufacturer shall provide independent and accredited certification that it applies a quality management system which meets the requirements of ISO 9001:2008 or ASTM F1193, manufacturing, sales, marketing and servicing of recreational aquatic products and accessories.
 - 3. The person(s) responsible for installation shall be on-site performing such service.
- C. Provide evidence of commitment of quality craftsmanship as demonstrated by the following:
 - 1. Products shall be designed and produced at a facility owned and directly supervised by the supplier.
 - 2. A full-time licensed engineer must be on staff.
 - 3. A full-time quality control manager must be on staff.
 - 4. Established customer service department and a ready supply of replacement parts.

1.6 SUBMITTALS

- A. Refer to General Requirements and Division 01.

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SECTION 13 11 47 POOL PLAY EQUIPMENT

- B. Shop drawings:
 - 1. Promptly after award of the contract, the contractor shall submit complete shop drawings to include, but not be limited to:
 - a. Location and sizes of pipe connections and spray fittings
 - b. Equipment flowrates and pressure demands
 - c. Required Safety equipment (landing pads, stanchions, etc.)
 - d. Required conventional footings, thickened slabs, fasteners and/or anchors as engineered by the manufacturer.
 - e. Materials of construction
 - f. Color Renderings of Thematic Finishes and Structures
 - g. Structure Elevations above Finished Grade and Required Clearances
 - h. Area of pool or pad requiring flat concrete work
 - i. Details of connections to sloping concrete work
 - j. Comprehensive Color Selection Work Sheet and Color Samples
 - k. Recommended safety signage
 - 2. Submittals for above grade features shall be certified and sealed by a structural engineer, licensed in the project state.
- C. Provide a printed, bound hard copy of the operation, maintenance and service instructions for the complete system including the following: operational functions as designed, scheduled maintenance, maintenance processes, start-up procedures, and winterization requirements.

1.7 SUBSTITUTIONS

- A. Refer to General Requirements and Division 01.
- B. Pool Play Equipment, other than the basis of design, must be pre-approved for equivalency by the Owner and Engineer prior to bidding. Vortex, Whitewater West Industries, Splashtacular, Waterplay, Raindrop and Proslide shall be permitted manufacturers for equivalent substitutions.
- C. Climbable aquatic play structure walkable surfaces shall be plus or minus 10% of the surface area of the basis of design structure. Access to the structure and slide terminations off the structure shall be generally consistent with the basis of design. Total elevation and elevation of walking platforms shall be generally consistent with the basis of design.
- D. Substituted play structure shall be designed to accommodate the pool or spray pad floor slopes as designed. Structures requiring modification of the pool or spray pad shall not be acceptable.
- E. Above grade pool play equipment, including climbable aquatic structures, will be reviewed for thematic, aesthetic and play value equivalency.
 - 1. Substituted climbable aquatic structures shall meet or exceed the total number of interactive play/spray elements, and provide equivalent ADA access and specialty equipment. Substitution requests shall include an accounting and description of the total number of interactive play elements accessible on the play structure from grade and total number of features meeting ADA guidelines.
 - 2. Spray and play elements shall provide similar spray patterns and/or interactive play value to the basis of design product.
 - 3. Substituted play equipment shall provide a cohesive theme to match the basis of design and complement the facility.
 - 4. Because form, aesthetics and theme are subjective in nature, the Owner shall have the ultimate approval authority for equivalent above grade specialty equipment.
- F. Submittal: Provide for review, a complete set of themed renderings and engineering shop drawings, photos of similar installations, hydraulic calculations, and specifications, prepared specifically for this project and submitted to the Engineer/Owner for review. Drawings shall include the located play structure with footings, pipe connections, safety zones and spray zones identified. Modifications required to pump system, electrical design, piping, surface drains and surge tank design for use of the substituted products must be specifically identified as part of the submittal package. The proposed pump model, electrical panel modifications, hydraulic calculations, pipe size, pipe penetration layout, drain size and sump design shall be provided as part of the submittal.

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SECTION 13 11 47 POOL PLAY EQUIPMENT

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Refer to General Requirements and Division 01.
- B. Product Delivery, Storage and Handling
 - 1. Pool play equipment must be properly wrapped and secured in place while in transit to the project site. Care shall be observed during offloading and handling to prevent excessive stress and abrasions.
 - 2. Store pool play equipment in safe areas, out of the way of traffic and other construction activities, until the actual time of the installation. If required, provide safety barricades or other like precautions for the protection of public and adjacent property.
 - 3. Unless otherwise required by the manufacturer, maintain safety wrapping through installation.
 - 4. Loading and unloading equipment, as required, shall be coordinated and provided by Contractor.
 - 5. Identifying and resolving shipping damage issues shall be the responsibility of the Contractor.

1.9 WARRANTIES

- A. Provide the minimum warranties as follows:
 - 1. All materials, components, and coatings to be warranted to be free from defects in workmanship or materials and free from defects arising from process of manufacture for a period of 1 year.
 - 2. The warranty period shall start at the time of substantial completion.
 - 3. All warranties are to be managed by the equipment manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide the equipment scheduled on the drawings, and any necessary fittings, anchors, and connectors as required and not provided by the manufacturer. The equipment shall be the manufacturer and design/model number listed on the drawings or a pre-approved substitution. Although unit quantities are shown, it is the installing contractor's responsibility to verify actual quantities required.
- B. Pool Play Equipment shall be suitable for installation in aquatic facilities and public play areas.
- C. Pool Play equipment shall be provided with Grounding / Bonding lugs compliant with NEC requirements.
- D. Safety and Craftsmanship
 - 1. All exposed edges of pool play equipment shall be machined to a rounded edge.
 - 2. All welds shall be grinded, polished, watertight, and factory pressure tested.
 - 3. Nozzles and Spray heads shall be recessed, flat or rounded to provide no protrusion hazard.
 - 4. All assembly and interactive pool play components shall be designed and built to ensure a completely safe play environment with no pinch, entrapment potential or protrusion hazard.
 - 5. All accessible posts and support posts shall have material covering the anchoring assembly and hardware.
 - 6. All products shall be designed in accordance with the latest ASTM and CPSC, for aquatic play equipment.
- E. Provide manufacturer's recommended safety signage and AHJ required signage, rated for outdoor use, except where noted otherwise.

2.2 CLIMBABLE AQUATIC STRUCTURES

- A. Climbable Aquatic Structures shall be designed to withstand its self-weight, imposed live load from patrons, climatic loads, and seismic effects as required by the latest ASTM F2461 and the

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relevant Structural Design Codes applicable at the project site location; whichever is more stringent.

B. Aquatic Structures Materials:

1. Structural Tubing: Factory powder coated, Type 304/304L stainless steel type, minimum schedule 10 thickness or hot dipped galvanized min schedule 40 per ASTM A123/A123M. Fiber reinforced polymer (FRP) and/or molded fiberglass, PVC, filament wound tubing, and aluminum shall not be utilized for any above or below grade structural components of the aquatic structures.
2. Structural Decks: Perforated stainless steel with factory finished slip-resistant surface or self-supporting fiberglass with factory slip-resistant finish. Decks shall be structurally designed, capable of supporting a minimum load of 100 lb/ft². Deck finish shall be UV and chemical resistant and suitable for public spaces.
3. Stairs: Stairs shall have a minimum depth of 12", except where required by ADA to be 14" and a minimum width of 28 inches, unless otherwise indicated on the contract drawings. Stairs shall be compliant with ADA regulations for "transfer" systems, where required.
4. Barrier Panels/Guardrails/Handrails: Barrier panels on elevated platforms and stairs shall provide a minimum 42" guardrail height with a continuous handrail at a height of 34 to 38" on stairs. Barrier panels shall be polycarbonate, fiber reinforced plastic, or hot-dipped galvanized steel with a factory applied finish treated for extended UV resistance. For Acrylic panels, minimum UV resistance / light transmission threshold shall be a minimum of 82% as per ASTM D1003. Grab rails shall be aluminum or an equivalent corrosion resistant material not requiring paint.
5. Below Deck Barrier: Areas beneath the walking surface, less than 84" clear from the pool or spray pad finish, shall be protected with a non-climbable barrier. Means for controlled access to these areas shall be provided for maintenance activities and installation.
6. Bridges: Bridges shall be non-corrosive, slip-resistant and designed with no pinch-points or entrapment potential. Bridges shall be provided with guard rails and handrails, as required in Barrier Panels/Handrail section of this spec. Bridges shall provide a minimum clearance of 7'-6" to spray pad surface, 5'-0" to water surface, and 8'-0" minimum to pool floor.
7. Nozzles: Nozzles shall be non-corrosive, impervious to galling, precision machined, and shall use tamper resistant tools for installation and removal. Nozzles and spray heads shall be recessed, flat or rounded to provide no protrusion hazard and sized to prevent finger and toe entrapment.
8. Interactive Valves: All Butterfly valves shall be stainless steel with EPDM seat. Valve handles shall be non-climbable and located to prevent impact. All ball valves shall be PVC or stainless steel. All rope pull operated valves shall be self-closing with stainless steel or brass bodies and/or operating parts. Valves and piping shall be capable of withstanding a 79 kg (175 lb.) live load.
9. Finishes:
 - a. Steel Structure: Provide a factory applied finish that is UV, chemical resistant, damage resistant and suitable for public spaces.
 - 1) Powder coat paint finish coatings shall be heat-cured super-durable powder coating.
 - 2) Galvanized steel shall be hot-dipped galvanized, with catalyzed epoxy primer, painted with two coats of catalyzed polyurethane topcoat or an equivalent high performance Tnemec epoxy paint system.
 - b. Concrete Pedestals: Contractor shall install pool finish materials on all submerged and freeboard level concrete pedestals. Match pool wall finishes detailed in the Pool Drawings and Finish Schedule.
10. Flange Protection: On all accessible support posts and play product bases provide a covering for the anchoring assembly hardware to protect against pinch points and protrusions.

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11. Integral Play Structure Manifold: Provide an integral pipe manifold contained beneath the play structure Below Deck Barrier. The main structural body shall be type 304/304L stainless steel pipe, PVC, structurally capable of withstanding anticipated forces, durable, and highly resistant to corrosive environments. Rigid fiber reinforced polymer (FRP) and/or molded fiberglass, filament wound tubing, Galvanized Steel, or Aluminum shall not be utilized for manifold main body.
 12. Mounting and Assembly Hardware: All hardware and anchoring systems shall be high corrosion resistant marine grade type 304 or 316/316L stainless steel and utilize self-locking device (locking nuts, locking washers or thread locking compound) to avoid loosening and to deter vandalism and theft.
 - C. The climbable aquatic structure shall contain the play components itemized on the drawings or equivalent features at a minimum. Additionally, the play components shall:
 - D. Climbable Aquatic Play Structure Slides:
 1. Poly Slides: Shall be constructed of rotationally molded U.V. stabilized linear Low-Density Polyethylene (LDPE) and color as specified. Slide slope should be a maximum of 30 degrees from horizontal, shall meet the ASTM F2461 standard and shall include the slide landing mat and installation hardware.
 2. Fiberglass Waterslides: All waterslide flumes shall be constructed of marine grade fiberglass reinforced plastic with chemical and UV resistant gel coat. Structural members shall be factory painted, type 304/304L stainless steel or hot-dipped galvanized structural tubing.
 - a. Fiberglass Waterslides with runout: The run-out cross section shall be 10- 22" (305mm) in height to allow safe and easy exit for riders.
 - b. Fiberglass Waterslides terminating in pool: Slides from the play structure terminating in a pool without a runout shall meet all applicable requirements of Specifications 13 11 65 and ASTM-F2376-08 "Standard Practice for Classification, Design, Manufacture, Construction, and Operation of Water Slide Systems".
- 2.3 ABOVE GRADE POOL PLAY EQUIPMENT (Other than Climbable Aquatic Structures)
- A. Above grade pool play equipment shall be as shown and scheduled on the contract documents.
 - B. Materials of Construction for Above Grade Specialty Equipment shall be:
 1. Safety: Non-climbable, aquatic play features shall meet ADA compliance for handicap accessibility and meet or exceed current ASTM playground safety standards. Equipment must be designed and manufactured to prevent finger entrapment.
 2. Steel Components: Factory Powder Coated, Type 304/304L Stainless Steel or hot-dipped galvanized for structural tubing and components. All curved support posts shall be smooth with no joints or ripples.
 3. Fasteners: All fasteners and hardware shall be constructed of 304L/316L marine grade stainless steel. No unfinished plain steel hardware shall be allowed. Exposed and accessible hardware shall be tamper-resistant, requiring a special tool for removal.
 4. Finish: Provide a factory installed finish that is UV, chemical resistant, damage resistant and suitable for public spaces.
 - a. Powder coat paint finish coatings shall be heat-cured super-durable powder coating.
 - b. Galvanized steel shall be hot-dipped galvanized, with catalyzed epoxy primer, painted with two coats of catalyzed polyurethane topcoat or an equivalent high performance tnemec epoxy paint system.
 5. Spray Nozzles, Caps and Heads: Shall be manufactured from corrosion resistant solid Ultra-High Molecular Weight Polyethylene (UHMW) plastic, rigid UV treated polyurethane, Lead Free Brass or 304/304L Stainless Steel. Exposed hardware shall be tamper resistant. PVC, Nylon, and Delrin™ material shall not be utilized.
 6. Rotational Joints: This joint shall provide smooth operation, be free of any pinch points and contain no flexible hoses.

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7. Hoses: Flexible hose shall be constructed of high-grade PVC compound for flexibility with internal braided reinforcement. It shall be installed using stainless steel hose fittings and two (2) protective covers without sharp edges and pinch points. Hose shall be installed to prevent entanglement.
 8. Interactive Valves: All Butterfly valves shall be stainless steel with EPDM seat. Valve handles shall be non-climbable and located to prevent impact. All ball valves shall be PVC. All rope pull operated valves shall be self-closing with stainless steel or brass bodies and/or operating parts. Valves and piping shall be capable of withstanding a 79 kg (175 lb.) live load.
 9. Water guns/cannons: The water gun/cannon shall be mounted on a base that will allow the gun to be directed by the user. Water guns/Cannons shall have pivot controls, capable of limiting rotational range.
- C. Manifolds:
1. Mounting and Connections: Provide a water distribution manifold consisting of a main pipe divided in multiple water outputs and valves to permit water flow adjustment for each output line.
 2. Location: The Water Distribution Manifold shall be located as shown on the drawings
- 2.4 FLUSH MOUNTED POOL PLAY EQUIPMENT
- A. Flush mounted pool play equipment shall be as shown on the contract documents.
- B. Materials of Construction for Flush Mounted Equipment shall be:
1. Safety: Installed flush with adjacent surfaces, except where noted on contract documents. Pool play features are to meet or exceed current ASTM playground safety standards, ADA Standard for handicap accessibility and be designed and manufactured to prevent finger and toe entrapment.
 2. Nozzles: Provided with temper resistant brass, stainless-steel or equivalent material spray cap and winterizing cap.
 3. Maintenance: All outdoor pool play features of flush mount design shall address winterization.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- A. Product Installation
1. When applicable, templates shall be supplied to facilitate the installation of embedded anchoring equipment.
 2. All posts shall have electrical grounding studs incorporated into their associated anchoring equipment. All play products shall be grounded by the installer per local codes.
 3. Drawings and Instructions: Product drawings and installation manuals shall be supplied by the manufacturer for ease of installation.
- B. Concrete Pedestal Finishes:
1. Contractor shall install pool finish materials on all submerged and freeboard level concrete pedestals. Match pool wall finishes detailed in the Pool Drawings and Finish Schedule.
- C. Manufacturer's Installation Instructions
1. All equipment of this section shall be installed in accordance with industry standards and comply with manufacturer's installation instructions/recommendation. The contractor shall notify the engineer in writing of any discrepancies between the contract documents and the manufacturer's instruction. This notification shall include a request for clarification prior to installation.
- D. Install equipment true and level, with flush fitment to surfacing material.
- E. Protect Equipment from damage during installation and up to substantial completion. Repair or replace damaged parts.
- F. Touch up:

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1. Touch up finish paint (if applicable) and touch up paint for cold galvanizing shall be provided by the manufacturer.
2. All repairs to galvanized surfaces shall be carried out in accordance with ASTM A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

G. Start up:

1. Follow manufacturer's instructions for start-up.
2. Prior to start-up Contractor shall confirm all piping is free of debris that can clog nozzles.
3. Contractor shall adjust the overall flow and/or distribution to the pool play equipment for balanced aesthetic and safe play.
4. Contractor shall verify proper operation of all interactive components.
5. Upon completion of construction, the contractor shall provide the owner /operator adequate training on the pool play equipment uses, operations and maintenance.

END OF SECTION 13 11 47

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POOL PLAY EQUIPMENT**

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SECTION 13 11 60 POOL QUARTZ AGGREGATE FINISH

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Includes but is not limited to the complete installation of a quartz aggregate finish as designated in the plans and specifications within strict accordance to manufacturer instructions and listed references.

1.2 RELATED DOCUMENTS

- A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.3 REFERENCES

- A. The following latest edition reference specifications, guides and standards shall become part of this Specification as if herein written. If provisions conflict, the more stringent provisions shall apply.
 - 1. National Plasterer's Council "Pool Plaster Technology", Phone # 866-483-4672, www.mpconline.org
 - 2. National Spa and Pool Institute "Start Up Do's and Don'ts for Newly Plastered Swimming Pools; Why You Should Use Plaster in Your Swimming Pool; Care Tips for New Swimming Pool Plaster and Technical Manual", Phone # 703-838-0083.

1.4 QUALITY ASSURANCE

- A. The installer shall provide documentation providing a minimum of five (5) successful installations of similar scope and complexity with current contact information and phone number.
- B. The installer shall be a member of the National Plasterer's Council in good standing.
- C. The installer shall provide documentation/certification that the laborer's performing the work on site have been factory trained by the pool finish manufacturer.
- D. The installer shall provide a letter of reference from the pool finish manufacturer.

1.5 SUBMITTALS

- A. Refer to General Requirements and Division 01.
- B. Submit product literature and sample colors for Quartz Aggregate Finish and manufacturer approved bond coat forty (40) days prior to use. Quartz Aggregate material shall be listed in the material submitted.
- C. Submit all documents required above for experience and qualification.
- D. Provide three (3) 3'x3' onsite mock-ups of varying grades of coarseness for Owner's approval. The pool contractor is responsible to coordinate approval of mockups prior to the quartz aggregate pool finish installation.

1.6 SUBSTITUTIONS

- A. Refer to General Requirements and Division 01.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. If material is stored, it must be in a cool, dry area, protected from the elements.

1.8 WARRANTIES

- A. It shall be noted that the pools may be subject to be drained for prolonged periods of time for normal maintenance and cleaning.
- B. Provide Manufacturer's Product Warranty on the Quartz Aggregate Pool Finish Product. The pool finish manufacturer shall acknowledge that the pool(s) are subject to be drained completely for winterization and periods during normal maintenance and shall guarantee the pool finish for five (5) years covering any defects caused by product failure.

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- C. Provide Special Project Application Warranty on the Quartz Aggregate Finish Application. The pool finish installer shall acknowledge that the pool(s) are subject to be drained completely for winterization and periods during normal maintenance and shall guarantee the pool finish application for two (2) years covering any defects caused by the application of the product not limited to: abnormal cracks (other than closed shrinkage cracks that may appear), discoloration, hollow spots and de-lamination.
- D. Special Project Warranty on Concrete Structure and Special Aggregate Finish: The Pool Contractor shall guarantee for two (2) years repair of the special aggregate finish covering any defects, cracks and/or leaking in the pool shell.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS AND MANUFACTURERS

- A. Sun Stone by:
CLI Industries, Inc.
P.O. Box 593704
Orlando, FL 32859,
(407) 851-2660.
www.clindustries.com
- B. Approved Equal

2.2 INSPECTION/MEETINGS AND PREPARATION

- A. Schedule a pool finish pre-installation conference before applying the pool finish.
 - 1. Attendees: Manufacturer's representative, Pool Finish Installer, Contractor and its superintendent and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the work.
 - 2. Agenda: Review the manufacturer's application instructions and discuss items of significance that could affect progress and installation, including but not limited to the following:
 - a. Construction schedule
 - b. Critical work sequencing
 - c. Accessibility
 - d. Designation of responsible personnel qualified to do the work
 - e. Concrete surface preparation requirements
 - f. Bond coat curing and application
 - g. Pool Finish application and surface preparation
 - h. Finishing methods as recommended by the manufacturer to include exposing the aggregate
 - i. Verify and discuss proposed work force is adequate to complete the installation as recommended by the manufacturer
 - j. Verify pool mechanical and chemical system is prepared for immediate start up after filling the pool
 - 3. Record significant discussions and agreements and disagreements of the conference, and the approved schedule. Promptly publish and distribute any issues or discrepancies to the Architect/Engineer prior to installing the pool finish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. All pool finish work must strictly follow manufacturer installation guidelines, references and recommendations.

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- B. Environmental conditions must comply with manufacturer's requirements, and finish may not be applied to frozen or frost laden surfaces or when the temperature is 40 degrees F or due to fall to 40 degrees within 24 hours.
- C. The filtration and chemical system must be ready for startup and operating immediately after the pool is filled for pool finish curing per manufacture instruction.
- D. The pool finish applicator shall coordinate with the pool shell concrete contractor, specific concrete finish requirements for the pool finish application.
- E. It is the applicator's responsibility to ensure that the concrete substrate is adequate for proper bonding of pool finish in accordance with manufacturer recommendations.
- F. Prepare all pool surfaces to receive the quartz aggregate finish per manufacturer recommendation.
- G. A brush or roll on bonding coat produced and approved by the pool finish manufacturer is required to be applied to the entire pool structure where the pool finish is to be applied. The manufacturer's approved bond coat must be installed and cured in accordance with manufacturer instructions prior to applying the quartz aggregate finish. No exceptions.
- H. Adding any supplements to the manufacturer's pre-bag mix is strictly prohibited unless manufacturer's approved written documentation is submitted and is pre-approved by the pool Architect/Engineer.

3.2 APPLICATION

- A. All pool finish work must strictly follow manufacturer installation guidelines, references and recommendations.
- B. Apply the quartz aggregate finish so that it is flush with the pool gutter, tiles and other embedded items as detailed in the plans and specifications.
- C. The pool finish must be installed to a thickness and tolerance between 3/8" to 1/2" or as recommended by the manufacturer.
- D. Finish quartz aggregate in a workmanlike fashion. Trowel surface smooth. Proceed with application to natural breaks.
- E. No hollow areas discolored or delaminated areas will be acceptable, any and all hollow areas must be chipped out and repaired, patching shall be done in a quality workmen's like fashion. If hollow spots are detected where individual patching required will reduce the overall aesthetic value, it will be the Architect/Engineers discretion to have an entire area between breaks removed and replaced.
- F. All pool floors and horizontal surfaces shall have a slip resistant finish. Slip resistance shall meet Dynamic Coefficient of Friction (DCOF) value of WET:> 0.42. Abrasive resistance shall meet a DCOF value of WET:>0.60.
- G. The contractor is responsible for all brushing/cleaning, chemical monitoring and other requirements set forth by the manufacturer installation and curing instructions. This shall not be the responsibility of the owner.
- H. The installing contractor shall guaranty the finish to be free of sharp edges and splatter that may cause cuts on swimmers' feet.

END OF SECTION 13 11 60

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POOL QUARTZ AGGREGATE FINISH**

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SECTION 13 11 61 POOL CERAMIC TILE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Porcelain Ceramic Pool Tile

1.2 RELATED DOCUMENTS

- A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.3 REFERENCES

- A. The following latest edition reference specifications, guides and standards shall become part of this Section as if herein written. If provisions conflict, the more stringent provisions shall apply.
 - 1. ANSI A108 – Specifications for Installation of Ceramic Tile
 - 2. ANSI A137.1 – Tile Grade Requirements
 - 3. ASTM C-150, Type 1 – Portland Cement
 - 4. ASTM C-206, 7 Type S – Hydrated Lime
 - 5. ASTM C-144 - Sand
 - 6. ANSI A118.1 – Dry Set Mortar
 - 7. TCA 759 – Dry Set Mortar
 - 8. ANSI A118.3 – Epoxy Adhesive
 - 9. TCNA – Tile Council of North America, Handbook for Ceramic, Glass, and Stone Tile Installation, latest edition
 - 10. ISO 13007 – International Standards Organization; Classification for Grouts and Adhesives.

1.4 SUBMITTALS

- A. Refer to General Requirements and Division 01.
- B. Submit product data and samples for each tile product indicated.
- C. Submit shop drawings for approval before ordering tile. Include the following:
 - 1. Plan, elevations, and sections of pool tank and deck.
 - 2. Indicate tile layout, patterns, color, expansion joints, junctions with dissimilar materials and setting details.
- D. Plans of all tile marking showing exact locations and positions of individual tiles.
- E. Maintenance data: Include routine maintenance and stain removal methods.
- F. Provide five copies of submittals.

1.5 SUBSTITUTIONS

- A. Refer to General Requirements and Division 01.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to General Requirements and Division 01.
- B. Deliver all products to job in manufacturer's unopened containers with grade seals unbroken and labels intact.
- C. Keep tile cartons dry.

1.7 QUALITY ASSURANCE

- A. Single source responsibility:
 - 1. Obtain each type and color tile material from single source.
 - 2. Obtain setting and grouting materials from one manufacture to ensure compatibility.
 - 3. Obtain membrane from same manufacturer as setting material or from manufacturer approved by setting material manufacturer to ensure compatibility.
 - 4. Furnish fifteen (15) year guarantee from installation material manufacturer. This guarantee is inclusive of installation materials, finish product, and labor.

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- B. Manufacturer Qualifications:
 - 1. Tile: Minimum five (5) years' experience in manufacture of tile products.
 - 2. Setting Materials: Minimum ten (10) years' experience in manufacture of setting and grout materials specified.
 - C. Installer Qualifications: Specializing in tile work having a minimum of 5 years successful documented experience with finish work comparable to that required for this project.
 - D. Certifications:
 - 1. Submit "Master Grade Certificate" for each shipment, type, and composition of tile, signed by tile manufacturer and installer with requirements of ANSI A137.1.
 - 2. Submit manufacturers certifications that tile, setting materials, adhesives, and grouts are suitable for intended use in submerged, swimming pool environment.
 - E. Field Samples:
 - 1. Sample Installation:
 - a. For final review of each type of installation, construct sample panel of approximately 100 square feet.
 - b. Install in location as directed by Architect and approved by Owner's Representative.
 - c. Show workmanship of finished work and construction techniques including installation and incorporation of waterproofing membrane. Where a particularly difficult detail or technique is required, or where special sizes or shapes of product are needed, they shall be included in sample panel.
 - d. Approved field samples will serve as project standard and may remain as part of the work.
 - F. Pre-Installation Conference:
 - 1. Require attendance of General Contractor, Pool Contractor, Tile Installer and Installers of related work. Review installation procedures and coordination required with related and adjacent work. Hold meeting at least one week prior to commencing work of this section. Publish meeting minutes within 5 days of meeting, distribute minutes to participants, copy Architect.
 - 2. Meeting agenda shall include, but is not limited to:
 - a. Surface preparation
 - b. Tile and installation material compatibility
 - c. Edge protection, transition and prefabricated movement joint profiles
 - d. Waterproofing techniques
 - e. Crack Isolation techniques
 - f. Environmental requirements
 - g. Finish protection
- 1.8 DELIVERY, STORAGE AND HANDLING
- A. Deliver materials in manufacturer's unopened containers, fully identified with brand, name, type and grade. Comply with requirements in ANSI A137.1 for labeling sealed tile packages.
 - B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location. Protect materials from contamination, dampness, freezing or overheating in accordance with manufacturer's instructions.
 - C. Broken, chipped, warped, stained or damaged tile will be rejected.
 - D. Store liquid latexes in unopened containers and protect from freezing.
- 1.9 ENVIRONMENTAL REQUIREMENTS
- A. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation.
 - B. Do not begin installation until construction in spaces is complete and ambient temperature and humidity conditions are consistent with standards and manufacturers written instructions.
 - C. Ventilate spaces receiving tile in accordance with manufacturer's instructions.

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1.10 WARRANTIES

- A. Contractor shall provide written materials and installation warranty, executed by the contractor, Installer and Manufacturer, agreeing to repair or replace tile that fails in material or workmanship within the specified warranty period to Architect/Engineer prior to filling pool with water.
 - 1. Warranty Period: Two (2) years after Substantial Completion, or manufacturer's system warranty, if longer.
 - 2. Warranty Period: Fifteen (15) years after Substantial Completion, or manufacturer's system warranty, if longer

PART 2 - MATERIALS

2.1 GENERAL

- A. ANSI Standard for Ceramic Tile: Provide tile that complies with ANSI 137.1 for types, compositions, and grades of tile indicated.
- B. ANISI Standard for Tile Installation Materials: Provide materials that comply with ANSI standards referenced in "American Standard Specifications for the Installation of Ceramic Tile" with products and materials indicated for setting and grouting.
- C. Furnish ceramic tile required as follows. Colors shall be as selected by Owner and Architect.
- D. Furnish all tiles required for special markings and lettering in conformance with the drawings and applicable Codes, including depth markings and no diving markers.
- E. Racing lane tile edges shall be installed flush with finish pool floor.
- F. Target tile shall be installed flush with finish pool wall.
- G. Use surface bullnose on pool edge where required for proper trim and as directed on the drawings.

2.2 POOL CERAMIC TILE

- A. Indoor Pool Ceramic Tile
 - 1. Agrob Buchtal, Dal-Tile - Keystone or equal as scheduled.
 - a. Provide impervious tile with water absorption rate of less than .5% per ASTM C373. Sizes, types, and slip resistance as scheduled, see end of this section [Drawings].
 - b. Color as selected by Owner/Architect (see Architect's tile selection schedule).
 - c. Increase the slip resistance of all end wall target tile with the addition of 7.5% by weight abrasive grains.
 - d. Provide special shapes, bullnose and other tile as required.

2.3 MORTAR, GROUT AND ADHESIVE MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements herein, provide products from one of the following manufacturers or an approved equal:
 - 1. Custom Building Products, Huntington Beach, CA.
 - 2. Laticrete International, Inc., Bethany, CT.
 - 3. MAPEI Corporation, Deerfield Beach, FL.

2.4 MORTAR MATERIALS: THICK SET

- A. Latex – Portland Cement Mortar: Thick Set (ANSI A118.4)
- B. Description: Two component system; latex additive water emulsion added to Portland cement mortar in place of water or replacing part of the water. The dry-set mortar must be pre-blended and must be specified by the latex manufacturer for use with the particular latex additive. Use amount of liquid latex recommended by latex additive manufacturer.
- C. Acceptable Products:
 - 1. Thick Bed Mortar mixed with Patching & Leveling Latex Additive, by Custom Building Products

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2. Laticrete 226 thick bed mortar mixed with Laticrete 3701 Mortar Admix, by Laticrete International.
 3. MAPEI, 4 to 1 Mud Bed Mix mixed with MAPEI, Planicrete AC, by MAPEI Corporation.
- 2.5 MORTAR MATERIALS: THIN SET AND SLURRY BOND COAT
- A. Improved Modified Dry-Set Cement Mortar: Thin Set (ANSI A118.15)
 - B. Description: Two component system; latex additive water emulsion added to Portland cement mortar in place of water or replacing part of the water. The dry-set mortar must be pre-blended and must be specified by the latex manufacturer for use with the particular latex additive. Use amount of liquid latex recommended by latex additive manufacturer.
 - C. Acceptable Products:
 1. Laticrete 254 Platinum thin set mortar by Laticrete International.
 2. Keralastic System consisting of Keralastic polymer additive and Kerabond dry-set mortar by MAPEI Corporation.
- 2.6 EPOXY GROUT
- A. Multi-component, factory prepared, 100 percent epoxy resin and hardener with sand or mineral filler material. (ANSI A118.3)
 - B. Acceptable Products:
 1. CEG-Lite by Custom Building Products
 2. Laticrete SpectraLock Pro Grout by Laticrete International.
 3. Kerapoxy CQ by MAPEI Corporation.
- 2.7 ELASTOMERIC JOINT SEALANT
- A. Provide as required by TCNA guidelines, and as indicated on drawings, conforming to ASTM 920 and ASTM C 794
 - B. Acceptable products:
 1. Commercial 100% Silicone Sealant by Custom Building Products
 2. Latasil by Laticrete International
 3. Mapesil by MAPEI Corporation
- 2.8 ANTI-FRACTURE/ WATERPROOFING MEMBRANE
- A. Multi-component, factory prepared, anti-fracture/ waterproofing membrane system comprised of a self-curing liquid rubber polymer
 - B. Acceptable Products:
 1. RedGard by Custom Building Products
 2. Laticrete Hydroban by Laticrete International.
 3. Mapelastic AquaDefense by MAPEI Corporation.
- 2.9 WALL PATCH & RENDER MORTAR
- A. Quick-Setting, Fiber-Reinforced, Cementitious Patch and Render Mortar.
 - B. Acceptable Products:
 1. Custom Float Bedding Mortar by Custom Building Products
 2. Laticrete 3701 Fortified Mortar Bed by Laticrete International
 3. Planitop 330 Fast by MAPEI Corporation.
- 2.10 MISCELLANEOUS MATERIALS
- A. Temporary protective coating: Provide product that is formulated to protect exposed surfaces of tile against adherence of mortar and grout, is compatible with tile and mortar/grout products, and is easily removable after grouting is completed without damaging grout or tile.
 1. Grout release in form of manufacturers standard propriety liquid coating that is specially formulated and recommended for use as a temporary protective coating for tile.
 - B. Acceptable Products:
 1. Aqua Mix Grout Release by Custom Building Products

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2. Stonetech Grout Release by Laticrete International.
3. UltraCare Grout Release by MAPEI Corporation.
- C. Epoxy Grout Haze Remover.
 1. Aqua Mix Non-cement Grout Haze Remover
 2. Stontech Epoxy Grout Haze & Coating Stripper by Laticrete International
 3. UltraCare Epoxy Grout Haze Remover by MAPEI Corporation
- 2.11 MIXING MORTAR AND GROUT
 - A. Mix mortars and grouts in accordance with manufacturer's instructions.
- 2.12 EXTRA MATERIALS
 - A. Supply extra 5% of each color of flat and trim in clean marked cartons for Owner's use.

PART 3 - EXECUTION

- 3.1 ACCEPTABILITY OF SURFACES
 - A. Before tiling, check area to be tiled for acceptability as follows:
 1. Surface medium-rough texture.
 2. All surfaces to be tiled shall be free of dust, rust, paint, from oil or other release coatings.
 3. Provision for ladders and other embedments at proper locations.
 4. Concrete true to line, level, plumb and curvature.
 5. Width, depth and length will permit finished accuracy of markings and dimensions.
 6. Verify surfaces for compatibility with tile setting material manufacturer's requirements prior to installation.
- 3.2 ENVIRONMENTAL CONDITIONS
 - A. Protect all newly tiled areas.
 - B. Maintain temperature at 50 degrees F minimum during tile work and for seven days after completion or furnish protection as approved by the Architect/Engineer.
- 3.3 PREPARATION
 - A. Clean substrates.
 - B. Wet down or wash dry, dusty surfaces and remove excess water immediately prior to tile applications.
 - C. Install waterproofing membrane at pools A & B.
 - D. Install slurry bond coat.
 - E. Do not seal substrate unless required by manufacturer.
 - F. Prime substrate if required by manufacturer.
- 3.4 INSTALLATION
 - A. Tile installation, General
 1. Install tile materials in accordance with ANSI A137.1, other reference ANSI or TCNA specifications, and TCNA "Handbook For Ceramic, Glass, and Stone Tile Installation", except for more stringent requirements of manufacturer or these specifications.
 2. Cut and fit tight to protrusions and vertical interruptions.
 3. Work tile joints uniform in width, subject to variance in tolerance in tile size. Make joints watertight, without voids, cracks, excess mortar or grout.
 4. Prepare surface, fit, set, bond, grout and clean in accordance with applicable requirements of ANSI standards and Tile Council of North America.
 5. Floors and walls: dry set: TCNA F113, F115, and W202E.
 6. Comply with tile setting material manufacturer's installation requirements.
 - B. Thin set method

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1. Apply mortar or adhesive with notched trowel using scraping motion to work material into good contact with surface to be covered. Back bed tiles with mortar. Maintain 95 percent coverage on back of tile and fully bed all corners.
 2. Apply only as much mortar or adhesive as can be covered within allowable windows as recommended by mortar or adhesive manufacturer or while surface is still tacky.
 3. Set tile in place and rub or beat with small beating block.
 4. Beat or rap tile to ensure proper bond and also to level surface of tile.
 5. Align tile to show uniform joints and allow to set until firm.
 6. Clean excess mortar or adhesive from surface of tile with wet cheesecloth while mortar is fresh.
 7. Sound tile after setting. Replace hollow sounding tiles.
- C. Thick Set Method
1. Apply slurry bond coat.
 2. While the slurry bond coat is wet, spread the mortar and compact well.
 3. While slurry bond coat is wet and sticky, set tile in place and beat in well.
 4. Beat or rap tile to ensure proper bond and also to level surface of tile.
 5. Align tile to show uniform joints and allow to set until firm.
 6. Clean excess mortar or adhesive from surface of tile with wet cheesecloth while mortar is fresh.
 7. Sound tile after setting. Replace hollow sounding tiles.
 8. Maintain ambient temperature above 50 F and below 100F for 72 hours after installation.
- D. Grouting
1. Allow tile to set a minimum of 72 hours before grouting.
 2. If bonding materials are rapid setting, follow manufacturer's recommendations.
 3. Install in accordance with grout manufacturer's recommendations and ANSI A108.10.
 4. Pack joints full and free before mortar takes initial set.
 5. Clean excess grout from surfaces per manufacturer recommendations, as work progresses.
- 3.5 LAYOUT
- A. Align all joints to give straight uniform grout lines.
 - B. Observe exact minimum length per dimensions shown on Contract Drawings.
 - C. Observe exact minimum width per dimensions shown in Contract Drawings.
 - D. Observe +/- 1/16" maximum finish elevation tolerance on all gutter edges.
 - E. Provide expansion joints per TCNA EJ171.
- 3.6 WORKMANSHIP
- A. Supply first-class workmanship in all tile work.
 - B. Use all products in strict accordance with recommendations and directions of manufacturer.
 - C. Proportion all mixes in accordance with latest ANSI Standard Specifications.
 - D. Smooth all exposed cut edges.
 - E. Gutter edges shall not vary from level or true plane more than 1/8" of pool static water level.
- 3.7 CLEANING
- A. Clean excess mortar from surface with water as work progresses.
 - B. Clean tile surface as thoroughly as possible on completion of grouting, perform cleaning while mortar is fresh and before it hardens on surfaces.
 - C. Before acid cleaning, saturate with clean water all grout joints in areas to be cleaned.
 - D. Use manufacturers suggested products for cleaning off grout film.
 - E. Remove temporary protective coating by method recommended by coating manufacturer. Trap and removing coating to prevent it from clogging drains.
- 3.8 PROTECTION
- A. Prohibit traffic from tile finish for 72 hours after installation.

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- B. Protect work so that it will be without any evidence of damage or use at time of acceptance.
- C. Allow tile finish to set for 14 days prior to submerging tile.

3.9 TILE SCHEDULE

- A. See Tile schedule, following [on Drawings], for tile information.

END OF SECTION 13 11 61

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SECTION 13 11 65 WATER FLUME RIDES

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Scope of Work: Work shall include the furnishing of all labor, materials, equipment, engineering expertise and other incidentals to the construction of:
 - 1. One (1) indoor body flume ride.
 - 2. One (1) outdoor inner tube flume ride designed for use with tubes and an outside shoulder width not less than 84" and an inside depth of 36".
 - 3. One (1) outdoor body flume ride all to include but not be limited to:
 - a. Fiberglass flume components.
 - b. Flume support system.
 - c. Starting platform, all stairways and railings and steps as necessary to enter ride.
 - d. Concrete footings and foundations.
- B. Work Provided Elsewhere in the Specifications or on the Drawings:
 - 1. Furnish and install pumps for water supply to the slide and all necessary piping as specified by the successful water flume ride bidder.
 - 2. Cut-outs in pool wall to accept slides.
 - 3. Patch in and waterproofing of entry sections into the pool after installation of the slide.
 - 4. Pool and deck structure around slide foundation and columns.
 - 5. Refer to Division:
 - a. Earthwork - 31.
 - b. Concrete - 03.
 - c. Pool - 13.
 - d. Electrical - 26.
 - 6. Refer to General & Supplementary Conditions - This contractor shall be bound by the General and Supplementary Conditions.

1.2 REGULATIONS

- A. The Water Flume Ride starting platform, stairways and railings shall be designed and installed to conform to all requirements of:
 - 1. The Department of Public Health, and all other state and local health and building codes.
 - 2. WWA Considerations for Operating Safety, published by World Waterpark Association.
 - 3. ASTM-F2376-08 "Standard Practice for Classification, Design, Manufacture, Construction, and Operation of Water Slide Systems".
 - 4. Suggested Health and Safety Guidelines for recreational water slide flumes, published by U.S. Department of Health and Human Services.
 - 5. Applicable local, provincial or state building codes.

1.3 SITE CONDITIONS

- A. Topography - The drawings indicate the location and building information pertaining to the site for Water Flume.
- B. Soils - Refer to Division 02.

1.4 USE OF SITE

- A. General
 - 1. The contractor will restrict his construction to the general area shown on the drawings.
 - 2. Access and egress shall be coordinated with the general contractor and controlled so as not to conflict with the normal operations of the project.
- B. Design
 - 1. The design, shown on the drawings show the intended use and desired locations of the elements in relation to the adjacent deck uses.

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2. The slide manufacturer, in providing its bid, warrants that it is licensed to do work in the project's state and municipality and holds appropriate professional registrations, permits and/or meets other requirements by authorities having jurisdiction.
 3. The slide manufacturer shall indemnify and hold harmless the architect and the owner from any and all actions caused by or related to the design, fabrication and installation of the work of this specification section.
- 1.5 PERMITS & FEES
- A. The manufacturer and/or the contractor shall provide sufficiently detailed information on all items furnished to secure all necessary permits, including but not limited to:
 1. Building permit.
 2. State Department of Public Health construction and operating permits.
 - B. All applicable fees and permits for construction will be paid for by the contractor(s) and shall be included in the bid price. The Department of Public Health construction permit for the swimming pools will be paid for by owner.
- 1.6 JOB CONDITIONS
- A. Protection:
 1. Use all means necessary to protect existing work and, in the event of damage, immediately make all repairs and replacements necessary, subject to approval of the architect/engineer and at no additional cost to the owner.
 - B. Store Products:
 1. Contractor shall assume full responsibility for the protection and safe keeping of products under this contract stored on the site.
 - C. Lines, Levels and Layout of Work:
 1. The contractor shall establish and guarantee all lines, levels, etc. called for on the drawings.
 2. The contractor shall be responsible for the lines, levels, etc. of all his subcontractors.
- 1.7 SUBMITTALS
- A. Submit in accordance with Division 0.
 - B. Construction Schedule:
 1. The contractor will cooperate with scheduling determined for the complete job so as not to create any delays or slowdown of other contractors.
 - C. Shop Drawings:
 1. Promptly after award of the contract, the contractor shall submit complete shop drawings to include, but not be limited to:
 - a. Course layout with dimensions.
 - b. Flume detail.
 - c. Flume support details, including footings and foundations.
 - d. Tower and stair details, including foundations, structural support, bracing, and starting chute as indicated on the plans.
 - e. Modifications to plunge area, if any, required for the safety of the contractor's slide path design.
 - f. Modifications to the slide pumps, if any, required for the contractor's slide path design.
 2. All shop drawings shall be certified and sealed by a structural engineer, registered and licensed in the project state.
- 1.8 GUARANTEE/WARRANTY
- A. Labor and Material Payments Bonds: The contractor may be required to furnish bonds equal to the total contract amount guaranteeing the payment of all labor and materials. See General Project Requirements.

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- B. Special Project Requirements: Manufacturer agrees to provide evidence of product liability insurance naming the owner, architect and Water Technology, Inc. as additional insured. This insurance will be maintained for a minimum of five (5) years or as required by statute, whichever is greater. In addition, the manufacturer agrees to indemnify, hold harmless, and defend the owner, the architect and Water Technology, Inc. including their agents and employees for any and all claims, damages, losses and expenses of whatsoever nature, including but not limited to claims for property damage, personal injury (including death), attorneys fees, litigation expenses, court costs and all other damages arising out of or incidental to, resulting from or in connection with performance of this manufacturer's work.
- C. Qualification of Workmen: At least one (1) person who is thoroughly familiar with the materials, methods and equipment being utilized shall be present at all times during the construction to direct the work where required.
- D. Approved Manufacturers - The following manufacturers have submitted sufficient information to be pre-qualified as sources of water flume equipment:
 - 1. PROSLIDE TECHNOLOGY, INC., 2650 Queensview Dr. Suite 150, Ottawa, Ontario, CANADA K2B 8H6, (613) 526-5522.
 - 2. SPLASHTACULAR Operations Facility Kansas: 102 W. Kaskaskia, Suite 201 Paola, KS 66071 (800) 844-5334; Corporate Office – California 78-670 Hwy 111, PMB 225 La Quinita, CA 99253.
 - 3. WHITEWATER WEST INDUSTRIES, 655 S. Sunset Street Suite E Longmont, CO 80501; (702) 405-6040.

PART 2 - PRODUCTS

2.1 FIBERGLASS FLUME COMPONENTS

- A. General: The fiberglass flume components are those various elements that compose the water flume and include:
 - 1. Starting Section.
 - 2. Curved Sections.
 - 3. Straight Sections.
 - 4. Drop or Accelerating Sections and Deceleration Sections.
 - 5. Built-up Sections Including Lead-ins and Lead-outs.
 - 6. Exit Section or End Section.
 - 7. All other incidental fiberglass components necessary for a complete system.
 - 8. All sections shall be bolted and caulked. No fiberglass joints allowed.
- B. Fiberglass Laminate Materials:
 - 1. Gelcoat: Interior gel coat shall be "crystal clear" high quality isophthalic polyester with U.V. inhibitors. 20 mils thickness. Exterior coat 18 mils wet clear gloss U.V. protective coating.
 - 2. Resins: Thixotropic promoted low profile polyester resin with alternate layers of continuous roving chop and 18 oz. woven roving.
 - 3. Structure: Fiberglass lamination with sandwich panel center line reinforcement. Standard flume section shall be 3/16" thick, minimum weight 14 oz. per square foot. Flanges shall be minimum 1/4" thick and extend at least 4-3/4" from the slide surface, "L" type.
- C. Joints, Connections and Seams:
 - 1. Flume to flume joints shall be fastened with 3/8" stainless steel bolts, washers (2 per bolt), and self-locking nuts.
 - 2. Flume to support system connections shall be made with stainless steel hardware and shall be connected separately from water slide section connections.
 - 3. Fiberglass joint connections shall be made watertight using waterproof non-shrink caulking with suitable adhesion to fiberglass. Silicone sealants will not be permitted.
 - 4. Joint sealant/adhesive material: Premium-grade, high-performance, moisture-cured, 1-component, polyurethane-based, non-sag elastomeric sealant.

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- 5. Products:
 - a. Sikaflex®-1A with Sikaflex Primer 449,
 - b. 3M 5200,
 - c. Alternative manufacturers standard to the slide manufacturer specifications and approved as equivalent by architect/engineer.
 - D. Color:
 - 1. Shall be as standard to the manufacturer, and approved by architect/engineer, integral to the fiberglass and the same top and bottom (inside and outside). Verify color selection with architect and owner.
 - E. Ride Configuration:
 - 1. The body slide length and configuration shall be as indicated in the drawings.
 - 2. Alternate configurations will be considered if rides commence and terminate at the same location/elevation, are of the same length and configuration, and all other features of the specifications are met.
 - F. Required Components: All slides shall be furnished with the following components:
 - 1. Entry tray shall be pre-plumbed for water injection down-stream of the rider entry point. Rider entry area shall be a non-skid surface, no steps are permitted.
 - 2. Factory pre-drilling of all sections.
 - 3. Waterproof joint sealant as specified in Article 2.01.C.
 - 4. Stainless steel assembly hardware as specified in Article 2.01.C
- 2.2 FLUME SUPPORT, TOWER AND STAIR SYSTEM
- A. General: The flume support tower and stair system shall consist of all elements necessary to safely and securely support the fiberglass water flume from the starting platform to the plunge pool and consists of:
 - 1. Concrete footings and foundations, including excavation, backfill and compaction.
 - 2. Concrete supports.
 - 3. Factory painted galvanized steel tower and stair system. Follow paint manufacturer's specifications for surface preparation of galvanized steel.
 - 4. All connecting hardware.
 - B. Design: The supports and footings shall be certified by a licensed structural engineer in the project state for the soil conditions as indicated, and the stresses generated by the water flume ride during use.
 - C. Concrete
 - 1. Cast-in-place: Minimum compressive strength shall be 3,000 psi at 28 days. Maximum size aggregate shall be 3/4 inch. Slump shall not be more than 3 inches. Concrete shall be vibrated but not to excess so as to cause segregation of materials. Check all applicable drawings for locations of blockouts, anchors, inserts, etc. before concrete is placed.
 - 2. Reinforcing Steel:
 - 3. $F_y = 60,000$ psi min., for: ASTM A615 (deformed bar) or equivalent. ASTM A82 (welded wire fabric) or equivalent.
 - 4. Unless otherwise noted, concrete cover of reinforcing shall be as follows: Footing 3 inches and walls, pedestals, and columns 1 1/2 inch minimums.
 - 5. All concrete procedures to conform to latest ACI Building Code.
 - 6. Steel reinforcing lap splices for concrete slab shall be a minimum of 36 bar diameter.
 - D. Structural Steel
 - 1. Shall consist of radial arms with end yoke type fastening assembly for each support point. (NOTE: A central column support with radial arms may be used to support circular sections of 180 degrees or greater.)
 - 2. Structural steel shall be new material of sizes and shapes listed in current AISC handbooks and as indicated on drawings.
 - 3. Shapes and plates: ASTM A36 or equivalent minimum $F_y = 36,000$ psi (248.2 MpA).
 - 4. Square structural section: ASTM A500 minimum $F_y = 46,000$ psi (317 MpA).

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5. Round steel pipes: ASTM A53 grade B minimum $F_y = 35,000$ psi (241.3 MPa).
 6. Cast steel: ASTM A27 minimum $F_y = 36,000$ psi or equivalent.
 7. Tension rods, bolts, and anchor bolts: ASTM A36 minimum allowable tensile stress $F_t = 19,100$ psi (131.7 MPa).
 8. Structural bolts: ASTM A325, friction type or equivalent minimum allowable shear stress, $F_v = 21,000$ psi (144.8 MPa). Minimum allowable tensile stress, $F_t = 44,000$ psi (303.4 MPa).
 9. Welding electrodes: E480XX electrode (E70XX). Minimum allowable shear stress, $F_v = 21,000$ psi (144.8 MPa).
 10. Grout: Masterflow 713 or approved equal non-shrink, non-metallic grout. Use as recommended by manufacturer.
 11. All plates, shapes and tubes in contact are to be welded with $\frac{1}{4}$ -inch minimum fillet welds all around unless otherwise indicated.
 12. Unless otherwise noted all steel structure shall be galvanized.
 13. Contractor shall supply temporary bracing to take care of all loads on the structure during erection to ensure the safety of the structure, leave as long as is required, remove when safety is assured.
 14. All flumes and support arms shall be properly set and installed prior to installation of permanent column bracing. Additional column bracing as required by engineer, in addition to those noted on the drawing, shall be provided upon site inspection.
 15. All hollow structural sections shall be closed airtight with end plates sealed with welds.
 16. All steel shall be thoroughly cleaned of all loose mill scale, loose rust, oil and dirt.
 17. Surface to be welded shall be free from loose scale, rust, paint or other foreign matter. Care shall be taken to minimize stresses due to heat expansion, contraction and distortion by using proper sequence in welding and by other approved methods.
 18. Fabrication and erection shall conform to the latest editions of the ASTM Specifications and Code of Practice: Welding shall be done by welders certified with AWS D-1.1.
 19. Equivalent structural steel sizes listed in current AISC or CISC Handbook may be used upon approval of the architect/engineer.
 20. Definitions:
 - a. ASTM - American Society of Testing Materials.
 - b. AISC - American Institute of Steel Construction
 - c. CISC - Canadian Institute of Steel Construction
- E. Column System
1. A single or multiple concrete post system shall be used.
- F. Starting Tower/Stairway/Railing
1. General -The starting tower/stairway shall consist of:
 - a. A factory painted galvanized tower and stair support system with Duradek T-1800 or fiberglass grating. Risers shall be closed.
 - b. All stair treads shall have a step edge of a contrasting color.
 - c. Powder Coated Type 304 Stainless Steel. Color Selection by Owner/Architect.
 - d. Bracing and structural support (non-corrosive).
 - e. Hand rails on both sides of entire stair tower.
 2. Design
 - a. The structured design shall be certified by an engineer licensed in the project state. Structure shall be sized to handle the user volumes, the height required by the flume length, and the location on the existing topography.
 - b. Stair design shall follow current State building codes.
 - c. Coordinate with slide manufacturer.
 3. Concrete Footings & Piers
 - a. Shall be designed and constructed to support the design loads.
 - b. All concrete shall have a minimum twenty-eight (28) day compressive strength of 4,000 psi.
 - c. All footings shall be on undisturbed soil.

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- d. Vertical members shall be on concrete footings, above grade and be secured with flange plates and anchor bolts.
- 4. Hardware
- 5. Steel Hardware, ASTM A-7 or A-36 (hot dipped galvanized).
 - a. Bolts, Federal Specification FF-B-SC1.
- 6. Starting Tower
 - a. Shall be factory painted hot dipped galvanized steel structure and shall be supported by their own hot dipped galvanized steel columns. Coordinate design with building structural engineer and slide manufacturer.
 - b. Shall have Duradek T-1800 or Fibredek fiberglass grate, decking, treads, and closed risers.
- 7. Stairs and Railings
 - a. Stairs shall have factory painted hot dipped galvanized steel stringers with fiberglass grating treads and closed panels. Stairs shall have four foot minimum width.
 - b. Rail system shall be a minimum of 42" high at any point, non-climbable and designed to prevent accidental exit. Handrails shall be located at 34" above stair riser. Color selection by architect and owner.
 - c. The stair entry shall be provided with a 42" high lockable gate of similar construction as the rail system.
- 8. Finish
 - a. All galvanized metal:
 - 1) Wash all galvanized to be painted with a simple green soap, rinse thoroughly.
 - 2) Clean galvanized surfaces with Xylene, which will leave a whitish film - do not remove film.
 - 3) Prime galvanized with Devoe Tru-Glaze Epoxy Primer # 12735/12702, following manufacturer's instructions.
 - 4) Finish coat to be Devoe Deythane 369 Aliphatic Urethane Gloss Enamel #369-K-XXXX, following manufacturer's instructions - color by owner.
 - 5) Second coat may be necessary, depending on appearance of first finish coat; second coat to be Devoe Deythane 369 Aliphatic Urethane Gloss Enamel #369-K-XXXX.
 - b. All ferrous metal parts:
 - 1) Surface Preparation: Blast all surfaces to be coated to the extent of an SSPC-SP6 commercial-grade level of cleanliness. Create a 1.5 - 2.0 mil profile and prime before any rust bloom forms on the surface.
 - 2) Primer: Spray apply, in the shop, one full coat of Tnemec Series 90-97 Aromatic Urethane Zinc-Rich or Amercoat 68 HS primer to a DFT of 4.0 mils. Allow to cure as per data sheet (4 hours @ 75°F) before applying topcoat.
 - 3) Topcoat: Spray apply in the shop one even finish coat of Tnemec Series 74-Color Endura-Shield. Acrylic Polyurethane or Ameron PSX-700 finish to a minimum DFT of 5.0 mils. Allow to cure as per data sheet (6 hours @ 75°F) before handling/loading in the shop.
 - 4) Field Touchup: If the broken area of the shop applied film is rough from scaring, disc-abrade that area smooth and then solvent clean it as per an SSPC-SP1, level of cleanliness. Brush or roller apply one coat of Tnemec Series 135 Chembuild or Ameron epoxy primer. Allow to cure as per data sheet. Brush or roller apply one coat of Tnemec Series 74 or Ameron PSX-700 shop applied color to bring the film up to specification thickness.
 - c. Fiberglass handrail posts:
 - 1) Finish: Tnemec Series 74 or Ameron PSX-700 shop applied at 5.0 mils DFT.

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- 2) Field Touch-up: Tnemec Series 74 or Ameron PSX-700 shop applied at 5.0 mils DFT.
- 3) Manufacturer: Tnemec 816/483-3400 or Amercoat 800/244-0025 or pre-approved equal.
- d. Top deck and landing shall have a non-slip finish.
- e. Treads non-slip shall have a non-slip finish.
- f. All exposed concrete vertical surface shall have a sack rubbed finish.
- g. Seal all concrete with a minimum of two (2) coats of slip resistant Concrete Sealer.
- h. Colors shall be as selected by the architect and owner.

PART 3 - EXECUTION

3.1 GENERAL

- A. The installation of this work shall comply with the following governing and regulatory authorities.
 1. Department of Labor (OSHA).
 2. State Department of Public Health.
 3. All State and Local Building Codes.
 4. Any other agency that has legal jurisdiction.

3.2 FLUME CONSTRUCTION

- A. All construction shall conform to the recommendations of the approved manufacturer selected through this bidding process.
- B. The manufacturer shall be responsible for the quality of the flume material and equipment.
- C. The slide manufacturer shall be responsible for the layout, assembly and erection of the flume products in a workmanlike manner.
- D. Apply the specified joint sealant adhesive in between each flange and in between each splashguard connection. Apply sealant and finish to leave a smooth, leak-free joint/seam.
- E. Flume flanges shall be bolted together with 3/8 inch diameter bolts. All connectors shall be stainless steel.
- F. Flume joints shall be properly connected so as to avoid abrupt edges that may cause irritation.
- G. Fiberglassing over seams within the riding surface is not permitted. Sanding within the slide surface should be minimized to maintain adequate gel coat thickness and gloss. Any sanded areas shall be polished to a high gloss until undetectable.
- H. All flumes shall be properly cleaned and surfaces smooth finished, and complete with all the necessary sections prior to use of the slide.
- I. All flumes underground shall be carefully backfilled to prevent the flumes from getting damaged. All fill in contact with flume shall be of good quality and free of boulders.
- J. Flumes shall be inspected by the representative of the slide manufacturer to ensure a smooth finish prior to acceptance of work.

3.3 RIDE COMMISSIONING - PROVIDED BY SLIDE MANUFACTURER WITH COOPERATION & ASSISTANCE BY POOL CONTRACTOR

- A. The slides and rides shall be started and fully commissioned by a qualified agent employed by the Slide Manufacturer and in cooperation with the General Contractor & Owner. The Slide Manufacturer's commissioning requirements shall consist of all activities necessary to provide a fully functioning and safely operating ride ready for public use and include the following documentation for the Owner's reference:
 1. Start-up of pumps including setting and recording (frequency or RPM) of variable frequency drive speeds.
 2. Setting, recording (% open) and marking of all operating and balancing valve positions at the pump locations, slide tower, and all slide supply connection locations.
 3. Recording of all ride supply pump pressure and vacuum gauge readings (psi or in. Hg) at the time of the approved and commissioned slide flows and valve settings.

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4. Recording of all ride supply flow meter readings (GPM) at the time of the approved and commissioned slide flows and valve settings. Coordinate this work with the pool contractor to assure flow meter installations are complete and properly functioning prior to final commissioning.
5. Recording and marking of approved water level ranges in the slide start tub. Mark levels with a line and/or record the measurement in inches above the floor.
6. Setting and recording of the Prosplash Runout overflow weir plate, if applicable.
7. Recording and marking of approved water level ranges in the slide Prosplash Runout structure, if applicable. Mark levels with a line and/or record the measurement in inches above the floor.
8. Provide a written commissioning report that includes the following information for each slide:
 - a. Narrative on the slide operation including recommended loading procedures and operation through all sequences.
 - b. Record summary in table format of all data collected in Items 1 through 8 in Part 3.04(A).
 - c. Date, time, and initials of commissioning agent for each recorded item 1 through 8 in Part 3.04(A).
 - d. Name, signature, and date of the Commissioning Agent responsible for all work above.

3.4 OWNER INSTRUCTION - PROVIDED BY SLIDE MANUFACTURER

- A. Provide an experienced ride operator-instructor employed by the Ride (Slide) Manufacturer for operations and start-up after the slide has been placed into operation. During this period, the Owner's designated representative(s) shall be thoroughly instructed in all phases of the ride's operation, including but not limited to:
 1. Rider Rules
 2. Ride start-up and shutdown procedures.
 3. Vehicle dispatching.
 4. Rider loading and unloading.
 5. Vehicle handling and loading to conveyor, if applicable.
 6. Conveyor operations, if applicable.
 7. Water filling & emptying of Prosplash Runout, if applicable.
 8. Ride winterizing procedures, if applicable.
 9. Ride maintenance requirements & procedures divided into the following:
 - a. Daily
 - b. Weekly
 - c. Monthly
 - d. Seasonally
 - e. Annually
- B. The slide manufacturer shall deliver one Operating and Maintenance (O&M) Manual in electronic file format (.pdf) to the Architect/Engineer/Owner for review and approval, and four complete hard-copy sets of the approved documents to the Owner. O&M Manual shall include, but is not limited to the following:
 1. Narrative on the slide operation including recommended loading procedures and operation through all sequences.
 2. Recommended user requirements including recommended signage and height and weight restrictions
 3. Written slide warranty and contact information.
 4. A written summary of all information provided during the Owner's Instructions per Section 3.04.A., including maintenance information and recommended maintenance program.
- C. A written Slide Commissioning Report, per the requirements of Section 3.03A.(8).

END OF SECTION 13 11 65