DIVISION 3

CONCRETE

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SECTION 03300 CAST-IN-PLACE CONCRETE

- PART 1 GENERAL
- 1.01 REFERENCES
 - A. American Concrete Institute (ACI):
 - 1. ACI SP-66-88 ACI Detailing Manual.
 - ACI 304R-85 Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 - 3. ACI 305R-77 Hot Weather Concreting.
 - 4. ACI 306R-88 Cold Weather Concreting.
 - 5. ACI 318-83 Building Code Requirements for Reinforced Concrete.
 - 6. ACI 347-78 Recommended Practice for Concrete Formwork.
 - B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A615-87 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 2. ASTM C31-88 Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - 3. ASTM C33-86 Specification for Concrete Aggregates.
 - 4. ASTM C39-86A Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 5. ASTM C94-86 Specification for Ready-Mixed Concrete.
 - ASTM C143-78 Standard Test Method for Slump of Portland Cement Concrete.
 - 7. ASTM C150-86A Specification for Portland Cement.
 - 8. ASTM C231-82 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - 9. ASTM C260-86 Specification for Air-Entraining Admixtures for Concrete.
 - 10. ASTM C309-81 Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - 11. ASTM C494-86 Specification for Chemical Admixtures for Concrete.
 - C. U.S. Army Corps of Engineers Specification (CRD):
 - 1. CRD C572-74 Specifications for Polyvinyl Chloride Waterstop.
 - D. Concrete Reinforcing Steel Institute (CRSI):
 - 1. Placing Reinforcing Bars.

1.02 SUBMITTALS

- A. Statement by ready mix supplier giving source and material certificates, and proportions by weight of cement, fine and coarse aggregates, and admixtures.
- B. Provide with each load of concrete delivered, duplicate delivery tickets one for CONTRACTOR and one for DESIGNER with following information.
 - 1. Date and serial number of ticket.
 - 2. Name of ready mixed concrete plant, operator, and job location.
 - 3. Type of cement, admixtures, if any, and brand name.
 - 4. Cement content, in bags/cu yd of concrete, and mix design.
 - 5. Truck number, time loaded, and name of dispatcher.
 - 6. Amount of concrete in load, in cu yds, delivered.
 - 7. Maximum size aggregate.
 - 8. Gal of water added at job, if any, and slump of concrete after water was added.
 - 9. Temperature of concrete at delivery.
 - 10. Number of revolutions of mixer.
 - C. Reinforcing steel Shop Drawings conforming to ACI SP-66 showing bending diagrams, assembly diagrams, location diagrams, splicing and laps of bars, shapes, dimensions, and details for bar reinforcing.
 - D. Submit in accordance with Section 01340.
 - 1.03 QUALITY ASSURANCE
 - A. Tolerances:
 - 1. Maintaining formwork alignment during and after placing of concrete, in accordance with permissible tolerance limits set forth in ACI 347.
 - 2. Concrete shall be within 1/4 in. of 10-ft straightedge in all directions. Deviations from elevation indicated shall not exceed 1/4 in.
 - B. Concrete testing will be provided by QAC. Following tests will be performed.
 - 1. Slump, ASTM C143; Air Entrainment, ASTM C231. Temperature if slump or air content fall outside of specified limit, check test will be performed on another portion of same sample. If second test failure occurs, concrete will be rejected. The frequency for testing slump, air entrainment, and temperature will be for each truck of concrete delivered.
 - 2. Compressive Strength, ASTM C31 and C39. Test cylinders will be tested for compressive strength at 7, 14, 21 and 28 days following concrete placement. In the event design compressive strength is achieved at 7, 14 or 21 days, subsequent compressive strength test(s) may be waived by the designer. If analysis indicates concrete strength is insufficient, CONTRACTOR shall pay for testing, engineering analyses, and remedial work.

1.04 PROJECT/SITE CONDITIONS

- A. Hot Weather:
 - 1. Comply with ACI 305R.
 - 2. Concrete temperature shall not exceed 85'F.
 - 3. At air temperatures of 80°F or above, keep concrete as cool as possible during placement and curing. Cool forms by water wash.
- B. Cold Weather:
 - 1. Comply with ACI 306R.







- Temperature of reinforcement, forms, fillers, and other materials in contact with concrete at time of placement shall not be less than 35'F. Preheat if temperature is below 35'F.
- 3. Maintain air and forms in contact with concrete at temperature above 50'F for at least first 3 days and at temperature above 32'F for remainder of specified curing period.
- PART 2 PRODUCT

2.01 MATERIALS

- A. Portland Cement:
 - ASTM C150, Type I or II. Except tricalcium aluminae (C₃A) content of Type I shall not exceed 8%.
 - 2. When aggregates are determined to be deleteriously reactive, as defined by Appendix XI of ASTM C33, alkali content of cement defined by Table 1A of ASTM C150 shall not exceed 0.60%.
- B. Aggregates:
 - 1. ASTM C33, free of foreign materials.
 - 2. Fine Aggregate: Natural sand.
 - Coarse Aggregate: Crushed stone, crushed gravel or gravel. Size 467 (1 1/2 in. maximum).
 - 4. Potential reactivity of aggregates shall be determined in accordance with Appendix XI of ASTM C33.
- C. Admixtures for Concrete:
 - 1. Air-Entraining: ASTM C260.
 - 2. Chemical Admixtures: Optional, ASTM C494.
 - a. Water Reducing: Type A.
 - b. Retarding: Type B.
 - c. Water Reducing and Retarding: Type D.
- D. Water: Potable.
- E. Steel Reinforcing Bars:
 - 1. Deformed bars conforming to ASTM A615, grade 60.
 - 2. Epoxy coated or galvanized where noted on Drawings.
- F. Waterstops:
 - 1. Virgin PVC meeting requirements of CRD C572.
 - 6 in. wide by 3/8 in. thick at center, flat corrugated, unless otherwise noted.

- 3. Provide prefabricated tees, crosses, and other configurations as required. Splice in accordance with manufacturer's instructions.
- G. Membrane Forming Curing Compound:
 - I. Manufacturers:
 - a. Concrete Seal by Huntington Laboratories.
 - b. Toxkure by Tock Brothers, Inc.
 - c. Kur-N-Seal by Sonneborn Building Products, Inc.
 - d. Floor Treet by Forrer Chemical Company.
 - e. or Equal.
 - 2. ASTM C309 and complete with coatings to be applied.
- H. Epoxy Bonding Compound: Joining new to existing concrete.
 - I. Manufacturers:
 - a. Sikadur Hi-Mod by Sika Corporation.
 - b. Epoxtite 2362 by W.R. Grace and Company.
 - c. Euco Epoxy 452mv or 620 by Euclid Chemical Company.
 - d. Or equal.
- I. Non-epoxy Bonding Compound: Joining new to existing concrete where bonding compound cannot be placed immediately prior to pouring of new concrete.
 - I. Manufacturers:
 - a. Weld-Crete, by Larson Products Corporation.
 - b. Or equal.
- 2.02 CONCRETE MIX DESIGN
- A. ⁶ Concrete Mix: Measure and combine cement, aggregates, water, and admixtures in accordance with ASTM C94.
 - 1. Minimum Cement Content: 5-3/4 bags/cu yd.
 - 2. Minimum Strength: 4,000 psi.
 - 3. Air Content: 6%, $\pm 1\%$.
 - 4. Maximum/Slump: 4 in.
- 2.03 MIXING AND DELIVERY
- A. Furnish and deliver concrete in conformance with ASTM C94.



- Deliver and complete discharge within 1-1/2 hrs of commencing mixing or before 300 revolutions of drum or blades, whichever comes first. Β. This includes revolutions required by transit mix trucks. Limitations may be waived by DESIGNER if concrete is of such slump after 1-1/2 hrs or 300-revolution limit, it can be placed without addition of water.
 - Do not add water on job unless authorized by OWNER. If water added, additional mixing of 30 drum revolutions is required. С.

EXECUTION PART 3

- SUBGRADE PREPARATION 3.01
 - Subgrade and Bedding: Compacted and free of frost. If placement is allowed at temperatures below freezing, provide temporary heat and Α. protection as required to remove frost.
 - At CONTRACTOR'S option, provide vapor barrier or soak subgrade evening before placement and sprinkle ahead of placement of concrete. Β.
 - Remove standing water, ice, mud, and foreign matter before concrete С. is deposited.
- FORMS 3.02
 - Workmanship: Formwork shall prevent leakage of mortar. Removal of wall ties shall leave holes clean cut and without appreciable Α. spalling at face of concrete.
 - Materials: Β.
 - Unless specified otherwise, type of forms used is CONTRACTOR'S CONTRACTOR may use metal, plywood, presswood form 1. option. liners or plastic surfaced plywood.
 - Use approved commercially manufactured devices for form ties. Arrange ties so when forms are removed, no metal will be within 2. l in. of formed face of concrete. Ties for exterior walls shall have integral waterstop.
 - Do not disturb forms until concrete has adequately cured.
 - Form system design shall be CONTRACTOR'S responsibility.
 - JOINTS 3.03

С.

D.

Α.

Joints not shown on Drawings shall be subject to DESIGNER'S approval.

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Provide waterstop in construction joints of all exterior walls and Β. base slabs. Secure in-place. Place wire tie holes, if used, within l in. of edge. Vibrate concrete on both sides to ensure intimate contact between waterstop and concrete.

3.04 REINFORCEMENT PLACEMENT

- Correct displacement of reinforcement prior to and during concrete Α. pouring operations. Maintain clear cover as noted on Drawings. Tolerances shall be in accordance with ACI 318, unless noted
- Locate reinforcing to avoid interference with items that will be Β. drilled in later, such as concrete anchors.
- Reinforcing steel is to be approved by DESIGNER before being covered С.
- Use concrete brick for supporting bottom mat reinforcing on grade. · D . Use bolsters or chairs supported on concrete brick for supporting
- Do not field bend bars including bars partially embedded in concrete. Ε.
- F.

Welding of reinforcing bars will not be permitted.

- 3.05 CONCRETE PLACEMENT
 - Except as modified herein, ACI 304 Chapter IV, shall constitute Α. requirements of this Specification.
 - B. Support reinforcing steel in accordance with CRSI "Placing Reinforcing Bars," with maximum spacing of 4 ft-0 in.
 - Reinforcing steel shall be tied at intersections in accordance with С. CRSI "Placing Reinforcing Bars." Maximum spacing for footings and walls every third intersection or 3 ft-0 in. slabs and other Work every fourth intersection or 3 ft-0 in. Dowels Maximum spacing for
 - Care shall be taken to avoid damage to waterstop and reinforcing and D. ensure their accurate positioning after concrete placed.
- Ε. Do not move or spread concrete with vibrators.
- When placing of concrete is temporarily halted or delayed, provide F. construction joints as shown on Drawings and specified herein.
- Place concrete with aid of internal mechanical vibrator equipment G. capable of 7,000 impulses/min. Transmit vibration directly to Duration of vibration at any location shall be amount necessary to produce thorough consolidation and also to cause maximum amount of air bubbles to migrate to top of pour.

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- Set embedded items such as bolts, anchors, and piping, in concrete as Η. required by manufacturer of equipment used. Verify location with
- Place items constructed of dissimilar metals to avoid physical Ι. contact with reinforcing. Secure item and reinforcing to ensure they will not shift and come into contact during pouring. Contact between reinforcing and any other metal, other than bare, coated or plated
- 3.06 SLAB FINISHES
 - Float and Broom Finish: Α. Broom at right angles to direction of traffic to give nonskid finish. Use fine, soft bristled broom.
- 3.07 FINISHING FORMED CONCRETE
- . A. Ordinary Finish: Finish resulting directly from formwork for surfaces which will be hidden from view by earth, submergence in water or subsequent construction.
 - Patch honeycombing, stone pockets, form ties, spalls, and other 1.
- Β. Smooth Finish: Interior and exterior concrete surfaces permanently exposed to view.
 - Patch honeycombing, stone pockets, form ties, spalls, and other 1. 2.
 - Grind joint marks and fins smooth with adjacent wall surface. Remove oil stains and rinse surface.
- 3.08 PROTECTION AND CURING
 - Protect concrete from frost, rapid drying and keep moist for minimum Α. curing period of 7 days after placing.
 - Wet cure; apply curing compound after receiving approval from OWNER. Β. Do not use curing compound where other coating will be applied unless curing compound is compatible with coating to be applied.
 - Formed surfaces may be cured by leaving forms in-place. C. surface of forms left in-place during curing period as frequently as drying conditions may require to keep concrete surfaces moist. vertical surfaces, apply water to run down on inside of forms, if
- Protect from damaging mechanical disturbances, particularly load D. stresses, heavy shock, and excessive vibration.

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- E. Protect finished concrete surfaces from damage caused by construction equipment, materials or methods, and rain or running water.
- F. Do not load self-supporting structures in such way as to overstress concrete.

* * * END OF SECTION * * *



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DIVISION 5

METALS

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SECTION 05500 METAL FABRICATIONS

PART 1 GENERAL

1.01 REFERENCES

- A. American Institute of Steel Construction (AISC):
 - 1. Specification for Design, Fabrication, and Erection of Structural Steel for Buildings.
 - 2. Code of Standard Practice for Steel Buildings and Bridges.
 - Manual of Steel Construction (Allowable Stress Design), 9th Edition.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A36-88 Specification for Structural Steel.
 - ASTM A53-88 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - 3. ASTM A307-88 Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - 4. ASTM A325-88 Specification for High-Strength Bolts for Structural Steel Joints.
 - 5. ASTM A500-84 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 6. ASTM A780-80 Specification for Repair of Damaged Hot-Dip Galvanized Coatings.
- C. American Welding Society (AWS):
 - 1. AWS A2.4-86 Symbols for Welding, Brazing, and Nondestructive Examination.
 - AWS A5.5-81 Specification for Low Alloy Steel Covered Arc Welding Electrodes.
 - 3. AWS A5.17-80 Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
 - 4. AWS D1.1-88 Structural Welding Code Steel.
- D. Steel Structures Painting Council (SSPC):
 - 1. SSPC SP6-85 Commercial Blast Cleaning.
- E. Aluminum Association (AA):
 - AA 30-86 Specifications for Aluminum Structures Construction Manual Series Section 1.

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F. American Iron and Steel Institute (AISI).

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- G. American Hot-Dip Galvanizers Association (AHDGA).
- 1.02 SUBMITTALS
 - A. Shop Drawings of items provided, detailing materials, sizes, connections, anchors, and painting.
 - 1. One reproducible and one print of Shop Drawings.
 - B. Manufacturer's catalog sheets on manufactured items.
 - C. Provide International Conference of Building Officials (ICBO) or other similar building code organization recommendations regarding safe allowable design loads for concrete anchors.
 - D. Submit in accordance with Section 01340.
- 1.03 QUALITY ASSURANCE
 - A. Welding:
 - 1. Steel:
 - a. Conform to codes for arc and gas welding in building construction of AWS and to AISC Specifications. Surfaces to be welded shall be free from loose scale, rust, grease, paint, and other foreign material, except mill scale which will withstand vigorous wire brushing may remain. No welding shall be done when base metal lower than 0°F.
 - b. Qualify welding operators in accordance with AWS Dl.l. Qualification tests shall be run by recognized testing laboratory approved by DESIGNER at CONTRACTOR'S expense.
 - c. Welding operators shall be subject to examination for requalification using equipment, materials, and electrodes employed in execution of Work. Such requalification, if ordered by DESIGNER, shall be done at CONTRACTOR'S expense.
 - Aluminum: Weld with gas metal arc (GMA) or gas tungsten arc (GTA) processes in accordance with manufacturer's recommendations as approved and in accordance with recommendations of AWS.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Conform to following specifications:
 - 1. Steel Shapes and Plates: ASTM A36.
 - 2. Square and Rectangular Structural Tubing: ASTM A500, Grade B.

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3. Round Structural Tubing and Steel Pipe:

a. ASTM A53, Type E or S, Grade B.

- 4. Stainless Steel: Exterior and Submerged AISI, Type 316; Interior and Architectural - AISI, Type 304; Bolts and Anchors - AISI, Type 303 or 304.
- 5. Aluminum Structural Shapes and Plates: Alloy 6061-T6 or 6063-T6; conform to referenced specifications and ASTM sections found in AA current construction manual series.
- 6. Connection Bolts for Steel Members: ASTM A325.
- Anchor Bolts: 1/2 in. minimum dia; nonsubmerged ASTM A307 galvanized; submerged - stainless steel.
- 8. Connection Bolts for Wood Members: ASTM A307, galvanized.
- 9. Connection Bolts for Aluminum: Stainless steel.

2.02 FABRICATION

- A. Connections and Workmanship:
 - 1. Fabricate details and connection assemblies in accordance with drawings and with projecting corners clipped and filler pieces welded flush.
 - 2. Weld shop connections, bolt or weld field connections, unless otherwise noted or specified.
 - 3. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.
 - 4. Use connections of type and design required by forces to be resisted and to provide secure fastening.
 - a. AISC standard 2-angle web connections or single plate framing connections capable of supporting minimum of 50% total uniform load capacity of members joined as tabulated in uniform load constants of AISC "Manual of Steel Construction."
 - b. Connections shall consist of minimum of two 3/4-in. dia bolts or welds developing minimum of 10,000 lbs.
 - c. Make bearing type bolted connections with minimum 3/4-in. dia bolts with threads included in shear plane, unless detailed otherwise.

5. Welding:

- a. Grind exposed edges of welds to 1/8 in. minimum radius. Grind burrs, jagged edges, and surface defects smooth.
- b. Prepare welds and adjacent areas so there is (1) no undercutting or reverse ridges on weld bead, (2) no weld spatter on or adjacent to weld or any other area to be painted, and (3) no sharp peaks or ridges along weld bead. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

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- 6. Bolting:
 - a. Draw up bolts or nuts tight. Use bolts of lengths required so bolts project at least 4 to 5 threads beyond face of nut. Use washers unless detrimental. Provide hexagonal head bolts with hexagonal nuts.
 - b. Provide holes required for connection of adjacent or adjoining Work wherever noted on Drawings. Locate holes for bolting equipment to supports to tolerance of ±1/16 in. of dimensions indicated.
- B. Fit Work together in fabrication shop and deliver complete or in parts, ready to be set in place or assembled in field.
- C. Galvanizing:
 - 1. Galvanize after fabrication.
 - 2. Galvanize by hot-dip process conforming with appropriate ASTM and AHDGA specifications.
 - 3. Galvanize in plant having facilities to produce quality coatings and capacity for volume of Work.
 - 4. Ship and handle in manner avoiding damage to zinc coating.
- D. Painting and Finishes:
 - 1. Do not paint ferrous metal items to be encased in concrete.
 - 2. Where other finish not specified, clean ferrous metal after fabrication to remove oil, mill scale, rust, and foreign matter in accordance with SSPC SP6. Apply one coat of shop primer yielding 1.5 mil dry thickness.
 - 3. Give surfaces not accessible after assembly or erection 2 shop coats using different colors of paint, 3.0 mil total dry thickness.
 - Paint aluminum in contact with concrete in accordance with AA 30. Under no circumstances shall aluminum contact dissimilar metal.
- 2.03 CONCRETE ANCHORS
 - A. Wedge Anchors:
 - 1. Manufacturers:
 - a. Rawl-Stud Anchor by Rawlplug Company, Inc.
 - b. Wedge Anchor by ITT Phillips Drill Division.
 - c. Kwik-Bolt II by Hilti Corporation.
 - d. Or equal.
 - 2. Usage: In concrete.
 - a. Zinc or chromate plated carbon steel may be used where totally embedded, in interior locations with controlled humidity and other protected locations.

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- b. Stainless steel shall be used in other locations such as outside, in tanks or whenever attaching aluminum or galvanized steel.
- 3. Drop-In Anchors:
 - 1. Manufacturers:
 - a. HDI Anchor by Hilti Corporation.
 - b. Multi-Set Anchor by ITT Phillips Drill Division.
 - c. H/S Drop-In by Rawlplug Company, Inc.
 - d. Or equal.
 - 2. Zinc or chromate plated carbon steel.
 - 3. Usage: In concrete.
 - a. Interior locations with controlled humidity and other protected locations.
 - b. Do not use drop-in anchors in corrosive or humid areas such as wet wells, liquid containing tanks, exterior applications.
- C. Adhesive Anchors:
 - 1. Manufacturers:
 - a. Anchor-It Fastening System by Adhesive Technology Corporation.
 - b. Foil-Fast Epoxy Injection Gel System by Rawl/Sika.
 - c. EPCON Injection System by ITW Ramset/Red Head.
 - d. Or equal.
 - 2. Epoxy adhesive with Type 316 stainless steel stud or anchor rod assembly, nuts, and washers.

2.04 LADDERS

- A. Fixed rail ladders shall be fiberglass unless approved by OWNER.
- B. Punch rails and pass rungs. through rails. Fabricate brackets for fastening ladder to wall and attach to ladder. Ladder shall conform to applicable federal, state, and local safety requirements.
- 2.05 FIBERGLASS GRATING
 - A. Fiberglass grating, Chemgrate or equal, maximum 1/4-in. deflection under uniform load of 100 psf.
 - B. Band edges and cut outs.

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- A. Layout and install connectors such as concrete anchors and anchor bolts to secure metal fabrications to structure.
- B. Concrete Anchors:
 - 1. Drill holes in concrete and masonry work with rotary driven twist drills only. Fill voids in masonry with grout.
 - Do not install until concrete has reached specified minimum strength (f'c).
 - Do not install closer than 6-bolt dia to edge of concrete or masonry, or closer than 12-bolt dia to another anchor unless detailed on Drawings.
 - 4. Minimum embedment shall be 8-bolt dia.
 - 5. Install in accordance with manufacturer's recommendations.
- C. Erect to lines and levels, plumb and true, and in correct relation to adjoining work. Secure parts using concealed connections whenever practicable.
- D. Plumb and true vertical members to tolerance of $\pm 1/8$ in. in 10 ft. Level horizontal members to tolerance of $\pm 1/8$ in. in 10 ft.
- E. Provide items such as bolts, shims, blocks, nuts, washers, and wedging pieces to complete installation.
- F. Drill field holes for bolts. Do not burn holes.
- G. New holes or enlargement of unfair holes by use of cutting torch is cause for rejection of entire member.
- H. Perform cutting, drilling, and fitting required for installation of metal fabrications.
- I. Field welds shall be approved by OWNER before prime painting. Clean slag from welds prior to inspection.
- 3.02 ADJUSTMENTS AND CLEANING
 - A. Field repair of damaged galvanized coatings.
 - 1. Repair galvanized surfaces damaged during shipping or erection/ construction operations.
 - 2. Repair surfaces using zinc-rich paint.
 - 3. Prepare surfaces and apply in accordance with ASTM A780, Annex A2.

* * * END OF SECTION * * *



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SECTION 05520 ALUMINUM HANDRAILS AND RAILINGS

- PART 1 GENERAL
- 1.01 REFERENCES
 - A. Aluminum Association:

1. AA SAS-30 - Specifications for Aluminum Structures.

1.02 SUBMITTALS

- A. Shop Drawings:
 - Shop drawings for railings including splices, attachments, and mounting.
 - 2. Identify location and type indicated.
 - Indicate railings in related and dimensional position with scale elevations.
 - 4. Indicate required field measurements.
 - 5. One reproducible and one print of Shop Drawings.
 - B. Design and Test Data:
 - 1. Catalog data or design information.
 - a. Submit test data showing load, and deflection due to load, in enough detail to prove handrail system and base connections satisfy OSHA requirements.
 - C. Samples:
 - Duplicate samples, 6 in. long, of typical pipe showing finish.
 Sample of each fitting.
 - D. Manufacturer's literature and assembly and installation instructions.
 - E. Maintenance Instructions: Manufacturer's recommendations describing procedures for maintaining including cleaning materials, application methods, and precautions as to use of materials which may be detrimental to finish when improperly applied.
 - F. Submit above in accordance with Section 01340.
- 1.03 QUALITY ASSURANCE
 - A. Requirements of Regulatory Agencies:
 - Handrails and railings shall meet requirements of OSHA and local building codes.

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- B. Handrails provided shall be end products of one manufacturer to achieve standardization for appearance, maintenance, and replacement.
- 1.04 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver, store, and handle components in manner preventing damage to finished surfaces.
 - 1. Pack pipe and elbows in individual plastic shrink film to protect finish. Do not remove until after installation.
 - B. Storage of Materials:
 - 1. Store components in dry, clean location, away from uncured concrete and masonry.
 - 2. Cover with waterproof paper, tarpaulin or polyethylene sheeting.
- PART 2 PRODUCTS
- 2.01 MANUFACTURERS
 - A. Alumaguard.
 - B. Enerco Metal Products, Inc.
 - C. Or equal.
- 2.02 MATERIALS
 - A. Rails, Posts, and Formed Elbows: Aluminum, Alloy 6061-T6 or 6063-T6, Schedule 40, 1-1/2 in. IPS (1.90 in. OD, 0.145 in. wall thickness).
 - B. Fittings:
 - 1. Fabricate from material similar to railings.
 - 2. Elbows, flanges, sleeves, brackets, and similar items shall be set screw or bolted type.
 - 3. Connections shall be continuous dia type for smooth appearance and to permit continuous sliding of hands.
 - C. Safety Chains: 1/4-in. stainless steel link chain with spring actuated stainless steel clasp.
- 2.03 FINISHES
 - A. Clear satin anodized finish on exposed surfaces.
 - 1. Extruded Components: 0.7 mil anodized.
 - 2. Cast Components: 0.4 mil anodized.



- B. Light, circumferentially-brushed finish before anodizing on pipe shaped components.
- 2.04 FASTENINGS
 - A. Mechanical Fasteners: Stainless steel.
- 2.05 FABRICATION
 - A. Field verify dimensions before fabrication.
 - B. Fabricator to conform to details shown. Form connections and changes in rail direction by using prefabricated fittings or radius bends.
 - .C. Remove burrs from exposed cut edges.
 - D. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces or use prefabricated bends.
 - E. Locate rails as shown on Drawings.
 - F. Close pipe ends using prefabricated fittings.
 - G. Space posts not more than 4 ft oc. Erect posts plumb in each direction.
 - H. Provide minimum 1/4 in. thick toe plate. Extend not less than 4 in. above walking surface.
 - I. Blend in color discrepancies on anodized aluminum areas due to fabrication such as welding and exposed fasteners.
- PART 3 EXECUTION
- 3.01 INSTALLATION
 - A. Install as shown on Drawings and approved submittals.
 - B. Coat base flanges to be in contact with concrete with bituminous paint.
 - C. Set posts plumb and aligned to within 1/8 in. in 12 ft.
 - D. Set rails horizontal or parallel to rake of steps to within 1/8 in. in 12 ft.
 - E. Assemble and install in accordance with printed instructions of manufacturer.



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- F. Locate safety chains as shown on Drawings. One chain shall be at top, other chain shall be centered between grating and top chain. Chain drape shall not exceed 3 in.
- 3.02 CLEANING

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- A. Wash thoroughly using clean water and soap, rinse with clean water.
- B. Do not use acid solution, steel wool or other harsh abrasive.
- C. If stain remains after washing, remove finish, and restore in accordance with manufacturer's recommendations.
- 3.03 REPAIR OF DEFECTIVE WORK
 - A. Remove stained or otherwise defective Work and replace with material meeting Specification requirements.

* * * END OF SECTION * * *

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DIVISION 8

DOORS, WINDOWS, AND GLASS

SECTION 08018 FIBERGLASS REINFORCED PLASTIC DOORS AND FRAMES

PART 1 GENERAL

1.01 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM D635-88 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
 - 2. ASTM E84 REV A-89 Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. Door and Hardware Institute (DHI):
 - 1. Recommended locations for Builder's Hardware.
- 1.02 SUBMITTALS
 - A. Shop Drawings:
 - 1. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items. Indicate coordination of glazing frames and stops with glass and glazing requirements.
 - B. Product Data:
 - 1. Manufacturer's technical product data, substantiating product compliance with requirements.
 - C. Submit in accordance with Section 01340.
- 1.03 QUALITY ASSURANCE
 - A. Provide fiberglass doors, frames and accessories as complete units produced by one manufacturer.
 - B. Fiberglass door manufacturer shall provide hardware.
- 1.04 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver materials to site in sealed, undamaged containers identified with manufacturer's name, brand, style, pattern, and color.
 - B. Store in original cartons, on end on such manner to prevent falling or damage to face, corners, and edges.

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- 1.05 GUARANTEE
 - A. Manufacturer shall unconditionally guarantee fiberglass doors and frames for five yrs against failure due to corrosion.
 - B. Alterations to door by OWNER will void warranty.
- PART 2 PRODUCTS
- 2.01 MANUFACTURERS
 - A. Chem-Proof Door Company.
 - B. Or equal.
- 2.02 FABRICATION
 - A. Doors:
 - Construct of fiberglass reinforced plastic (FRP) using polymers tailored to specific corrosive environment with glass content of 35% by weight.
 - 2. Flush construction having no seams or cracks and shall have mortises molded in by manufacturer.
 - 3. 1-3/4-in. thick with 15 mil plus or minus 3 mil color gel coat and shall have minimum R-factor of 9.
 - 4. Sizes indicated on Drawings with clearances of 1/8 in. at jambs and head and 1/2 in. at bottom unless otherwise indicated or specified.
 - B. Styles and Rails:
 - 1. Construct of 2 layers of 1.5 oz/sq ft fiberglass mat and one layer of 10 oz/sq yd fiberglass cloth.
 - 2. Mold in one continuous piece to U-shaped configuration and to exact dimensions of door.
 - C. Door Plates:
 - 1. Molded in one continuous piece with 2 layers of 1.5 oz/sq ft of fiberglass mat and with 16 oz/sq yd uni-directional roving.
 - D. Frames:
 - 1. Construct of same materials and method as doors.
 - 2. Jamb shall be of uniform cross-sectional thickness so back of jamb shall preset uniform surface against wall opening.
 - Reinforcement for mounting hinges and other hardware shall be of mild steel plates strategically located, buried in matrix of polyester material so that they will not be exposed.



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- E. Reinforcing for Hardware:
 - 1. Install reinforcing and compression members to accommodate half surface hinges and other hardware in voids between door plates.
 - Fill with equivalent of 4 to 6 lbs of expanded polyurethane foam having flame spread of 25 or less in accordance with ASTM E84
- F. Resins:
 - 1. Fire retardant formulation plus antimony trioxide to achieve flame spread of 25 or less in accordance with ASTM E84.
 - 2. Self-extinguishing in accordance with ASTM D635.
- G. Ledge for Window Openings: One piece, molded integrally with both door plates so that no moisture may penetrate door cavity through window opening. Retain window glass by 4 fiberglass glazing pins and seal in such manner that integrity of seal remains intact.
- H. Color: Grey.
- PART 3 EXECUTION
- 3.01 INSTALLATION
 - A. Install frames plumb, rigid and in true alignment. Brace securely during construction to retain their proper position and clearances.
 - B. Secure jambs with stainless steel concrete anchors.
 - C. Installation in accordance with manufacturer's written instructions using only noncorrosive materials and methods.
- 3.02 ADJUST AND CLEAN
 - A. Final Adjustment: Check and readjust operating finish hardware items, leaving frames undamaged and in complete and proper operating condition.
 - B. Protection Removal: Immediately prior to final inspection, remove protective plastic wrappings from prefinished doors.

* * * END OF SECTION * * *





SECTION 08110 STEEL DCORS AND FRAMES

PART 1 GENERAL

1.01 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI Al15-88 Door and Frame Preparation.
- B. American Society for Testing and Materials (ASTM):
 - ASTM A153-82 Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
 - ASTM A366-85 Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
 - 3. ASTM A525-87 Standard Specification for General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process.
 - 4. ASTM A526-85 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Commercial Quality.
 - ASTM A568 REV A-88 Standard Specification for Steel, Sheet, Carbon, and High Strength, Low Alloy, Hot-Rolled, and Cold-Rolled, General Requirements for.
 - ASTM A569-85 Standard Specification for Steel, Carbon (0.15 Maximum, Percent) Hot-Rolled Sheet and Strip Commercial Quality.
 - 7. ASTM C236-87 Standard Test Method for Steady-State Thermal Performance of Building Assemblies by Means of Guarded Hot Box.
 - 8. ASTM E90-87 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
 - 9. ASTM E152 REV A-81 Standard Methods of Fire Tests of Door Assemblies.
 - 10. ASTM E413-87 Classification for Rating Sound Insulation.
- C. Door and Hardware Institute (DHI):
 - 1. Recommended Locations for Builder's Hardware.
- D. National Fire Protection Association (NFPA):
 - 1. NFPA 80-86 Standard for Fire Doors and Windows.
- E. Steel Door Institute (SDI):
 - SDI 100-85 Recommended Specifications Standard Steel Doors and Frames.
 - 2. SDI 105-82 Recommended Erection Instructions.
 - 3. SDI 106 (1987) Recommended Standard Door Type Nomenclature.





1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data substantiating product compliance with requirements.
- B. Shop Drawings: Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
 - Provide schedule of doors and frames using same reference numbers for details and openings as those on Drawings.
 - 2. Indicate coordination of glazing frames and stops with glass and glazing requirements.
- C. Submit in accordance with Section 01340.
- 1.03 QUALITY ASSURANCE
 - A. Provide doors and frames complying with SDI 100 and as specified.
 - 3. Fire-Rated Door Assemblies: Where indicated or required, provide fire-rated door and frame assemblies complying with NFPA No. 80 which have been tested, listed, and labeled in accordance with ASTM E152 by nationally recognized independent testing and inspection agency acceptable to authorities having jurisdiction.
- 1.04 DELIVERY, STORAGE, AND HANDLING
 - A. Identify Work not permanently factory assembled before shipment to ensure proper assembly at Project site.
 - B. Deliver hollow metal work cartoned or crated to provide protection during transit and job storage.
 - C. Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided refinished items equal new Work and are acceptable to OWNER, otherwise remove and replace damaged items.
 - D. Store doors and frames at Project site under cover. Place units on minimum 4-in. high wood blocking. Avoid use of nonvented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide minimum 1/4 in. spaces between stacked doors to promote air circulation.

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- PART 2 PRODUCTS
- 2.01 MANUFACTURERS
 - A. Thermal Rated Steel Door and Frame Assemblies:
 - 1. Ceco Corporation.
 - 2. Curries Manufacturing, Inc.
 - 3. Or equal.

2.02 MATERIALS

- A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, ASTM A568 and A569.
- B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, ASTM A366 and A568.
- C. Galvanized Steel Sheets: Zinc coated carbon steel sheets of commercial quality, ASTM A525 and A526, G60 zinc coating, mill phosphatized.
- D. Supports and Anchors: Fabricate of galvanized sheet steel, minimum 18 ga.
- E. Inserts, Bolts, and Fasteners: Manufacturer's standard units, except hot-dip galvanize items built into exterior walls, ASTM A153, Class C or D as applicable.
- F. Shop-Applied Paint:
 - Primer: Rust inhibitive enamel or paint, air-drying or baking, suitable as base for specified finish paints.

2.03 FABRICATION, GENERAL

- A. Door and frame shall be rigid, neat in appearance, and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant.
- B. Comply with SDI 100.
 - Exterior Doors: SDI 100, Grade III, extra heavy duty, Model 2, minimum 16 ga faces.
 - Interior Doors: SDI 100, Grade II, heavy duty, minimum 18 ga faces.
- C. Materials:
 - 1. Exposed faces of doors and panels, including stiles and rails of nonflush units shall be cold-rolled steel.

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- Frames, concealed stiffeners, reinforcement, edge channels, louvers, and moldings shall be cold- or hot-rolled steel, minimum 16 ga.
- 3. Exterior Doors: Close top and bottom edges as integral part of door construction or by addition of minimum 16 ga inverted steel channels.
- D. Exposed Fasteners:
 - 1. Countersunk flat Phillips heads for exposed screws and bolts.
- E. Finish Hardware Preparation:
 - 1. Comply with ANSI All5 for door and frame preparation.
 - 2. Reinforce doors and frames to receive surface applied hardware. Drilling and tapping for surface applied finish hardware may be done at Project site.
 - 3. Locate finish hardware as indicated on approved Shop Drawings or, if not indicated, in accordance with DHI.
- F. Shop Painting:
 - 1. Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.
 - Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.
 - 3. Apply shop coat of prime paint of even consistency to provide uniformly finished surface ready to receive finish paint.
- 2.04 STANDARD STEEL DOORS
 - A. Provide metal doors of types and styles indicated on Drawings or schedules.
 - B. Door Louvers:
 - Sightproof stationary louvers for interior doors constructed of inverted V- or Y-shaped blades formed of 24 ga cold-rolled steel set into 20 ga steel frame.

2.05 STANDARD STEEL FRAMES

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- A. Provide metal frames for doors, transoms, side lights, borrowed lights, and other openings of types and styles shown on Drawings and schedules.
 - 1. Fabricate of minimum 14 ga hot-dip galvanized steel.
 - 2. Conceal fastenings unless otherwise indicated.
 - 3. Miter and weld corners.

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- B. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-swing frames and 2 silencers on heads of double-swing frames.
- C. Plaster Guards: Provide 26 ga steel plaster guards or mortar boxes welded to frame at back of finish hardware cutouts where mortar or other materials might obstruct hardware operation, and to close off interior of openings.
- PART 3 EXECUTION

3.01 INSTALLATION

- A. Install standard steel doors, frames, and accessories in accordance with Shop Drawings, manufacturer's data, and as specified.
- B. Placing Frames:
 - 1. Comply with SDI 105 unless otherwise indicated.
 - Except for frames located at cast-in-place concrete or masonry and drywall installations, place frames prior to construction of enclosing walls and ceilings.
 - 3. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors set.
 - 4. After wall construction complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
 - 5. Masonry Construction: Locate 3 wall anchors per jamb at hinge and strike levels.
 - 6. Metal Stud: Install minimum of 3 wall anchors per jamb at hinge and strike levels.
 - 7. Fire-Rated Frames: In accordance with NFPA No. 80.
- C. Door Installation:
 - 1. Fit hollow metal doors accurately in frames within clearances specified in SDI 100.
 - 2. Place fire-rated doors with clearances as specified in NFPA No. 80.

3.02 ADJUST AND CLEAN

- A. Prime Touch-up: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touch-up of compatible air drying primer.
- B. Final Adjustments: Check and re-adjust operating finish hardware items, leaving steel doors and frames undamaged and in complete and operating condition.

* * * END OF SECTION * * *

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DIVISION 10

SPECIALTIES

SECTION 10440 SPECIALTY SIGNS

- PART 1 GENERAL
- 1.01 SUMMARY
 - A. Section Includes:
 - 1. Panel signs.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - ASTM A167 REV A-89 Standard Specification for Stainless and Heat-Resisting Chromium - Nickel Steel Plate, Sheet, and Strip.
 - ASTM B209-89 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 3. ASTM B221-88 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
 - ASTM D790-86 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - 5. ASTM D1003-61 Test Method for Haze and Luminous Transmittance of Transparent Plastics.
 - B. National Association of Architectural Metal Manufacturers (NAAMM):
 - 1. Metal Finishes Manual.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and installation instructions for each type of sign required.
- B. Samples: Submit samples of each sign form and material showing finishes, colors, surface textures, and qualities of manufacture and design of each sign component including graphics.

PART 2 PRODUCTS

- 2.01 MATERIALS, GENERAL
 - A. Aluminum Sheet: Alloy and temper recommended by aluminum producer or finisher for type of use and finish indicated, with not less than strength and durability properties specified in ASTM B209 for 5005-H15.



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- B. ABS Plastic: High impact thermoplastic composed of copolymers of acrylonitrile, butadiene, and styrene.
- C. Fasteners: Use concealed fasteners, unless otherwise indicated, fabricated from metals, which are noncorrosive to either sign materials or mounting surface.
- D. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
- 2.02 FABRICATION OF PANEL SIGNS
 - A. General:
 - Fabricate panel signs to comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
 - 2. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 in. measured diagonally from corner to corner.
 - 3. Unframed Panel Signs: Fabricate unframed panel signs with edges mechanically and smoothly finished to conform with following requirements.
 - a. Edge Condition: Square cut.
 - b. Edge Color for Plastic Laminate: Same as copy.
 - c. Corner Condition: Rounded to radius indicated.
 - B. Graphic Image Process:
 - Graphic Content and Style: Provide sign copy to comply with requirements indicated for sizes, styles, spacings, content, positions, materials, finishes, and colors of letters, numbers, symbols, and other graphic devices as selected by OWNER.

2.03 FINISHES

- A. General:
 - Colors and Surface Textures: For exposed sign materials which require selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not otherwise indicated, selected by OWNER from manufacturer's standards.
 - 2. Metal Finishes: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations.

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B. Aluminum Finishes:

- Baked Enamel Finish: AA-M4xCl2C42Rlx (manufacturer's standard nondirectional mechanical finish including sanding and filing; cleaning with inhibited chemicals; conversion coated with an acid-chromate-fluoride-phosphate treatment; and painted with organic coating specified below).
 - a. Organic Coating: Manufacturer's standard thermosetting enamel system consisting of prime coat and finish coat.
- PART 3 EXECUTION
- 3.01 INSTALLATION
 - A. General:
 - Locate sign units and accessories where shown or scheduled, using mounting methods of type described and in compliance with manufacturer's instructions, unless otherwise indicated.
 - 2. Install sign units level, plumb, and at height indicated, with sign surfaces free from distortion or other defects of appearance.
- 3.02 CLEANING AND PROTECTION

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- A. At completion of installation, clean soiled sign surfaces in accordance with manufacturer's instructions.
- B. Protect units from damage until acceptance by OWNER.

* * * END OF SECTION * * *





DIVISION 11

EQUIPMENT

- PART 1 GENERAL
- 1.01 SUMMARY
 - A. Pumps to be placed horizontally into primary leachate collection sumps.
- 1.02 SUBMITTALS
 - A. Shop Drawings.
 - B. Manufacturer's written installation instructions.
 - C. Submit in accordance with Section 01340.
 - D. Operation and Maintenance (O&M) Data:
 - 1. Submit in accordance with Section 01730.
- 1.03 QUALITY ASSURANCE
 - A. Design Criteria:
 - 1. Design pumps for conditions given in Table 11309 of this section.
 - 2. Working parts shall be readily accessible for inspection and repairs, easily duplicated, and replaced.
 - 3. Construct suitable for submerged installation.
 - 4. Direct connect to vertical shaft motor.
 - 5. Design to operate safely in reverse direction of rotation due to water returning through pump.
- PART 2 PRODUCTS
- 2.01 MANUFACTURERS
 - A. Pumps:
 - 1. Grundfos Pumps Corporation.
 - 2. Goulds.
 - 3. Or equal.
- 2.02 PUMPS
 - A. Provide pump and motor designed for continuous submerged operation.



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- B. Provide check valve integral to pump discharge housing.
 - 1. Construct of 300 series stainless steel.
- C. Pumping downthrust absorbed by motor thrust bearing.
 - 1. Adjustable Mitchell design (improved "Kingsbury" type).
 - 2. Construct of ceramic running against self-aligning metal impregnated carbon pads.
- D. Provide stainless steel priming inducer.
 - 1. Design to ensure proper pump lubrication and prevent dry running if liquid level drops below pump intake.
- E. Provide stainless steel filter screen.
 - 1. Integral to suction inlet assembly.
- F. Provide fabricated stainless steel diffuser guide vanes.
- G. Provide fabricated stainless steel impellers.
 - 1. Fit seal ring around each impeller eye or skirt.
 - Construct seal rings of stainless steel tetrafluoroethylene (TFE).
- H. Provide centerless ground stainless steel pump shaft.
- I. Provide TFE shaft bearings of hexed design.
- J. Provide stainless steel split cones and split cone nuts.
- K. Provide integral fabricated stainless steel diffuser chambers.
 - 1. Design to eliminate up thrust.
 - 2. Container diffuser guide vanes and intermediate shaft bearings.
- L. Provide high tensile strength stainless steel straps.
- M. Provide, splined or keyed stainless steel pump shaft coupling.
- N. Motor:
 - 1. Canned rotor design.
 - 2. Hermetically sealed epoxy encapsulated stator sealed in stainless steel enclosure.
 - 3. Stainless steel clad rotor.
 - 4. Construct parts in contact with pumped liquid of stainless steel.



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- 5. Shaft and Seal:
 - a. Tungsten carbide running on tungsten carbide.
 - b. Upper seal ring molded into spring loaded rubber diaphragm.
- 6. Upper Radial Bearing:
 - a. Diamond hard ceramic running against tungsten carbide shaft journal.
 - b. Lubricated by pumped fluid.
- 7. Motor Circulation Pump:
 - a. Stainless steel.
 - b. Circulate pumped fluid in rotor.
 - Design to ensure effective bearing lubrication and winding heat dissipation.
- 8. Lower Radial Bearing:
 - Diamond hard ceramic running against tungsten carbide shaft journal.
 - b. Lubricated with pumped fluid.
- 9. Rubber Diaphragm:
 - a. Design to automatically compensate for internal motor liquid expansion due to temperature or pressure changes.
- 10. Provide neoprene jacketed RHW insulated power cable.

2.03 SPECIAL REQUIREMENTS

- A. Provide each pump with 80-ft, factory-installed, sealed, heavy duty, teflon coated electric service cable.
 - 1. Splice incoming wire in motor terminal housing.
 - 2. After splicing, fill terminal housing with epoxy to seal outer core jacket and strands.
 - 3. Provide secondary elastomer compression grommet to ensure complete sealing and strain relief.
 - 4. Provide primary leachate system pumps with bare end cables to be hard wired to local control panels.
- 2.04 ACCESSORIES
 - A. Provide 2-in. dia hose for use with leachate pump, and quick connect couplings in accordance with Section 15076.
 - B. Pull-out Cable: Provide 80-ft of 1/4 in. stainless steel, pullout cable.



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- 1. Minimum Breaking Strength: 1,700 lbs.
- 2. Conform to applicable FS RR-W-410C and MIL-W-83420D.
- 3. Good flexibility and designed for use on small diameter pulleys and winches.
- C. Provide stainless steel fabricated wheeled carriage for conveyance of pump on side application.
- PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment according to manufacturer's written instructions and approved submittal.
- B. Attach pump power cable to stainless steel pump pull-out cable at 5-ft intervals using nylon ties.
- C. Wiring shall conform to requirements of Division 16.



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TABLE 11309 PUMP AND ELECTRICAL MOTOR CHARACTERISTICS

PUMP CHARACTERISTICS

	Small Capacity	Large Capacity	Larger Capacity
Pump Designation	Leachate Pump	Leachate Pump	Leachate Pump
Number of Units	15 (includes 1 spare)	15 (includes 1 spare)	2
Materials Being Pumped	Leachate	Leachate	Leachate
Minimum Solids Size (in.)			
Constant or Variable Speed	Constant	Constant	Constant
Configuration (1)*	e	e	e
Minimum Suction Size (in.)(2)*			
Minimum Discharge Size (in.)(2)*	2 NPT	2 NPT	3 NPT
Rated Capacity (gpm)	35	60	140
Total Dynamic Head at Rated			
Capacity (ft)(3)*	35	50	50
Minimum Capacity (gpm)			
Total Dynamic Head of Minimum			
Capacity (ft)(3)*			
Maximum Pump Speed (rpm)	3.450	3 450	3 4 5 0
Minimum Pump Speed (rpm)			5,450
Lubrication (4)*	Pumped Fluid	Pumped Fluid	Pumped Fluid
Rotation when Viewed from Driver	Clockwise	Clockwise	Clockwice
Type of Drive (5)*			CIOCKWISC
Special Requirements	All Stainless Steel	All Stainless	All Stainlecé Staal
	Construction	Construction	Construction

ELECTRIC MOTOR CHARACTERISTICS

Horsepower - Min.	1/2	1-1/2	6
Rated Speed (rpm)	3,450	3,450	3.450
Service Factor	1.15	1.15	1.15
General Type (6)*	а	а	a
Housing Type (7)*	c, d	c , d	c, d
NEMADesign	В	В	B
Insulation Class	В	В	В
Voltage	460	460	460
Phase	3	3	3
Code Letter	G	G	G
Special Requirements			

()* Indicates footnotes on following page NA. Indicates not applicable

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TABLE 11309 VERTICAL PUMP AND ELECTRIC MOTOR CHARACTERISTICS (Continued)

- 1. Configuration can be:
 - a. Propeller pump axial flow.
 - b. Propeller pump mixed flow.
 - c. Vertical turbine pump enclosed impeller.
 - d. Vertical turbine pump semi-open impeller.
 - e. Vertical submersible pump.
- 2. If larger pump size or different pump other than those shown are furnished by CONTRACTOR, he shall be responsible for added expense of piping and changes in Drawings.
- 3. Does not include elbow, column, strainer, and other internal losses in pump.
- 4. Product lubricated or oil lubricated.
- 5. Type of drive can be:
 - a. Variable frequency.
 - b. Magnetic coupling (eddy current coupling).
 - c. Wound rotor.
 - d. Fluid drive.
 - e. Variable sheave (local or remote control).
- 6. General type can be:
 - a. Squirrel cage.
 - b. Wound rotor.
- c. Synchoronous.
- 7. Housing type can be:
 - a. ODP (open dripproof).
 - b. TEFC (totally enclosed fan cooled).
 - c. Explosionproof.
 - d. Submersible.
 - e. Splashproof.

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f. Weather protected.

* * * END OF SECTION * * *

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DIVISION 13

SPECIAL CONSTRUCTION

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SECTION 13121 PRE-ENGINEERED METAL ROOF

- PART 1 GENERAL
- 1.01 SUMMARY
 - A. Intent of these Specifications and Drawings is to establish quality and performance level for structural design, material, durability, and workmanship.

1.02 REFERENCES

- A. Aluminum Association (AA):
 - 1. Specification for Aluminum Structures.
- B. American Institute of Steel Construction (AISC):
 - 1. Manual Steel Construction, 9th Edition.
- C. American Iron and Steel Institute (AISI):
 - 1. Cold-Formed Steel Design Manual (1983).
- D. American Society for Metals (ASM):
 - 1. Metals Handbook, 9th Edition, Volume 2.
 - a. Aluminum Alloy No. 6063.
- E. American Society for Testing and Materials (ASTM):
 - 1. ASTM A6-90 Standard Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use.
 - 2. ASTM A36-89 Standard Specification for Structural Steel.
 - 3. ASTM A307-90 Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - 4. ASTM A325-90 Standard Specification for High-Strength Bolts for Structural Steel Joints.
 - 5. ASTM D659-86 Standard Method of Evaluating Degree of Chalking of Exterior Paints.
 - 6. ASTM D2244-89 Standard Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
 - 7. ASTM E84-89 Standard Test Method for Surface Burning Characteristics of Building Materials.

- F. American Welding Society (AWS):
 - 1. AWS D1.1-90 Structural Welding Code: Steel.
- G. Federal Specifications (FS):
 - FS TT-P-664C(2) Primer Coating, Synthetic, Rust-Inhibiting, Lacquer-Resisting.
- H. International Conference Building Officials (ICBO):
 - 1. Uniform Building Code and Supplements 1982.
- I. Metal Building Manufacturer's Association (MBMA):
 - 1. Metal Building Systems Manual (1986).

1.03 SUBMITTALS

- A. Shop Drawings:
 - 1. Include structural framing details, connections, plans and sections for site specific roof stamped by Professional Engineer registered in State of New York.
 - 2. Include anchor bolt setting plans.
 - 3. Provide horizontal and vertical forces applied to structure wall.
 - 4. State type of material, finishes, and painting for all locations.
- B. Roof panel guarantees.
- C. Color chips for roof panels and trim.
- D. Submit in accordance with Section 01340.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Roof shall be design of manufacturer regularly engaged in fabrication of pre-engineered structures.
 - 2. Use new, unused materials, free from defect, and of American manufacture.
- B. Regulatory Requirements:
 - 1. Building code having jurisdiction over area in which site is located.
 - 2. Underwriters' Laboratories, Inc. (UL).

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- 1.05 DELIVERY, STORAGE, AND HANDLING
 - A. Protect stored materials from damage.
 - B. Replace damaged material if repair or corrections cannot be made in field.
- 1.06 GUARANTEE
 - A. Roof Panels:
 - 1. Guarantee durability of roof panels due to rupture, structural failure, or perforation for 20 yrs.
- PART 2 PRODUCTS
- 2.01 PERFORMANCE CRITERIA
 - A. Design Loads:
 - 1. General:
 - a. Basic design loads: Dead, live, wind, and earthquake in addition to dead load.
 - b. Other design loads, whether static, dynamic, or kinetic nature, shall be considered as auxiliary loads.
 - 2. Vertical Live Loads:
 - a. Design roof covering for 50 psf uniformly distributed or 200-lb concentrated (point) load (over 1 ft by 1 ft area) located at center of maximum roofing (panel) span. Most severe conditions govern.
 - Design purlins for 35 psf uniformly distributed over roof area they support.
 - c. Primary framing (frames) shall be designed for 35 psf uniformly distributed over roof area it supports.
 - d. Above loads shall be in addition to applicable dead loads and applied to horizontal projection of roof.
 - 3. Wind Loads:
 - a. Wind load: 15 psf pressure proportioned and applied as horizontal and uplift forces according to and as recommended by State of New York Codes, Rules and Regulations Building Construction Subchapter B, and MBMA. Most severe condition governs.

- 4. Seismic (Earthquake) Loads:
 - a. Design roof for seismic forces.
 - b. Provisions for determining seismic forces shall be those as recommended by ICBO.
- 5. Auxiliary (Additional Collateral) Loads:
 - Consider other superimposed dynamic or static loads as part of design requirements and combined with normal design (live and wind) loads as prescribed hereafter.
 - 1) Static loads such as piping and lighting systems.
- B. Description:
 - 1. Pre-engineered metal roof covered by this section shall be structure of steel (frames) rafter beams devoid of valleys.
 - 2. Roof slope shall be not less than 1/2:12.
 - 3. Interior column (supports) not allowed.
 - 4. Minimum unobstructed clear height throughout interior of building shall be El. 335.75 in the life station.
 - 5. Horizontal plane bracing permitted if above building's required interior clear height.
 - 6. Roof shall be designed for removal in one piece. Anchor bolts shall be readily accessible for roof removal. Provide lifting lugs at top of roof for removal.
- 2.02 COMPONENT CRITERIA
 - A. Structural Framing:
 - 1. Shapes and Plates: ASTM A36 or manufacturer's standard.
 - 2. Anchor Bolts: ASTM A307 minimum.
 - 3. Connection Bolts: A325.
 - B. Roof Covering and Supports: Roof construction shall carry UL construction (uplift) classification of no less than Class 30.
 - 1. Roof Panels:
 - a. Exposed metal roof covering: 24 ga (minimum) commercially pure aluminum-coated or zinc-aluminum-coated steel panels of configuration to provide specified load carrying capabilities and deflection requirements of this section.
 - b. Roof panels: "Standing-seam interlocking" design, secured to purlins with concealed structural fastening system.
 - c. Concealed system: Shall provide minimal through penetration of exposed roofing surface and allow roof covering to move independently of any differential thermal movement by structural framing system.

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- d. Except at concealed fastener, there shall be no thermal contact of roof panels with supporting purlin.
- e. Standing seams shall have factory-applied, nonhardening sealant, and be continuously locked or crimped together by mechanical means during erection.
- f. Roof panels with laptype side (longitudinal) joints and exposed structural fasteners not acceptable.
- g. Fasten to purlins with concealed clip or backing device of steel having protective metallic coating. Through penetration of roofing surface by exposed fasteners shall occur only at terminal locations of roof panels. Such fasteners shall be stainless steel or aluminum screws, bolts or rivets with weatherseal washers. Carbon steel shank fasteners with vinyl heads are acceptable.
- Deflection of roof panel shall not exceed L/180 of span when supporting applicable vertical live loads previously described.
- 2. Purlins:
 - a. Purlin configuration, thickness, and spacing shall be building manufacturer's standard provided design criteria, including deflection, is met or exceeded.
 - b. Deflection of purlin shall not exceed L/180 of span when supporting applicable vertical live loads previously prescribed and any collateral loads required.
- 3. Roof Jacks and Curbs:
 - a. Openings, 8 in. or smaller:
 - May be flashed and sealed to roof panel by jacks, if complete structural support and weathertightness maintained.
 - Material shall be metal with protective metallic coating or plastic alloy with acrylic film laminated to exterior surface.

2.03 FABRICATION

- A. Fabricate as shown on approved Shop Drawings. Do not modify Shop Drawings or Specifications.
- B. Welder shall be certified for type of welding required.
- C. Fabrication and erection welding and welding equipment shall comply with requirements of AWS.
- D. Electrodes for structural welds shall be E70 series.



- E. Surfaces shall be free of scale, rust, grease, paint or other foreign matter prior to welding.
- F. After welding, brush welds with wire brushes. Welds shall show uniform section, smoothness of weld metal, weather edges without overlaps, and freedom from porosity and clinkers. Where necessary to achieve smooth connections, joint shall be dressed smooth.
- 2.04 STRUCTURAL STEEL PRIMER
 - A. Provide uncoated structural steel surfaces one shop coat of rust inhibitive (primer) paint compatible with finish painting system.
 - B. Surfaces inaccessible after erection shall be covered with 2 coats before erection.
- 2.05 INSULATION
 - A. Providing overall heat transfer (U) value of not more than .09.
 - B. Apply insulation system under exposed metal roofing panels.
 - C. Place insulation of required thickness and density either over purlins or in roof cavity between purlins and support by sloped, unpierced, or pierced ceiling of noncombustible material.
 - D. Place vapor membrane nearest interior of building, whether it be exposed or nonexposed.
 - E. Lap or fold and staple joints in accordance with roof manufacturer's standard.
 - F. Except at each concealed structural fastener, thermal (break) spacer shall separate roof purlin from roof panel. Spacer shall be material having density of not less than 2 pcf and, if of combustible material, shall be classified (ASTM E84) as having flame spread rating no greater than 25.
 - G. Noncombustible roof insulation shall be flexible fiberglass blankets with vapor resistant membrane. Vapor resistant membrane may be laminated to insulation as composite unit or added as separate component of insulation system. Insulation and vapor membrane, if supplied as laminated composite unit, shall carry UL fire hazard classification indicating flame spread rating of 25 or less, as tested assembly. If supplied as separate components, each (tested separately) shall carry previously specified fire hazard classification.

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PART 3 EXECUTION

- 3.01 GENERAL
 - A. Erection of metal roof, accessories, insulation, and interior finish, if applicable, shall be performed by one of following.
 - 1. Authorized dealers or builders of manufacturer.
 - 2. Building manufacturer's crews.
 - 3. Other erectors authorized by manufacturer as trained and qualified to erect manufacturer's product. In this case, manufacturer shall inspect Work and certify its correctness.
 - B. Assemble in accordance with approved erection or assembly drawings, details, and instructions. No modifications to assembly drawings, details or instructions shall be made.
- 3.02 ADJUSTMENT AND CLEANING
 - A. Touch up defects such as mars and abrasions to panels and framing, weld burrs in field.
 - B. Adjust ridge ventilator to operate properly.

* * * END OF SECTION * * *



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SECTION 13623 FLOW METER (MAGNETIC)

- PART 1 GENERAL
- 1.01 SUMMARY
 - A. Provide standard magnetic flow meters and converters as shown on Drawings and Schedule 1 of this section.
- 1.02 SUBMITTALS
 - A. Submit maintenance-service contract.
 - B. Submit in accordance to Section 01340.
 - C. Operation and Maintenance (O&M) Data:
 - 1. Submit in accordance with Section 01730.
- 1.03 QUALITY ASSURANCE
 - A. Supplier's or Manufacturer's Services:
 - Supplier's or manufacturer's technician for equipment specified herein shall be present at job site or classroom designated by OWNER for minimum of 3 mandays, travel time excluded, for assistance during plant construction, plant startup, equipment calibration, and training of OWNER'S personnel for plant operation. Include minimum of:
 - a. l manday for Installation, Calibration, and Startup Services.
 - b. 1 manday for Instructional Services.
 - c. 1 manday for Post Startup Services.
 - Supplier or manufacturer shall direct services to system and equipment operation, maintenance, and troubleshooting and system related areas other than process design and philosophy. See Section 01600.
 - B. Source Quality Control:
 - Flow meter shall be hydraulically calibrated at facility located in United States and calibration traceable to National Bureau of Standards.
 - 2. Wire and test meter, suitable for operation. Conduit and signal wiring for meter installed between converter and terminals at designated panel.

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- 1.04 GUARANTEE
 - A. Provide replacement parts during guarantee period for defective component at no additional cost.
- PART 2 PRODUCTS
- 2.01 STANDARD MAGNETIC FLOW METER
 - A. Manufacturers:
 - 1. Foxboro.
 - 2. Rosemount.
 - 3. Or equal.
 - B. Low frequency, electromagnetic induction type and shall produce dc pulse signal directly proportional and linear to liquid flow rate.
 - C. Provide sufficient length of signal cable to interconnect meter and converter. Use single conduit run between converter and meter.
 - D. Splashproof and weather-resistant housing with accidental submergence rating, 30 ft water for 48 hrs. Watertight external and internal electrical conduit connections. Suitable for installation and operation in Class 1, Division 2 hazardous areas.
 - E. Operate on 117 vac, 60 Hz power supply. Line voltage compensation inherent to meter.
 - F. Flow meter liner, electrode materials, and electrode type shall be suitable for process but restricted to materials listed under Materials of Construction in Schedule 1 of this section.
 - G. Provide meter with capability for portable electrode cleaning. Portable cleaner to have easily accessible connections from liquid meter body.
 - H. Use grounding rings or gaskets on each end of magnetic flow meter to provide good ground path and prevent interference with flow signal. Probes not acceptable.
 - I. Sensing head interchangeable with meter body of same manufacturer without performing flow recalibration.
 - J. Ratio of flow velocity to reference voltage signals generated identical for all meter sizes. Meter shall be compatible with secondary readout instrument without circuit modifications.

- K. Changes in density, viscosity, temperature, pressure or conductivity within limits of flow meter shall not affect accuracy. Maintain accuracy for field repairs performed by supplier's service technician during warranty period.
- L. Magnetic flow meter shall be high impedance device of not less than 10^{12} ohms to minimize span shift due to electrode coating.
- M. Limit power consumption to 5 watts/in. of pipe diameter.
- N. Where continuous submergence specified, remote mount driver near magnetic flow meter to have driven shielding on leads from electrode to converter.
- 2.02 SIGNAL CONVERTER
 - A. Remote mounted, microprocessor controlled.
 - 1. Operate on 120 vac, 60 Hz power.
 - 2. Provide pulsed dc voltage to magnet coils of magnetic flow meter to establish magnetic field.
 - 3. Voltage Frequency: 7.5 or 15 Hz field selectable.
 - 4. Convert flow signal from magnetic flow meter to analog and digital output signals, for bidirectional flow.
 - B. Span to be continuously adjustable between 3 and 31 ft/sec over 10:1 range. Adjustment shall be by direct reading range switches. Zero adjustment not necessary; zero stability characteristic of meter system.
 - C. Standard back lighted display for easy reading of flow data. Display shall have 2 rows of 16 alpha numeric characters. Top row shall indicate instantaneous flow rate in direct engineering units, field selectable. Bottom row shall indicate totalizer count in direct engineering units, field selectable.
 - D. Converter interchangeable with magnetic flow meter of same manufacturer and requires no additional flow calibration adjustment.
 - E. Power: 120 vac, 60 Hz.
 - F. System accuracy, including magnetic flow meter, to be 0.25% of flow rate between 10% and 100% flow. Repeatability shall be %0.25% and linearity %0.2%.
 - G. 4-20 mAdc analog current output into 0 to 900 ohm load and 24 vdc scaled, pulse output that is software adjustable.
 - H. Locate flow rate indicator within each converter.
 - I. House in cast aluminum enclosure to meet NEMA 4 requirements.

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- J. Provide integral zero return which shall provide constant zero output when activated by external nonpowered contact.
- K. Noise reduction feature to minimize effects of noise generating processes.
- 2.03 TAGGING
 - A. Provide Type 316 stainless steel tag permanently affixed to unit (primary and transmitter if separately mounted).
 - B. Engrave with process application as listed in Specifications.
 - C. Include DESIGNER'S tag number as listed in Specifications and on P&IDs.
- 2.04 SPECIAL TOOLS AND EQUIPMENT
 - A. Provide:
 - 1. One spare converter for every 10 magnetic flow meter converters.
 - 2. Portable electrode cleaning generators with handle and 50 ft of cable with plug-in connectors, to ratio of 1 ultrasonic generator for every 5 meters.
 - 3. Three sets of circuit boards for sensing head and signal converter.
 - 4. Two sets of special tools and test equipment, including calibrator required for repair and recalibration of equipment.
 - B. Provide spool piece same size and diameter as meters for replacement in-line when meter out for repair.
- PART 3 EXECUTION
- 3,01 INSTALLATION
 - A. Install in accordance with manufacturer's written instructions and approved submittals.









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SCHEDULE 1 TO SECTION 13623 MAGNETIC FLOW METER SCHEDULE

Tag <u>No.</u>	Description	Media	Flo Minimum _(fps)	w Maximum (fps)	Design _(fps)_	Size (in.)	Materials of <u>Construction</u>
FE-1-1	RMU-l Lift Station Pump Discharge	Leachate	5.4	10.8	7.15	4	(2,3,8,10,12)
FE-2-1* through FE-2-14	RMU-1 Primary Pump Discharge for Cells 1 through 14	Leachate	4.6	13.3	7.7	2	(2,3,8,10.12)

* FE-2-# Represents cell number.

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MATERIALS OF CONSTRUCTION

4. Polyurethane

5. Neoprene

Electrode Type

1. Plain (Flush)

2. Bullet Nose

Flange Material

<u>Liner Material</u>

3. Teflon

<u>Electrode Material</u>

- 6. Zirconium
- 7. Tantalum
- 8. Hastelloy "C"
- 9. 316 Stainless Steel

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Flange Rating

12. ANSI 150 13. ANSI 300

10. Carbon Steel 11. 304 Stainless Steel

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* * * END OF SECTION * * *



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SECTION 13631 ULTRASONIC FLOWMETER (TRANSIT TIME)



PART 1 GENERAL

- 1.01 SUBMITTALS
 - A. Shop Drawings:
 - 1. Furnish graphed/plotted copy of hydraulic calibration of each meter. Include serial numbers of standards used.
 - B. Submit in accordance with Section 01340.
 - C. Operation and Maintenance (O&M) Data:
 - 1. Submit in accordance with Section 01730.
- 1.02 QUALITY ASSURANCE
 - A. Extra Materials: Furnish one set of circuit boards for signal converter.
- PART 2 PRODUCTS
- 2.01 MANUFACTURERS
 - A. 1. Panametrics Model 6068/6468.
 2. Polysonics Model UFM91.
 3. Or equal.
- 2.02 GENERAL
 - A. Provide flow meters and converters as shown on Schedule 1 of this section.
 - B. Principle of Operation: Cross-correlation signal detection technique or other.
 - 1. Sound Wave Type: Sheerwave, longitudinal.
 - 2. Doppler dual-head Transducer detection.

2.03 TRANSDUCER

- A. Clamp-on mounting type.
- B. Sufficient cable to interconnect transducer to remote mounted transmitter.



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- C. Capable of being relocated to different dia pipe and being fieldrecalabrated.
- D. Flow Rates: ± 0.3 to ± 30 ft/sec.
- E. Accuracy:

\$12 in. and \$5 ft/sec = ±0.1 ft/sec.
 \$12 in. and \$5 ft/sec = ±5% typical.
 \$12 in. and \$5 ft/sec = ±0.05 ft/sec.
 \$12 in. and \$5 ft/sec = ±2% typical.

- F. Repeatability: ± 0.2 to ± 0.5 % of full scale.
- G. Linearity: 0.1%.
- H. Pipe Size: 1/8 to 120 in. in dia.
- I. Transducer Temperature Limits: +32RF to +122RF for standard transducers and -40 RF to +450RF for high/low temperature version.
- J. Installation: Slide track mount fixture suitable for use on 1 to 48-in. dia. pipes. Large pipe clamping blocks used for pipe sizes above 48 in.
- 2.04 SIGNAL CONVERTER FOR TRANSMIT TIME TRANSDUCER
 - A. Surface mount in NEMA 4X enclosure.
 - B. Keypad with LCD display for local indication of parameters and programming.
 - C. Set-up shall not require additional test equipment.
 - D. Output:
 - 1. 40-20 mA, isolated.
 - 2. RS232/423 serial port.
 - 3. Or as specified by the manufacturer.

E. Display: Forward and reverse totalized flow, resettable from keypad.

- F. Self-Diagnostics:
 - 1. Measured fluid sound speed.
 - 2. Acoustic signal strength.
 - 3. Signal to noise ratio.
 - 4. Transit time.
 - 5. Reynolds number.
 - 6. Ream angle through fluid.
 - 7. Or as specified by the manufacturer.
- G. Power Requirements: 120 vac, 60 Hz.



2.05 SOURCE QUALITY CONTROL

- A. Data derived from meter manufacturer's calibration facility. Master test meter shall be National Bureau of Standards (NBS) traceable.
- B. Wire and test meter, suitable for operation. Conduit and signal wiring for meter installed between converter and terminals at designated panel.
- PART 3 EXECUTION
- 3.01 INSTALLATION
 - A. Install in accordance with manufacturer's written instructions and approved submittals.
 - B. Mount transducer on outside wall of standard pipe using strap and coupling compound.
- 3.02 FIELD QUALITY CONTROL
 - A. Manufacturer's Field Services:
 - 1. Supplier's or manufacturer's technician for equipment specified herein shall be present at job site or classroom designated by OWNER for minimum of 4 mandays, travel time excluded, for assistance during plant construction, plant startup, equipment calibration, and training of OWNER'S personnel for plant operation. Include minimum of:
 - a. 2 mandays for Installation Services.
 - b. 1 manday for Instructional Services.
 - c. 1 manday for Post Startup Services.
 - Supplier or manufacturer shall direct services to system and equipment operation, maintenance, and troubleshooting and system-related areas, other than process design and philosophy. See Section 01600.





SCHEDULE 1 TO SECTION 13631 TRANSIT TIME FLOW METER SCHEDULE

Service Location	Desig- nation _No	Appli- cation	Line Diameter (in.)	Indicator Flow Range <u>(ft/sec)</u>	Require- ments
RMU-l Lift Station	FE/FQI-1-1	Leachate	4	4 to 10	Single Channel
Cell No. l Primary/ Secondary	FQI-1 FE-P-1 FE-S-1	Leachate	2	3 to 10	Dual Channel
Cell No. 2 Primary/ Secondary	FQI - 2 FE - P - 2 FE - S - 2	Leachate	2	3 to 10	Dual Channel
Cell No. 3 Primary/ Secondary	FQI - 3 FE - P - 3 FE - S - 3	Leachate	2	3 to 10	Dual Channel
Cell No. 4 Primary/ Secondary	FQI-4 FE-P-4 FE-S-4	Leachate	2	3 to 10	Dual Channel
Cell No. 5 Primary/ Secondary	FQI-5 FE-P-5 FE-S-5	Leachate	2	3 to 10	Dual Channel
Cell No. 6 Primary/ Secondary	FQI-6 FE-P-6 FE-S-6	Leachate	2	3 to 10	Dual Channel

* * * END OF SECTION * * *





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DIVISION 15

MECHANICAL



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SECTION 15060

- PIPE, TUBE, FITTINGS, AND MECHANICAL IDENTIFICATION
- PART 1 GENERAL
- 1.01 SUMMARY
 - A. Section Includes:
 - 1. Piping Materials:
 - a. Steel pipe.
 - b. Plastic pipe.
 - 2. Pipe/Tube Fittings:
 - a. Fittings for steel pipe.b. Fittings for plastic pipe.
 - Miscellaneous piping materials/products.
 - 4. Underground type plastic line markers.
 - B. Pipe, tube, fittings, and mechanical identification furnished as part of factory fabricated equipment, are specified as part of equipment assembly in other sections.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI A13.1-81 Scheme for the Identification of Piping Systems.
 - 2. ANSI Bl.20.1-83 Pipe Threads, General Purpose (Inch).
 - 3. ANSI B16.1-89 Cast Iron Pipe Flanges and Flanged Fittings.
 - 4. ANSI B16.3-85 Malleable Iron Threaded Fittings, Classes 150
 - and 300.
 - 5. ANSI B16.4-85 Cast Iron Threaded Fittings, Classes 125 and 250.
 - 6. ANSI B16.5-88 Pipe Flanges and Flanged Fittings.
 - 7. ANSI B16.9-86 Factory-Made Wrought Steel Buttwelding Fittings.
 - ANSI B16.11-80 Forged Steel Fittings, Socket Welding and Threaded.
 - 9. ANSI B16.12-83 Cast Iron Threaded Drainage Fittings.
 - 10. ANSI B16.14-83 Ferrous Pipe Plugs, Bushings, and Lock Nuts with Pipe Threads.
 - 11. ANSI B16.28-86 Wrought Steel Buttwelding Short Radius Elbows and Returns.
 - 12. ANSI B16.39-86 Malleable Iron Threaded Pipe Unions, Classes 150, 250, and 300.





B. American Society of Mechanical Engineers (ASME):

1. ASME Boiler and Pressure Vessel Code, Section II, Part C.

- 2. ASME Boiler and Pressure Vessel Code, Section IX.
- C. American Society for Testing and Materials (ASTM):
 - ASTM A47-84 Standard Specification for Malleable Iron Castings.
 - 2. ASTM A53-90 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless.
 - ASTM A74-87 Standard Specification for Cast Iron Soil Pipe and Fittings.
 - 4. ASTM A135-89 Standard Specification for Electric-Fusion (Arc) Welded Steel Pipe (NPS 4 and over).
 - 5. ASTM A183-83 Standard Specification for Carbon Steel Track Bolts and Nuts.
 - ASTM A234-90 Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - 7. ASTM A312-89 Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
 - 8. ASTM A333-88 Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service.
 - 9. ASTM A518-86 Standard Specification for Corrosion-Resistant High-Silicon Iron Castings.
 - 10. ASTM A536-84 Standard Specification for Ductile Iron Castings.
 - ASTM A671-89 Standard Specification for Electric Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures.
 - 12. ASTM A672-89 Standard Specification for Electric Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures.
 - ASTM A691-89 Standard Specification for Carbon and Alloy Steel Pipe, Electric Fusion-Welded for High-Pressure Service at High Temperatures.
 - 14. ASTM D1785-89 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - 15. ASTM D2000-90 Standard Classification System for Rubber Products in Automatic Applications.
 - 16. ASTM D2104-89 Standard Specification for Polyethylene (PE) Plastic Pipe, Schedule 40.
 - ASTM D2464-90 Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - ASTM D2466-90 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - ASTM D2467-90 Standard Specification for Socket Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - 20. ASTM D2564-88 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
 - 21. ASTM D2609-90 Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.



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- 22. ASTM D2665-89 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain. Waste, and Vent Pipe and Fittings.
- ASTM D3261-90 Standard Specification for Butt Heat Fusion 23. Polyethylene (PE) Plastic Fitzings for Polyethylene (PE) Pipe and Tubing.
- American Water Works Association (AWWA): D.
 - AWWA C110-87 Ductile-Iron and Gray-Iron Fittings, 3-in. 1. Through 48-in., for Water and Other Liquids.
 - AWWA C111-85 Rubber-Gasket Joints for Ductile-Iron and Gray-2. Iron Pressure Pipe and Fittings.
 - AWWA C200-86 Steel Water Pipe 6 in. and Larger. 3.
 - AWWA C203-86 Coal Tar Protective Coatings and Linings for 4. Steel Water Pipe Lines -- Enamel and Tape -- Hot Applied.
 - AWWA C206-88 Standard for Field Welding of Steel Water Pipe.
 - 5. AWWA C207-86 - Standard for Steel Pipe Flanges for Water Works 6. Services -- Sizes 4-in. Through 144-in.
 - AWWA C606-87 Grooved and Shouldered Type Joints. 7.
- Manufacturing Standardization Society of Valves and Fittings (MSS): Ε.
 - MSS SP-43-82 Wrought Stainless Steel Buttwelding Fittings. 1. Included Reference to Other Corrosion-Resistant Materials.
 - MSS SP-51-86 Class 150LW Corrosion-Resistant Cast Flanges and 2. Flanged Fittings.
 - MSS SP-79-89 Socket Welding Reducer Inserts. 3.
- 1.03 SUBMITTALS
 - Submit catalog cuts, specifications, installation Product Data: Α. instructions, and dimensioned drawings for each type of pipe, tube. Submit piping schedule fitting, and mechanical identification. showing manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.
 - Welding Certifications: Submit reports as required for piping work. Β.
 - Submit in accordance with Section 01340. С.
- OUALITY ASSURANCE 1.04
 - Manufacturers: Firms regularly engaged in manufacture of pipe, tube, Α. fittings, and mechanical identification of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 yrs.
 - Quality welding procedures, welders, and operators in Β. Welding: accordance with ANSI B31.1, Paragraph 127.5, for shop and Project site welding of piping work.

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1.05 DELIVERY, STORAGE, AND HANDLING



- Provide factory-applied basic end caps on each length of pipe. Main-Α. tain end caps through shipping, storage, and handling as required to prevent pipe end damage and eliminate dirt and moisture from inside of pipe and tube.
- Where possible, store pipe and tube inside and protected from Β. weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.
- Protect flanges and fittings from moisture and dirt by inside storage С. and enclosure, or by packaging with durable, waterproof wrapping.
- PART 2 PRODUCTS
- 2.01 PIPING MATERIALS
 - General: Provide pipe of type, joint type, grade, size and weight Α. (wall thickness or class) indicated for each service.
 - Β. Steel Pipe:
 - Black Steel Pipe: ASTM A53. 1.
 - Seamless Steel Pipe: ASTM A53. 2.
 - Electric Resistance-Welded Steel Pipe: ASTM A135. 3.
 - Electric Fusion-Welded Steel Pipe: ASTM A671. 4.
 - Alloy Steel Pipe: ASTM A333. 5.

Grade: Provide Grade 9, except as otherwise noted. а.

- 6. Steel Water Pipe: AWWA C200 for pipe 6 in. and larger.
- 7. Coal Tar Protective Coatings and Linings for Steel Water Pipe: AWWA C203 for enamel and tape, hot applied.
- Steel pipe shall be as follows. 8.
 - 3-in. and smaller: Schedule 80. а. 4-in. through 10-in.: Schedule 40. Ъ. 12-in. and greater: "Standard" class pipe. c.
- C. Plastic Pipe:
 - Poly Vinyl Chloride Pipe (PVC): ASTM D1785. Polyethylene Plastic Pipe (PE): ASTM D2104. 1.
 - 2.
 - Poly Vinyl Chloride Plastic Drain, Waste, and Vent Pipe (PVC): 3. ASTM D2665.
 - PVC Pipe and Fittings: Schedule 80. 4.
 - High Density Polyethylene (HDPE): Section 15064. 5.

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2.02 PIPE FITTINGS

- A. General: Provide factory-fabricated fittings of type. materials, grade, class, and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, value or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections and pipe manufacturer's recommendations where applicable.
- B. Fittings for Steel Pipe:
 - 1. Cast Iron Flanged Fittings: ANSI B16.1, including bolting.
 - 2. Cast Iron Threaded Fittings: ANSI B16.4.
 - Malleable Iron Threaded Fittings: ANSI B16.3, plain or galvanized as indicated.
 - Malleable Iron Threaded Unions: ANSI B16.39, selected by installer for proper piping fabrication and service requirements, including style, end connections, and metal-to-metal seats (iron, bronze or brass); plain or galvanized as indicated.
 Threaded Pipe Plugs: ANSI 16.14.
 - 6. Steel Flanges/Fittings: ANSI Bl6.5, including bolting and gasketing of following material group, end connection, and facing except as otherwise indicated.
 - a. Material group: Group 1.1.
 - b. End connections: Buttwelding.
 - c. Facings: Raised face.
 - Corrosion-Resistant Cast Flanges/Fittings: MSS SP-51, including bolting and gasketing.
 - Forged Steel Socket Welding and Threaded Fittings: ANSI B16.11, except MSS SP-79 for threaded reducer inserts rated to match schedule of connected pipe.
 - 9. Wrought Steel Buttwelding Fittings: ANSI B16.9, except ANSI B16.28 for short radius elbows and returns, rated to match connected pipe.
 - 10. Stainless Steel Buttwelding Fittings: MSS SP-43.
 - 11. Forged Branch Connection Fittings: Except as otherwise indicated, provide type as determined by installer to comply with installation requirements.
 - 12. Pipe Nipples: Fabricated from same pipe as used for connected pipe, except do not use less than Schedule 80 pipe where length remaining unthreaded is less than 1-1/2 in., where pipe size is less than 1-1/2 in., and do not thread nipples full length (no close nipples).
 - 13. Provide l'uninstalled "Spectacle" flange for each size steel pipe.
 - 14. Flanged connections are required at tanks, pumps, valves, and equipment, unless specifically noted otherwise.

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- C. Fittings for Plastic Pipe:
 - PVC/CPVC Pipe Fittings: ASTM D2464 for Schedule 80 threaded fittings; ASTM D2466 for Schedule 40 socket type; ASTM D2467 for Schedule 80 socket type; ASTM D2564 for solvent cement; and ASTM D2665 for drain, waste, and vent.
 - 2. PE Pipe Fittings: ASTM D2609 for insert fittings, ASTM D3261 for Schedules 40 and 80.
- 2.03 MISCELLANEOUS PIPING MATERIALS/PRODUCTS
 - A. Welded Materials: Except as otherwise indicated, provide welding materials as determined by installer to comply with installation requirements.
 - 1. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
 - B. Gaskets for Flanged Joints: Full faced for cast iron flanges, raised face for steel flanges unless otherwise indicated.
 - C. Piping Connectors for Dissimilar Nonpressure Pipe: Elastomeric annular ring insert or elastomeric flexible coupling secured at each end with stainless steel clamps, sized for exact fit to pipe ends. and subject to approval by plumbing code.
- 2.04 VIBRATION ISOLATION
 - A. Provide vibration isolation between tanks, pumps, and piping.
 - Type MFTFU or MFTNC with control cables, as manufactured by Mason Industries, Inc., or equal.
 - 2. Size equal to pipe size.
- 2.05 UNDERGROUND TYPE PLASTIC LINE MARKERS
 - A. General: Manufacturer's standard permanent, bright colored, continuous printed plastic tape, intended for direct burial service; not less than 6 in. wide by 4 mils thick. Provide tape with printing most accurately indicating type of service of buried pipe.
 - B. Provide multi-ply tape consisting of solid aluminum foil core between
 2 layers of plastic tape.
- PART 3 EXECUTION
- 3.01 INSTALLATION
 - A. General: Install pipe, tube, and fittings in accordance with recognized industry practices achieving permanently leakproof piping systems, capable of performing each indicated service without piping





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failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance and/or replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16 in. misalignment tolerance.

1. Comply with ANSI B31.1 - Code for Pressure Piping.

- B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and equipment. Hold piping close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building; limit clearance to 1/2 in, where furring is shown for enclosure to concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1.0 in, clearance outside insulation.
- C. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces.
- D. Piping System Joints: Provide joints of type indicated in each piping system.
 - 1. Thread pipe in accordance with ANSI B1.20.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside dia. Apply pipe joint compound or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint, and tighten joint to leave not more than 3 threads exposed.
 - 2. Weld pipe joints in accordance with ANSI B31.1.
 - 3. Weld pipe joints of steel water pipe in accordance with AWWA C206.
 - 4. Flanged Joints: Match flanges within piping system and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.
- E. Pipe greater than 3 in. dia shall be connected by flange to pumps, tanks, meters, valves, cleanouts, air relief, and equipment.
 - 1. At other locations, pipe greater than 3-in. dia shall be welded.
 - 2. Threaded connections may be used on pipe 3 in. dia and smaller.

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3.02 CLEANING, FLUSHING, INSPECTING

- A. General: Clean exterior surfaces of installed piping systems of superfluous materials and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.
 - Inspect pressure piping in accordance with procedures of ANSI B31.1.
- 3.03 PIPING TESTS
 - A. Test pressure piping in accordance with ANSI B31.1.
 - B. Repair piping systems sections which fail required piping test, by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics or other temporary repair methods.
 - C. Drain test water from piping systems after testing and repair work complete.
- 3.04 IDENTIFICATION
 - A. Pipe shall be color coded and marked in accordance with ANSI Al3.1-1981 "Scheme for Identification of Piping Systems," and as approved by OWNER.
 - 1. For insulated and jacketed pipe, insulation or jacket shall be so color coded and marked.
- 3.05 UNDERGROUND PIPING IDENTIFICATION
 - A. During backfilling/top soiling of each exterior underground piping system, install continuous underground type plastic line marker located directly over buried line at 6 to 8 in. below finished grade.
 - 1. Plastic line marker tape as manufactured by Polycon.

* * * END OF SECTION * * *

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SECTION 15064 HIGH DENSITY POLYETHYLENE PIPE

PART 1 GENERAL

1.01 REFERENCES

- A. American Society for Testing and Materials (ASTM Latest Version):
 - 1. ASTM D6038 Standard Test Method for Tensile Properties of Plastics.
 - 2. ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - 3. ASTM D1248 Standard Test Method for Flow Rates for Thermoplastics by Extrusion Plastometer.
 - 4. ASTM D1248 Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
 - 5. ASTM D1505 or ASTM D792 Standard Test Method for Density of Plastics by the Density-Gradient Technique.
 - 6. ASTM D1693 Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
 - 7. ASTM D2837 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
 - 8. ASTM D3350 Specification for Polyethylene Plastic Pipe and Fittings Materials.
 - 9. ASTM D2412 Standard Test Method for Determining External Loading Characteristics by Parallel Plate Loading (See Module 1 testing).
 - 10. ASTM D2122 or D374C Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings.
 - 11. ASTM F1055 Standard for Electrofusion Polyethylene Type Fittings for O.D. Controlled Polyethylene Pipe and Tubing.

1.02 SUBMITTALS

- A. Include results of tests with shipment of materials, with 2 additional copies of such test results furnished to OWNER. Cost of tests shall be borne by CONTRACTOR.
- B. If manufacturer's test data inadequate or unavailable, OWNER reserves right to require cores drilled for compressive strength tests. Costs of these tests shall be borne by CONTRACTOR.
- C. Submit manufacturing data listing stock density, melt flow, flextural modules, tensile strength, and coloration.
- D. Submit in accordance with Section 01340.

1.03. QUALITY ASSURANCE

- A. Source Quality Control:
 - 1. Conduct tests by OWNER approved testing agency to determine by following:



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- a. Pipe dimensions:
- 1) Average outside diameter.
- 2) Average inside diameter.
- 3) Minimum and average wall thickness.

b. Pipe flattening:

1) Deflect pipe to 40% deflection.

2) Remove load and examine specimen for evaluation of splitting, cracking or breaking.

- 2. Test reports shall show results of test tests and conformance to ASTM requirements.
- 3. CQA engineer must confirm that all manufacturer's piping certifications have provided testing to confirm that the required design parameters are met. ASTM D2412 Parallel Plate Loading Testing will be performed during the Leachate Compatibility testing of the pipe as outlined in Module 1 of this Permit from which the CQA engineer will confirm that the required design parameters are met. For the centerline SDR 13.5 HDPE pipe in Cells 7/8, a ring deflection maximum value of 3.4 percent will be used as an allowable limit.
- 4. CQA engineer will randomly verify the pipe characteristics by measurement of the piping wall thickness and perforation hole diameter and spacing.

PART 2 PRODUCTS

- 2.01 PHYSICAL PROPERTIES OF PIPE COMPOUND
 - A. Density: ASTM D1505, not less than 0.941 to 0.955 gms/cu cm.
 - B. Melt Flow: ASTM D1238, Condition E, not greater than 0.4 gms/10 min.
 - C. Flexural Modules: ASTM D790, 110,000 to less than 160,000 psi.
 - D. Tensile Strength at Yield: ASTM D638, 3,000 to less than 3,500 psi.
 - E. Environmental Stress Crack Resistance (ESCR): ASTM D1693 Condition C, shall be in excess of 1,000 hrs (5,000 hrs) with zero failures.
 - F. Hydrostatic Design Basis: ASTM D2837, 1,600 psi at 23°C.
 - G. 8 inch SDR 13.5 HDPE pipe will be the only HDPE pipe used for Cell 7 and 8 leachate collection systems.
 - H. For Drainage Tile and piping used above and outside of the Final Cover Liner System, pipe compound physical properties shall conform to that of 'HANCOR HEAVY DUTY PIPE' as manufactured by Hancor, INC. Or an approved equal.

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- 2.02 PIPE
 - A. Manufacturers:
 - 1. Philips Driscopipe, Inc., Dallas, Texas
 - 2. For Drainage Tile and piping used above and outside of the Final Cover Liner System, Hancor, Inc.
 - 3. Or approved equal.
 - B. High performance, high molecular weight, high density polyethylene pipe.
 - C. ASTM D1248 (Type III, Class C, Category 5, P34).
 - D. ASTM D3350, minimum cell classification value 354434C.
 - E. Marking: Intervals of 5 ft. or less.
 - 1. Manufacturer's name or trademark.
 - 2. Nominal pipe size.
 - 3. HDPE cell classification, ASTM D3350.
 - Legend: 1000 Industrial pipe SDR 11, or SDR 13.5 4.
 - 5. **ASTM D1248**
 - 6. Extrusion date, period of manufacture or lot number.
 - F. For Drainage Tile and piping used above and outside of the Final Cover Liner System, ASTM values shall conform to that of 'HANCOR HEAVY DUTY PIPE' as manufactured by Hancor, Inc. or an approved equal.



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G. Dimensions:

	Din	nensions (in.)		
Nominal <u>Size</u>	Nominal <u>OD</u>	Approx. <u>ID</u>	Minimum <u>Wall</u>	Nominal Weight Ibs/100 ft
4-in.	4.500	3,682	0.409	224
6-in.	6.625	5.421	0.602	485
8-in.	8.625	7.057	0.784	823
10-in.	10.750	8.796	0.977	1,2 78
12-in.	12.750	10.432	1.159	1,798
24-in.	24.000	19.636	2.182	6,372
	SE Dim	DR 13.5 ensions (in.)		
Nominal <u>Size</u>	Nominal <u>OD</u>	Approx. <u>ID</u>	Minimum <u>Wall</u>	Nominal Weight Ibs/100 ft
4-in.	4.500	3.834	0.333	185
6-in.	6.625	5.643	0.491	403
8-in.	8.625	7.347	0.639	682
10-in.	10.750	9.158	0.796	1,059
12-in.	12.750	10.862	0.944	1,489
24-in.	24.000	20.444	1.778	5,281

HDPE PIPE DIMENSIONS SDR 11

2.03 FITTINGS

- A. Molded from polyethylene compound having cell classification equal to or exceeding compound used in pipe to ensure compatibility of polyethylene resins.
- B. Be of same manufacture as pipe being provided unless the fitting is an electrofusion coupling.
- C. Flange Joints:
 - 1. 150-lb stainless steel or epoxy coated carbon steel manufacturer-installed backup flanges as recommended by manufacturer.
 - 2. Stainless steel bolts.
 - 3. Flanges and bolt patterns as specified by manufacturer.
 - 4. Surface weld joints to seal edges.
 - 5. Seal riser joints within 80 mil HDPE boot welded and clamped to riser.
 - 6. Stainless steel boot clamps

D. Markings:

- 1. Manufacturer's name of trademark.
- 2. Nominal size.
- 3. Material designation "HDPE".
- 4. ASTM D1248 (unless the fitting is an electrofusion coupling).

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2.04 LINER PENETRATION BOOTS

- Minimum in accordance with dimensions indicated on Drawings. Α.
- **B**. Construction from 80 mil HDPE flexible membrane, with manufacturer's recommendations. Clamp each boot to riser with stainless steel boot clamps, which will remain in-place after boot is welded to riser. Exposed edges of boot shall be filet welded to prevent moisture from penetrating between HDPE surfaces.

2.05 HIGH DENSITY POLYETHYLENE (HDPE) FLATSTOCK

- Α. Manufacturers:
 - 1. Philip Driscopipe, Inc.
 - 2. Or equal.
- B. High performance, high molecular weight, sheet stock.
- С. Provide to sizes and thickness indicated on Drawings.
- Conform to resin quality of pipe stock and liner stock. D.
- E. Round cut edges to minimize potential for liner damage during installation.
- PART 3 **EXECUTION**
- 3.01 INSTALLATION
 - Trench, backfill, and compact in accordance with Section 02221. A.
 - Β. Welded Joints:
 - 1. Weld in accordance with manufacturer's recommendation for butt fusion or electrofusion methods.
 - 2. Butt fusion or electrofusion equipment used in joining procedures shall be capable of meeting conditions recommended by pipe manufacturer, including, but not limited to, temperature requirements, alignment, and fusion pressures.
 - Extrusion welding may be allowed as a secondary method for joining 3. containment piping where butt fusion welding is not practical, but only where approved by DESIGNER and OWNER in writing.
 - Mechanical Jointing: C.
 - 1. Use on riser pipe sections.
 - Welding of HDPE pipe of the same diameter with different SDR thickness 2. shall be in accordance with the manufacturer's recommendations.
 - 3. Butt fuse fabricated flange adapters to pipe.
 - Connect slip-on stainless steel or epoxy coated carbon steel backup flanges 4. with stainless steel bolts.
 - Weld HDPE adapters to provide watertight fit. Fit mechanical jointing on 5. risers with protective HDPE boots clamped and bolted to riser.



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- 6. Clamp boot to riser with boot clamps to remain in-place after boot is welded to riser.
- 7. Filet weld exposed edges of boot to prevent moisture from penetrating between HDPE surfaces.

3.02 FIELD QUALITY CONTROL

- A. Pipe may be rejected for failure to conform to Specifications, or following.
 - 1. Fractures or cracks passing through pipe wall, except single crack not exceeding 2 in. in length at either end of pipe which could be cut off and discarded. Pipes within one shipment will be rejected if defects exist in more than 5% of shipment of delivery.
 - 2. Cracks sufficient to impair strength, durability or service-ability of pipe.
 - 3. Defects indicating improper proportioning, mixing, and molding.
 - 4. Damaged ends, where such damage prevents making satisfactory joint.
- B. Acceptance of fittings, stubs or other specially fabricated pipe sections shall be based on visual inspection at job site and documentation they conform to these Specifications.
- C. The leachate collection pipes along the centerline of the primary and secondary leachate collection systems, shall be placed directly on the geocomposite drainage layer. There shall be no requirement for tolerance regarding achievement of design grade and shimming is not required.
- 3.03 PRESSURE TESTING
 - A. Test in accordance with Section 01669.
 - B. Pressure testing is not required for the perforated leachate collection pipe and solid pipe extending from the perforated pipe as a riser pipe.
- 3.04 VERTICAL LEACHATE RISERS
 - A. Install first section of vertical HDPE risers. Concrete riser section length shall extend vertically no more than 2 ft below HDPE section. HDPE riser section shall be flanged to allow later extension during normal operations.

* * * END OF SECTION * * *

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SECTION 15072 WELDED STEEL PIPE

PART 1 GENERAL

1.01 REFERENCES

- A. American National Standards Institute (ANSI):
 - ANSI B1.1-89 Unified Inch Screw Threads (UN and UNR Thread Form).
 - 2. ANSI 331.1-89 Power Piping.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A36-89 Standard Specification for Structural Steel.
 - ASTM A139-89 Standard Specification for Electric-Fusion (Arc) Welded Steel Pipe (NPS 4 and Over).
 - ASTM A307-90 Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - 4. ASTM A325-90 Standard Specification for High-Strength Bolts for Structural Steel Joints (Metric).
 - C. American Water Works Association (AWWA):
 - AWWA C208-83 Dimensions for Fabricated Steel Water Pipe Fittings.
 - AWWA C207-86 Standard for Steel Pipe Flanges for Water Works Service, Sizes 4-in. Through 144-in.
 - AWWA C203-86 Coal-Tar Protective Coatings and Linings for Steel Water Pipe Lines -- Enamel and Tape -- Hot Applied.
 - 4. AWWA C206-88 Standard for Field Welding of Steel Water Pipe.
 - 5. AWWA C602-89 Cement-Mortar Lining of Water Pipe Lines -- 4-in. (100 mm) and Larger -- in-Place.
 - 6. AWWA C606-87 Grooved and Shouldered Type Joints.
 - 7. AWWA Mll-85 Steel Pipe -- A Guide for Design and Installation.

D. Fluid Sealing Association.

1.02 SUBMITTALS

- A. Welding Certificates:
 - 1. Submit reports as required for welding certifications.
- B. Submit in accordance with Section 01340.

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1.03 QUALITY ASSURANCE

- A. Welder's Qualifications:
 - Qualify and certify welding procedures, welders, and operators in accordance with ANSI B31.1, Paragraph 127.5, for snop and Project site welding of piping work.
- 1.04 PROJECT/SITE CONDITIONS
 - A. Coordinate dimensions and drillings of flanges furnished with flanges for valves, pumps, and other equipment to be installed in piping.
- PART 2 PRODUCTS
- 2.01 MATERIALS
 - A. Steel pipe shall be as follows.
 - 1. 3-in. and Smaller: Schedule 80.
 - 2. 4-in. Through 10-in.: Schedule 40.
 - 3. 12-in. and Greater: "Standard" class pipe.
- 2.02 FABRICATION
 - A. Pipe:
 - Fabricate to sizes, dimensions, and shapes indicated on Drawings.
 - Pipe size shall be nominal inside dia of pipe, fitting or special in in. where 12 in. and smaller in size and actual outside dia where 14 in. and larger in size.

3. Pipe size shall be nominal dia for push-on joint pipe.

- 4. Seams:
 - a. Except for seamless mill type pipe, make piping from steel plates rolled into cylinders or sections thereof with longitudinal seams butt welded or spirally formed and buttwelded.
 - b. There shall be not more than 2 longitudinal seams in piping 72 in. and smaller in size.
 - c. Buttweld girth seams at least 6 ft apart, except in specials and fittings.

B. Fittings:

- 1. Fabricate in accordance with AWWA C208.
- Elbows fabricated with radius of 1-1/2 times nominal dia and 2-piece for 0 to 22-1/2 degrees, 3-piece from 23 to 45, 4-piece from 46 to 67-1/2 degrees, and 5-piece from 68 to 90 degrees.

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- Reinforce tees, laterals, and outlets in accordance with ASME Pressure Vessel Code, Section VIII, Paragraph G-37 or AWWA Mil, Sections 19.4 and 19.5.
- 4. Shell thicknesses of reducing sections shall be same as required thicknesses for larger ends.
- Special Sections: Provide fittings and specials with ends as required and fabricate to shapes, sizes, and dimensions shown on Drawings.
- 6. Small Branch Connections:
 - a. Make branch connections 2-1/2 in., and smaller with welding fittings with threaded outlets.
 - b. Make branch connections 3 in. through 12 in. in size with pipe nipples or welding fittings.
 - c. Weld pipe nipples and welding fittings to pipe shell and reinforced as required to meet design and test requirements.
 - d. Pipe nipples shall be seamless black steel pipe and standard weight Schedule 40.
 - e. Threaded and welded outlets snall be Porter "W-Steelets," Vogt "Weld Couplets" or equal.
 - Locate small branch connections so as not to interfere with joints, supports or other details.
- C. Flanges:
 - Fit flanged end pipe with slip-on flanges and have longitudinal or spiral welds ground flush to accommodate type of flanges provided.
 - a. Bolts and bolt studs shall be in accordance with ASTM A307 and ANSI Bl.l with hexagonal or square heads, coarse thread fit, threaded full length with ends chamfered or rounded.
 - b. Project ends 0 to 1/4 in. beyond surface of nuts.
 - c. Use coarse threads in accordance with ANSI Bl.1.
 - 2. Flanges shall be in accordance with AWWA C207, Class B or D, using Tables I or II, depending on pressures.
 - 3. Face and finish flanges flat to plane surface.
 - 4. After attachment to pipe, maximum layback from inside edge of flange to outside edge of flange shall not exceed 1-1/2 degrees.
 - 5. Attach flanges normal to axis of pipe so alignment is satisfactory.
 - 6. Test flanges, after welding to pipe, for true plane and reface if necessary to bring within specified tolerances.
 - 7. Blind Flanges: Conform in dia, drilling, and thickness to flanges to which they attach and reinforce as required to produce watertight joint under specified test pressures.
 - 8. Provide 1 uninstalled "Spectacle" flange for each pipe size.
 - 9. Flanged connections required at tanks, pumps, valves, and equipment, unless specifically noted otherwise.

- D. Protective Coatings:
 - 1. Interior surfaces of steel pipe, fittings, and specials shall be unlined.
- E. Gaskets:
 - 1. Provide ring type flange gaskets made from 1/8 in. thick.
- 2.03 FLANGED COUPLING ADAPTERS
 - A. Manufacturers:
 - 1. Rockwell.
 - 2. Dresser "Style 128."
 - 3. Or equal.
 - B. Restrain flanged coupling adapters.
 - C. Provide tie rods of sufficient number and strength to restrain coupling at test pressure as listed in pipe schedule and piping detail plan.
 - D. Use minimum of two 5/8 in. dia tie rods at connections.
 - E. Spool pieces acceptable alternatives to flanged coupling adapters, except at magnetic flow meters.
- 2.04 EXPANSION JOINTS
 - A. Manufacturers:
 - 1. Sliding Expansion Joints:
 - a. Dresser "Style 63."
 - b. Smith-Blair.
 - c. Or equal.
 - 2. Flexible Connectors and Expansion Joints:
 - a. Garlock.
 - b. General Rubber.
 - c. Goodall.
 - d. Mercer.
 - e. Unaflex.
 - f. Mason.
 - g. Or equal.
 - B. Materials:
 - Joints shall allow minimum of 0.4375 in. pipe expansion (joint compression), 0.250 in. pipe compression (joint expansion). Design in accordance with Fluid Sealing Association, Series B.

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- 2. Provide single arch joints at equipment for isolation design in accordance with Fluid Sealing Association, Series B.
- 3. Construct flexible connectors with filled arch to eliminate sedimentation of solids in arched area.
- 4. Provide tie rods at flexible connectors and expansion joints of sufficient number and strength to restrain connection at test pressure as listed in pipe schedule. Use minimum of two 5/8 in. dia tie rods at connections.
- 5. Support flexible connectors and expansion joints adequately. Locate vertical supports within three pipe dia of connection and provide on each side of connection.

2.05 PROTECTIVE COATINGS

- A. Steel pipe, fittings, specials, and wall fittings shall be prepared, primed, coated, painted or wrapped as hereinafter specified.
 - B. Exterior Surfaces in Interior Locations:
 - Thoroughly clean by sandblasting and prime coat exterior surfaces, except machined surfaces, of pipe, fittings, specials, flanges, anchors, pipe supports, and blocking exposed in interior or exterior locations as specified and applied in shop.
 Field paint as specified.
 - C. Machined Surfaces:
 - 1. Shop coat machined surfaces with rust-preventive compound Dearborn Chemical "No-Ox-Id 2W," Houghton "Rust Veto 344," Rust-Oleum "R-9" or equal.
 - D. Coal Tar Coating:
 - 1. Coat and wrap exterior surfaces in underground locations in accordance with AWWA C203 and cathodically protected as approved by OWNER.
- 2.06 VIBRATION ISOLATION
 - A. Provide vibration isolation between tanks, pumps, and piping.
 - Type MFTFU or MFTNC with control cables, as manufactured by Mason Industries, Inc., or equal.
 - 2. Size equal to pipe.
- PART 3 EXECUTION
- 3.01 INSTALLATION
 - A. Install in accordance with approved submittals.

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- B. Pipe greater than 3 in. dia shall be connected by flange to pumps, tanks, meters, valves, cleanouts, air relief, and equipment.
 - 1. At other locations, pipe greater than 3 in. dia shall be welded.
- 3.02 WELDED JOINTS
 - A. Welds shall be sound and free from embedded scale of slag, have tensile strength across weld not less than that of thinner of connected sections, and be watertight.
 - B. Use buttwelds for welded joints in line pipe assemblies and fabrication of bends and other specials.
 - C. Use filled welds for flange attachment in accordance with AWWA C207.
 - D. Conform field welding of joints and preparation of pipe ends to AWWA C206 and ASTM Al39.
 - 1. Yield point determination of field welded joint shall be made by independent testing laboratory at beginning of Work. Costs for laboratory testing shall be paid for by CONTRACTOR.
 - Furnish specimens for weld tests to DESIGNER for testing by independent testing laboratory when, in judgement of DESIGNER, unsatisfactory weld is being made.
 - 3. Use of back-up welding strips or rings for welds not permitted.
- 3.03 CLEANING AND COATING
 - A. After installation of pipe, fittings, and specials, unlined or uncoated ends adjacent to field welded joints, including weld proper, shall be cleaned, primed, lined, and coated as specified for pipe adjacent to weld.
 - B. Preparation of surfaces to be lined and coated shall be as stipulated for shop application of coal tar primers and enamels, except foreign matter, including damaged lining or coating materials, shall be removed by scraping, chipping or brushing, and surfaces cleaned to bright metal free of rust, slag, and scale by means of wire brushing or sandblasting.
 - C. Entry for application of interior linings to unlined ends shall be from open ends or through access manholes.
 - D. Pour holes not provided.
- 3.04 FLANGED COUPLING ADAPTERS
 - A. Install flange coupling adapters in strict accordance with coupling manufacturer's written recommendations.

* * * END OF SECTION * * *

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SECTION 15076 HOSE AND QUICK-CONNECT COUPLINGS

- PART 1 GENERAL
- 1.01 REFERENCES
 - A. Military Specifications (MIL):
 - MIL-C-27487E Coupling Halves, Quick Disconnect, Cam Locking Type.
- 1.02 SUBMITTALS
 - A. Submit manufacturer's literature and shop drawings in accordance with Section 01340.
- PART 2 PRODUCTS
- 2.01 QUICE-CONNECT COUPLINGS
 - A. Manufacturers:
 - "Kamlok" quick couplings by OPW, Division of Dover Corporation.
 Or equal.
 - B. Description:
 - Each coupling shall consist of 2 pieces; male part (adaptor), and female part (coupler). Connection of 2 parts shall be made by inserting male into female and then moving 2 cam arms into locked position.
 - C. Couplings shall conform to MIL-C-27487E.
 - D. Pressure Rating: 150 psig (hydrostatic).
 - E. Materials:

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- 1. Body: Stainless steel.
- 2. Cam Arms: Stainless steel.
- 3. Gaskets: Teflon.
- F. Couplers and adapters shall be mounted on hoses using hose shank or pipe nipple, and stainless steel, spiral, double bolt amps.
- G. Adaptors shall be mounted on fixed pipes using female NT fitting.

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- 2.02 HOSE
 - A. Manufacturers:
 - Tigerflex Series "W" by Kuriyama of America, Inc.; Elk Grove Village, IL 60007.
 - 2. Spiraflex 1400, by Goodyear Tire and Rubber Company, Industrial Products Division; Akron, OH 44316.
 - 3. Or equal.
 - B. Description:
 - 1. Nominal Size: 2 in. or 3 in.
 - 2. Smooth inner bore.
 - 3. Convoluted cover.
 - 4. Transparent body.
 - 5. Flexible to min. 15°F.
 - 6. Capable of 90 degrees bends without kinking.
 - 7. Abrasion resistant.
 - 8. Crush resistant.
 - 9. Working Pressure: Minimum 40 psi.
 - 10. Provide continuous, uncut lengths.
 - a. Couple only where shown on Drawings, or as specified by DESIGNER.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's written instructions and approved submittals.

* * * END OF SECTION * * *



SECTION 15078 POLYVINYL CHLORIDE (PVC) PIPE

PART I GENERAL

1.01 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM D638-89 Standard Test Method for Tensile Properties of Plastics.
 - 2. ASTM D790-86 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - 3. ASTM D1789-90 Standard Specifications for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 4. ASTM D1785-91 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - 5. ASTM D2464-91 Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - 6. ASTM D2467-90 Standard Specification for Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - ASTM D2564-91 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
 - 8. ASTM D1505-85 Standard Test Method for Density of Plastics by the Density-Gradient Technique.
 - 9. ASTM D2837-90 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
 - 10. ASTM D2412-93 Standard Test Method for Determining External Loading Characteristics by Parallel Plate Loading (See Module 1 testing).
 - 11. ASTM D2122-90 or D374C-90 Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.

1.02 SUBMITTALS

- A. Include results of tests with shipment of materials, with 2 additional copies of such test results furnished of OWNER. Cost for test shall be borne by CONTRACTOR.
- B. If manufacturer's test data inadequate or unavailable, OWNER reserves right to require cores drilled for compressive strength tests. Costs of these tests shall be borne by CONTRACTOR.
- C. Submit manufacturing data listing stock density, flexural modules, and tensile strength.
- D. Submit in accordance with Section 10340.
- 1.03 QUALITY ASSURANCE
 - A. Source Quality Control:
 - 1. Conduct tests by OWNER approved testing agency to determine by following.
 - a. Pipe dimensions:
 - 1) Average outside diameter.
 - 2) Average inside diameter.
 - 3) Minimum and average wall thickness.
 - 2. Test reports shall show results of the tests and conformance to ASTM requirements.

- 3. CQA engineer must confirm that all manufacturer's piping certifications have provided testing to confirm that the required design parameters are met. ASTM D2412 Parallel Plate Loading Testing will be performed during the Leachate Compatibility testing of the pipe as outlined in Module 1 of this Permit from which the CQA engineer will confirm that the required design parameters are met. For the centerline Schedule 80 PVC pipe in Cells 9/10, 11/13 and 12/14, a ring deflection maximum value of 7.5 percent will be used as an allowable limit.
- 4. CQA engineer will randomly verify the pipe characteristics by measurement of the piping wall thickness and perforation hole diameter and spacing.

PART 2 PRODUCTS

- 2.01 PHYSICAL PROPERTIES OF PIPE COMPOUND
- A. The PVC pipe and fittings shall be manufactured from Type 1, Grade 1, PVC conforming to ASTM D1784 and 1785.
- B. 8 inch Schedule 80 PVC pipe will be the only PVC pipe used for Cells 9/10, 11/13 and 12/14 leachate collection systems.
- 2.02 PVC PIPES AND FITTINGS
 - A. PVC pipe shall be supplied in standard laying lengths not exceeding 40 feet.
 - B. PVC pipe shall be furnished perforated as specified on the Drawings. If pipes are manufactured unperforated and are to be installed perforated, then perforations shall be drilled into the pipe prior to delivery to the site.
- C. PVC pipes and fittings shall be homogeneous throughout the free and visible cracks, holes (other than international manufactured perforation), foreign inclusions, or other deleterious effects, and shall be uniform in color, density, melt index and other physical properties.
- D. Fittings at the end of pipes shall consist of PVC end caps unless indicated otherwise on the Drawings.
- E. The following shall be continuously indent printed on the pipe, or spaced at intervals not exceeding 5 feet:
 - 1. Name and/or trademark of the pipe manufacturer.
 - 2. Nominal pipe size.
 - 3. Schedule.
 - 4. Manufacturing Standard Reference (e.g., ASTM D1785).
 - 5. A production code from which the date and place of manufacture can be determined.
- F. Dimensions

PVC PIPE SCHEDULE 40/80

NOMINAL SIZE	OUTSIDE DIAMETER	SCHEDULE 40 Wall Thickness	SCHEDULE 80 Wall Thickness
4	4.500	0.237	0.337
6	6.625	0.280	0.432
8	8.625	0.322	0.500
10	10.750	0.365	0.593
12	12.750	0.406	0.687

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NOMINAL SIZE	OUTSIDE DIAMETER	SCHEDULE 40 WALL THICKNESS	SCHEDULE 80 WALL THICKNESS
14	14.000	0.438	
16	16.000	0.500	

G. Fittings.

- 1. Schedule 80 PVC.
- a. ASTM D2464 for threaded joint type.
- b. ASTM D2467 for socket joint type.
- H. Joints.
 - 1. Provide socket type at all locations except unions, valves, and equipment with threaded for flanged end connections.
 - 2. Threaded connections are not acceptable for nominal piping size greater than 2 in.
 - 3. Do not provide threaded joints for piping systems identified on Drawings or in other Sections to be provided without threaded joints.

I. Flanges.

- 1. PVC, 1-piece socket type, flat faced.
- J. Solvent Cement.
 - 1. Joint socket connections with PVC solvent cement conforming to ASTM D2564.
 - 2. As recommended by pipe and fitting manufacturer to assure compatibility.

K. Lag Screw

1. As an alternate to using PVC solvent cement for joining perforated and solid piping and fittings socket connections in the leachate collection system, join socket connections using two (2) 1/4" X 1" stainless steel lag screws per socket joint. Lag screws are to be installed approximately at a 10:00 and 2:00 orientation (i.e., approximately 120 degrees apart).

PART 3 EXECUTION

3.01 HANDLING AND PLACEMENT

- A. Care shall be exercised when transporting, handling and placing PVC pipe and fittings, such that they will not be cut, kinked, twisted, or otherwise damaged.
- B. Ropes, fabric or rubber-protected slings and straps shall be used as necessary when handling PVC pipe. Slings, straps, etc. shall not be positioned at joints. Chains, cables or hooks shall not be inserted in the pipe ends as a means of handling pipe.
- C. Pipe or fittings shall not be dropped onto rocky or unprepared ground. Under no circumstances shall pipe or fittings be dropped into trenches.

- D. PVC pipe shall be stored on clean level ground, free of sharp objects which could damage the pipe. Stacking shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. The pipes should be stored out of direct sunlight.
- E. The maximum allowable depth of cuts, gouges or scratches on the exterior surface of PVC pipe or fittings is 10 percent of the wall thickness. The interior of the pipe and fittings shall be free of cuts, gouges and scratches. Sections of pipe with excessive cuts, gouges or scratches shall be removed and the ends of the pipe joined at no cost to the OWNER.
- F. Whenever pipe laying is not activity in progress, the open end of pipe that has been placed shall be closed using a watertight plug.

3.02 INSTALLATION

- A. All PVC pipe and fittings shall be install in accordance with the manufacturer's instructions. All socket connections to be joined with lag screws shall be predrilled prior to lag screw installation.
- B. The Contractor shall carefully examine all pipe and fittings for cracks, damage or defects before installation. Defective materials shall be immediately removed from the site and replaced at no cost to the OWNER.
- C. The interior of all pipe and fittings shall be inspected, and any foreign materials shall be completely removed from the pipe interior before it is moved into final position.
- D. Field-cutting of pipes, where required, shall be made with machine specifically designed for cutting pipe. Cuts shall be carefully made, without damage to pipe or lining, so as to leave a smooth end at right angles to the axis of pipe. Cut ends shall be tapered and sharp edges filed off smooth. Flame cutting will not be allowed.
- E. For the secondary leachate collection pipes of Cells 7/8, 9/10, 11/13, and 12/14 and the primary leachate collection pipes of Cells 7/8, 9/10, and 12/14 along the centerline of the leachate collection systems, a zero tolerance shall be maintained. Piping shall be set to the nearest hundredth of a foot. Liner systems geosynthetics (e.g., geomembrane, geonet) are to be used as "shims" under the leachate collection piping to achieve design grades. The primary leachate collection pipe along the centerline of the Cell 11/13 primary leachate collection system shall be placed directly on the geocomposite drainage layer. There shall be no requirement for tolerance regarding achievement of design grades for the Cell 11/13 primary leachate collection pipe and shimming is not necessary.

3.03 PRESSURE TESTING

- A. Testing in accordance with Section 01669.
- B. Pressure testing is not required for the perforated leachate collection pipe and solid pipe extending from the perforated pipe as a riser pipe.

* * * * END OF SECTION * * *

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SECTION 15090 PIPE HANGERS, SUPPORTS, AND ANCHORS

- GENERAL PART 1
- SUMMARY 1.01
 - Description of Work: Α.
 - Furnish complete system of pipe supports and anchors with necessary inserts, bolts, nuts, restraining and hanger rods, 1. washers, miscellaneous steel, and other accessories. Absence of pipe supports and details on Drawings shall not relieve CONTRACTOR of responsibility for providing them.
 - 2.
- REFERENCES 1.02

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- American National Standards Institute (ANSI):
 - ANSI B31.1-89 Power Piping. 1.
 - American Society for Testing and Materials (ASTM):

 - ASTM A36-89 Standard Specification for Structural Steel. ASTM A307-90 - Standard Specification for Carbon Steel Bolts and 1.
 - Studs, 60,000 psi Tensile Strength. 2.

Manufacturer's Standardization Society (MSS):

- MSS SP-58-88 Pipe Hangers and Supports -- Materials, Design,
 - MSS SP-69-83 Pipe Hangers and Supports -- Selection and 1. 2.
- Application.
- National Fire Code (NFPA): D.

NFPA No. 13 - Installation of Sprinkler Systems.

SUBMITTALS 1.03

1.

- Shop Drawings: Α.
 - Pipe supporting system, including manufacturer's product data, dimensions, sizes, types, location, maximum loadings, thrust 1. anchorage, and installation instructions.
 - Submit in accordance with Section 01340.

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1.04 QUALITY ASSURANCE

- A. Source Quality Control:
 - 1. Firms regularly engaged in manufacture of pipe supports, hangers, anchors, and related products.
 - 2. Provide factory fabricated piping hangers and supports, clamps, hanger rod attachments, building attachments, saddles, shields, thrust anchorage, and other miscellaneous products of MSS SP-69 type indicated or shop-fabricated supports; comply with MSS SP-58 and manufacturer's published product information.
- B. Design Criteria:
 - 1. Pipe support system components shall withstand dead loads imposed by weight of pipes filled with water plus insulation, internal test pressures, and have minimum safety factor of 5.
- 1.05 PROJECT/SITE CONDITIONS
 - A. Support piping, in general, as described hereinafter. MSS types indicated are typical of types and quality of standard pipe supports and hangers to be employed.
- PART 2 PRODUCTS
- 2.01 MANUFACTURERS
 - A. Fee and Mason.
 - B. Grinnell.
 - C. Carpenter-Patterson.
 - D. Unistrut.
 - E. Superstrut.
 - F. Or equal.
- 2.02 HORIZONTAL PIPING HANGERS AND SUPPORTS
 - A. Hangers:
 - Unless otherwise shown or specified, hangers for 3-in. and smaller pipe shall be stainless steel U-bolts. Hangers for 3-in. pipe or greater shall be clevis or roller type.
 - 2. Each hanger shall be designed to permit minimum 1-1/2-in. adjustment after installation.

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MSS Type 41. including axle roller and threaded sockets. Single Roll Support: В. 1. Miscellaneous Materials: Steel Plates, Shapes and Bars: ASTM A36 steel. С. 1. EXECUTION Proceed with installation of hangers, supports, and anchors after ART 3 GENERAL 3.01 Install hangers, supports, clamps, and attachments from manhole required manholes complete. structure; comply with MSS SP-69. Group parallel runs of horizontal Α. piping to be supported together on trapeze type hangers where Β. Install supports to provide indicated pipe slopes and maximum pipe possible. deflections allowed by ANSI B31.1 are not exceeded. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for С. Install supports to allow controlled movement of piping systems, D. permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and Ε. Piping shall be free to move when pipe expands or contracts, except where fixed anchors are indicated. Where adequate hanger rod swing similar units. length cannot be provided or where pipe movement based on expansion of 1 in./100 ft for each 100'F change in temperature exceed 1/2 in., F. Prevent contact between dissimilar metals. Where concrete or metal provide approved roller supports. pipe support used, place 1/8 in. thick teflon, asbestos, neoprene rubber or plastic strip under piping at point of bearing. Cut to fit entire area of contact between pipe and support. G. Apply anti-seize compound to nuts and bolts. Do not use pipe supports inside steel tank in leachate pump station. This is to preserve integrity of epoxy coating. Η. Support piping in junction manholes and leachate transfer manholes. Ι. J. CWMPRMUR-17365

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3.02 THRUST ANCHORS AND GUIDES

A. Thrust Anchors:

- For suspended piping, center thrust anchors as closely as possible between expansion joints and between elbows and expansion joints. Anchors shall hold pipe securely and be sufficiently rigid to force expansion and contraction movement to take place at expansion joints or elbows and preclude separation of joints.
- 2. Provide thrust anchors as required to resist thrust due to changes in dia or direction or dead ending of pipe lines. Anchorage shall be required wherever bending stresses exceed allowable for pipe. Wall pipes may be used as thrust anchors.
- B. Pipe guides shall be provided adjacent to sliding expansion joints in accordance with recommendations of National Association of Expansion Joint Manufacturers.
- 3.03 PIPE SUPPORT
 - A. Spacing:

Type of Pipe	Diameter (in.)	Maximum Pipe Support Spacing (ft)
Steel or HDPE (in vaults	2	2.5
Steel or HDPE (in lift station) 4	2 10	5
Steel	6	15
HDPE	6	Spaced as noted below

- 1. Support HDPE pipe on both sides of reducing tee in leachate transfer vaults.
- 2. In junction manholes, provide 3 pipe supports.
- B. Where piping of various sizes is to be supported together, space supports for smallest pipe size or install intermediate supports for smaller'dia pipe.
- C. Provide minimum of 2 pipe supports for each pipe run.
- D. Where piping connects to equipment, support by pipe support and not equipment, unless approved by equipment manufacturer.

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- E. Unless otherwise shown or authorized by DESIGNER, place piping running parallel to walls approximately 1-1/2 in. out from face of wall and at least 3 in. below ceiling.
 - F. Pedestal pipe supports shall be adjustable with stanchion, saddle, and anchoring flange.
 - G. Piping supports for vertical piping passing through floor sleeves shall be galvanized steel riser clamps.
 - H. Support piping in manner preventing undue strain on valve, fitting or equipment.
- 3.04 BURIED PIPING
 - A. Provide reaction blocking, anchorages or other fittings installed in fills or other unstable ground or above grade as shown on Drawings.

* * * END OF SECTION * * *



SECTION 15092 MODULAR MECHANICAL SEAL SYSTEMS

- PART 1 GENERAL
- 1.01 SUBMITTALS
 - A. Manufacturer's literature and fabrication drawings.
 - B. Submit in accordance with Section 01340.
- PART 2 PRODUCTS
- 2.01 MODULAR MECHANICAL JOINT SEAL
 - A. Manufacturers:
 - "Link Seal" as manufactured by Thunderline Corporation, Wayne, Michigan.
 - 2. Or equal.
 - B. Form continuous interlocking synthetic rubber links shaped to continuously fill annular space between pipe and wall opening or wall sleeve. Provide pressure plate under each bolt head and nut.
 - C. Compression of unit shall cause rubber sealing elements to expand and provide watertight seal.
 - D. Size according to manufacturer's instructions.
 - E. Withstand hydrostatic head of 40 ft of water.

PART 3 EXECUTION

- 3.01 INSTALLATION
 - A. Provide for penetration of vaults, manhole walls, bases, covers, and carrier pipes as shown on Drawings.
 - B. Verify size, location, and type of penetrations prior to pouring concrete.
 - C. Install in accordance with manufacturer's written instructions and approved submittals.

* * * END OF SECTION * * * .

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- PART 1 GENERAL
- 1.01 SUMMARY
 - A. Section Includes:
 - 1. Ball valves.
 - 2. Check valves.
 - a. Split disc check valves.b. Ball check.
 - D. Duri oncont
 - 3. Air and vacuum relief valves.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI B1.20.1-83 Pipe Threads, General Purpose (Inch).
 - 2. ANSI B16.1-89 Cast-Iron Pipe Flanges and Flanged Fittings.
 - 3. ANSI B16.5-88 Pipe Flanges and Flanged Fittings.
 - ANSI B16.10-86 Face-to-Face and End-to-End Dimensions of Valves.
 - 5. ANSI B16.11-80 Forged Steel Fittings, Socket-Welding and Threaded.
 - 6. ANSI B16.34-88 Valves -- Flanged, Threaded, and Welding End.
- B. American Society of Mechanical Engineers (ASME):
 - 1. ASME B31.1-89 Power Piping.
- C. Fluid Controls Institute, Inc. (FCI):
 - 1. FCI 74-1 Spring Loaded Lift Disc Check Valve Standard.
- D. Manufacturing Standardization Society of the Valves and Fittings Industry, Inc. (MSS):
 - MSS SP-25-78 Standard Marking System for Valves, Fittings, Flanges, and Unions.
 - 2. MSS SP-45-82 Bypass and Drain Connection Standard.
 - 3. MSS SP-71-84 Cast-Iron Swing Check Valves, Flanged and Threaded Ends.
 - 4. MSS SP-72-87 Ball Valves with Flanged or Butt-Welding Ends for General Service.



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1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of valve. Include pressure drop curve or chart for each type and size of valve. Submit valve schedule showing manufacturer's figure number, size, service rating, and valve features for each required valve.
- B. Shop Drawings: Submit manufacturer's assembly type (exploded view) Shop Drawings for each type of valve indicating dimensions, weights, materials, and methods of assembly of components.
- C. Submit in accordance with Section 01340.
- D. Operation and Maintenance (O&M) Data:
 - Submit maintenance data and spare parts lists for each type of valve, include product data and Shop Drawings.
 - 2. Submit in accordance with Section 01730.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of valves of types and sizes required, whose products have been in satisfactory service(s) for not less than 5 yrs.
- B. Valve Types: Provide valves of same type by same manufacturer to greatest extent possible.
- C. Valve and Rating Identification: Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on valve body.
- D. Codes and Standards:
 - 1. MSS Compliance: Mark valves in accordance with MSS SP-25.
 - 2. ANSI Compliance: For face-to-face and end-to-end dimensions of flanged or welded end valve bodies, comply with ANSI B16.10.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Ball Valves:
 - 1. Conbraco Apollo.
 - 2. Or equal.





- B. Check Valves:
 - 1. Techno Check.
 - 2. APCO.
 - 3. Or equal.
- C. Air and Vacuum Relief Valve:
 - 1. APCO.
 - 2. Or equal.

2.02 VALVES

- A. General:
 - 1. Factory fabricated valves recommended by manufacturer for use in service indicated.
 - 2. Types and pressure ratings indicated.
 - End connections which properly mate with pipe, tube, and equipment connections.
 - 4. Where more than one type indicated, selection is CONTRACTOR's option.
 - 5. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
- B. Operators:
 - 1. Lever handle for ¼ turn valves 6 in. and smaller.
- C. Valve Features: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by CONTRACTOR for installation requirements.
 - 1. ASME B31.1 for power piping.
 - Flanged: Valve flanges comply with ANSI B16.1 (cast iron), ANSI B16.5 (steel) or ANSI B16.24 (bronze).
 - 3. Threaded Valve Ends: ANSI B1.20.1.

2.03 BALL VALVES

- A. Stainless Steel Construction:
 - 2-in. or 3 in. valves: 1,500 psi WOG, 150 psi steam, reinforced TFE packing and trim, stainless steel lever and nut, stainless steel port ball. Fed. Spec. WW-V35 C, Type II, Composition SS, Style 3.
 - a. Threaded Ends: Conbraco "Apollo" 76-100 Series or equal.
- B. MSS Compliance: MSS SP-72.



- 2.04 SPLIT DISC CHECK VALVES
 - A. Incorporate true butterfly design
 - B. Seatless construction.
 - C. Valve disc shall seal against body at angle of 30 to 45 degrees.
 - D. Nonslam operation.
 - E. Withstand temperature of -20° F to 450° F.
 - F. Type 316 stainless steel body and internals.
 - G. Teflon seal.
 - H. Capable of installation in any position.
 - I. Maximum pressure drop of 0.5 psi at 100 gpm flow rate.
 - J. 150-1b class.
 - K. Threaded or flanged body.
- 2.05 BALL CHECK VALVES
 - A. In accordance with Section 02751.
- 2.06 AIR AND VACUUM RELEASE VALVES
 - A. Cast iron body, cover, and baffle.
 - B. Stainless steel float, center guided for positive sealing.
 - C. Inlet and Outlet: 2-in. NPT.
 - D. Maximum Dia: 10-in.
 - E. APCO Model 144 or equal.
- PART 3 EXECUTION
- 3.01 INSTALLATION
 - A. Except as otherwise indicated, comply with following requirements.
 - 1. Install valves where required for proper operation of piping and equipment, include valves in branch lines where necessary to isolate sections of piping. Locate valves so accessible and separate support can be provided when necessary.

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- 2. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable.
- B. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install vales with following ends or types of pipe/tube connections in accordance with requirements of piping system sections.
 - 1. Pipe Size 2-in. or 3 in.: One of following at CONTRACTOR's option.
 - a. Threaded valves.
 - b. Flanged valves.
- C. Renewable Seats: Select and install valves with renewable seats, except where otherwise indicated.
- D. Fluid Control: Except as otherwise indicated, install ball valves to comply with ASME B31.9.
- 3.02 ADJUSTING AND CLEANING
 - A. Valve Adjustment: After piping systems tested and put into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks. Replace valve if leak persists.
 - B. Valve Identification: Tag 2-in. or 3 in. valves to include manufacturer's and supplier's name and phone number, and operating and basic maintenance instructions. Enclose in plastic sleeve fastened to valve.
 - C. Cleaning: Clean factory finished surfaces. Repair marred or scratched surface with manufacturer's touch up paint.

* * * END OF SECTION * * *

12/20/96 Revised: Date Approved



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ELECTRICAL

DIVISION 16

SECTION 16100 BASIC MATERIALS AND METHODS

PART 1 GENERAL

1.01 REFERENCES

- A. National Electrical Manufacturer's Association (NEMA).
- B. Underwriters Laboratories, Inc. (UL):

1. UL 943-85 - Ground-Fault Circuit Interruptors.

1.02 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit disconnects, motor starters, and overcurrent protective devices.
 - 2. Showing enclosure dimensions, nameplate nomenclature, electrical ratings, and thermal unit schedule.
 - 3. Product data sheets with printed installation instructions.
 - 4. Wiring diagrams and schematics.
- B. Submit in accordance with Section 01340.
- C. Operating and Maintenance (O&M) Data: Submit O&M data as specified for disconnects, motor starters, and overcurrent protective devices.
 - Manufacturer's printed instructions for replacing parts, performing cleaning, and operating and maintaining equipment.
 - 2. Repair parts list.
 - 3. Submit in accordance with Section 01730.

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. National Fire Protection Association (NFPA):
 - a. NFPA No. 70 National Electric Code (NEC) and New York amendments thereto.
 - 2. Underwriters Laboratories, Inc. (UL).
 - 3. Local codes and ordinances.

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- PART 2 PRODUCTS
- 2.01 GENERAL
 - A. Use of manufacturer's name and model or catalog number is for purpose establishing standard of quality and configuration desired.
- 2.02 GALVANIZED RIGID STEEL CONDUITS (GRS)
 - A. Manufacturers:
 - 1. Allied Steel.
 - 2. Republic Steel.
 - 3. Or equal.
 - B. Manufacturer's standard lengths.
 - C. Protected inside and out by hot-dipped galvanized or electrogalvanized coating.
- 2.03 FLEXIBLE CONDUIT
 - A. Manufacturers:
 - 1. Triangle PWC, Inc.
 - 2. Flexsteel.
 - 3. Or equal.
 - B. Galvanized flexible steel.
 - C. Standard conduit sizes.
 - D. Minimum Size: 1/2 in.
- 2.04 LIQUIDTIGHT FLEXIBLE CONDUIT
 - A. Manufacturers:
 - 1. O-Z/Gedney Company.
 - 2. Flex-Guard, Inc.
 - 3. Carol Cable Company.
 - 4. Or equal.
 - B. Galvanized flexible steel.
 - C. Standard conduit sizes.
 - D. Minimum Size: 1/2 in.
 - E. Heavy wall PVC jacket.



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2.05 FITTINGS

- A. Manufacturers:
 - 1. Appleton Electric Company.
 - 2. Steel City, Midland-Ross Corporation.
 - 3. Or equal.
- B. Steel or malleable iron, zinc galvanized or cadmium plated.
- C. Do not use set screw or indentor type fittings.
- D. GRS Connectors and Couplings:
 - 1. Threaded.
 - 2. Insulated throat.
 - 3. Gland compression type.
- E. Flexible Conduit Connectors and Couplings:
 - 1. Threaded.
 - 2. Grounding type.
 - 3. Insulated throat.
 - 4. Gland compression type.
- F. Liquidtight Flexible Conduit Fittings:
 - 1. Liquidtight.
 - 2. As specified in Paragraph 2.05.E.
- G. Expansion Joints:
 - Conduit expansion fittings complete with copper bonding jumper, Crouse-Hinds Type XJ.
 - Conduit expansion/deflection fittings with copper bonding jumper, Crouse-Hinds Type XD.
- H. Seals:
 - 1. Wall entrance, Appleton Type FSK or FSC.
- I. Drain Fittings:
 - 1. Automatic Drain Breather:
 - a. Explosionproof.
 - 1) Safe for Class I, Groups C and D.
 - b. Capable of passing minimum 25 cc water/min and minimum
 0.05 cu ft air/min at atmospheric pressure.



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J. Hazardous Areas:

- 1. Explosionproof.
- 2. Horizontal seal fittings, Crouse-Hinds Type EYS.
- 3. Vertical seal fittings, Crouse-Hinds Type EYD.
- 4. Vertical seal fittings shall have drain plug.

2.06 WIRES, CABLES, AND CONNECTORS

- A. Manufacturers:
 - 1. Wire and Cable:
 - a. Rome.
 - b. ITT.
 - c. Beldon.
 - d. Dekoron.
 - e. Or equal.
 - 2. Connectors:
 - a. Burndy.
 - b. Thomas and Betts.
 - c. Or equal.
- B. Copper wire only.
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600 v insulation (ASTM standard compounds) and color code conductors for low voltage (secondary feeders and branch circuits) as required by NEC.

- Type THWN Solid: Single conductor No. 10 AWG and smaller, No. 12 AWG minimum for 120 v, and 240 v general use wiring.
 Type XHHW Stranded: Single conductor We a two strands.
- Type XHHW Stranded: Single conductor No. 8 AWG and larger for 120 v, 240 v, and 480 v general use wiring.
 Type TW Stranded: Single conductor provides
- Type TW Stranded: Single conductor green equipment ground.
 Type USE Stranded: Single conductor from the stranded to the stranded to
- Type USE Stranded: Single conductor for under-ground direct burial.
 Type THWN Stranded: Single conductor No. 12 Mar.
- 5. Type THWN Stranded: Single conductor No. 12 AWG minimum for 120 v control wiring and No. 14 AWG minimum for graphic indication, nonshielded instrumentation and other control wiring operating at less than 120 v unless otherwise noted on Drawings.
 - a. Provide high density polyethylene jacketed multi-wire cable assemblies in underground conduit or duct.
- 6. Polyethylene insulated, tinned copper (19 by 27) stranding, No. 16 AWG, two conductors cabled with aluminum polyester electrostatic shielding, stranded tinned copper drain wire, and chrome vinyl outer jacket for interference sensitive instrumentation wiring.

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- a. Additional high density neoprene jacket on cables installed below ground and in duct encasements.
- D. Joints, Taps, and Splices:
 - 1. Joints, Taps, and Splices in Conductors No. 10 AWG and Smaller: Compression type solderless connectors with plastic cover.
 - Joints, Taps, and Splices in Conductors No. 8 AWG and Larger: Solderless compression type connectors of type that will not loosen under vibration or normal strains.

2.07 BOXES

- A. Manufacturers:
 - 1. Interior Outlet Boxes:
 - a. Appleton Electric Company.
 - b. Raco.
 - c. Steel City, Midland-Ross Corporation.
 - d. Or equal.
 - 2. Weatherproof Outlet Boxes:
 - a. Appleton Electric Company.
 - b. Crouse-Hinds Company.
 - c. O-Z/Gedney Company.
 - d. Or equal.

3. Junction and Pull Boxes:

- a. Hoffman Engineering Company.
- b. Keystone Columbia, Inc.
- c. Or equal.

⁶ B. Outlet Boxes - Surface Mounted:

1. General Use: 4-in. sq with raised device cover.

2. Weatherproof: Cast galvanized box with threaded hub.

C. Junction and Pull Boxes:

- Fabricate from code gauge galvanized steel, with covers held in-place by corrosion resistant machine screws.
- 2. Size as required by code for number of conduits and conductors entering and leaving box.
- 3. Provide with welded seams where applicable, and equip with corrosion resistant nuts, bolts, screws, and washers.
- 4. Finish with rust inhibiting primer.

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2.08 WIRING DEVICES

- A. Manufacturers:
 - 1. Arrow-Hart, Inc.
 - 2. Hubbel Wiring Device Division.
 - 3. Pass and Seymour, Inc.
 - 4. Appleton Electric Company.
 - 5. Sierra Electric.
 - 6. Crouse-Hinds Company.
 - 7. Or equal.
- B. Fabricated Devices:
 - Factory-fabricated, specification grade wiring devices in type, and electrical rating for service indicated.
 - 2. Wiring devices of one manufacturer.
 - 3. See Drawing symbol schedule for identification of device type.
- C. Switches:
 - General Use Lighting Switches: 20 amp toggle, equal to Hubbell No. 1221-I series.
 - 2. Switches controlling equipment, operation of which is not evident from switch position, shall include flush neon pilot light in conjunction with proper switch. Each switch shall be complete with engraved plate to identify equipment being controlled (white letters on black, 1/8 in. high minimum).
- D. Receptacles:
 - General use duplex receptacles: NEMA No. 5-20R, grounding type, 20 amp Hubbell No. 5362.
 - 2. Special purpose receptacles as shown on Drawings and schedules.
- ⁵ E. Wiring Device Plates and Covers:
 - 1. Wall plates for wiring devices with ganging and cut-outs as indicated, provided with metal screws for securing plates to devices, screw heads colored to match finish of plate.
 - 2. Device plates for surface mounted Type FS or FD boxes to be Type FSK galvanized steel.
 - 3. Device plates for surface mounted, 4-in. sq boxes to be 1/2 in. raised galvanized steel covers.
 - 4. Weatherproof plates and covers for exterior devices or devices in damp locations to be galvanized gray cast malleable with gasketed, lift cover plate as shown on Drawings.

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- MOTOR STARTERS 2.09
 - Manufacturers: Α.
 - Allen Bradley. 1.
 - 2. Cutler-Hammer.
 - Square D. 3.
 - Or equal. 4.
 - Magnetic Starters: в.
 - Minimum short circuit withstand rating in combination with motor 1. circuit protective device shall be 22,000 symmetrical amps or as indicated on Drawings.
 - Magnetic Motor Starter Construction: с.
 - Mounted in vertical position, gravity dropout. 1.
 - Double break silver alloy contacts. 2.
 - 3. Molded coil.
 - Contacts and/or coil replacement without removing starter from 4. enclosure or power wiring from starter.
 - 5. Straight-through wiring.
 - Overload Relay: 6.
 - 1-piece thermal unit construction. a.
 - One melting alloy type overload relay per phase, manually ь. reset.
 - Interchangeable thermal units. c.
 - Thermal units must be in-place to operate starter. d.
 - Replaceable overload relay circuit contacts. e.
 - Trip at 6 times LRC in 20 sec. £.
 - Overload relay submersible pumps and hermetically sealed motors. 7.
 - Same as above except trip at 6 times LRC in 3 to 5 sec. a.
 - NEMA standards for size and hp rating. 8.
 - NEMA 1 minimum. 9.

Control Circuits: D.

- Voltage not to exceed 120 v. 1.
- Control transformer mounted in starter enclosure. 2.
- Fuses on one secondary line. 3.
- One secondary line grounded. 4.
- Transformer sized for device, accessories connected thereto, and 5. 25% extra capacity minimum.

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- E. Controls:
 - 1. Reset button mounted in enclosure cover.
 - 2. Heavy duty, oiltight green push to test pilot lights mounted in enclosure cover when indicated.
 - 3. Heavy duty, oiltight pushbuttons and selector switches mounted in enclosure when indicated.
 - 4. 6-digit type elapsed time meters in tenths of hr mounted in enclosure cover when indicated.
- F. Enclosures:
 - 1. Magnetic Starters:
 - a. NEMA 4X outdoors and wet locations.
- 2.10 MOTOR AND CIRCUIT DISCONNECTS
 - A. Manufacturers:
 - 1. Cutler-Hammer.
 - 2. Square D.
 - 3. Or equal.
 - B. Enclosed Circuit Breaker Construction:
 - 1. Dual cover interlock.
 - 2. External trip indication.
 - 3. Provisions for control circuit interlock.
 - 4. Padlock provisions for padlock in Off position.
 - 5. Handle attached to box, not cover.
 - 6. Handle position indicates On, Off or Tripped.
 - 7. Provisions for insulated or groundable neutral.

C. Safety Switches:

- 1. NEMA heavy duty Type HD.
- 2. Dual cover interlock.
- 3. Visible blades.
- 4. Provisions for control circuit interlock.
- 5. Pin type hinges.
- 6. Tin plated current carrying parts.
- 7. Quick make and break operator mechanism.
- 8. Handle attached to box, not cover.
- 9. Handle position indication, On in up position and Off in down position.
- 10. Padlock provisions for up to 3 padlocks in Off position.
- 11. UL listed lugs for type and size of wire specified.
- 12. Spring reinforced fuse clips for Type R fuses.
- 13. Provisions for insulated or groundable neutral.

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- D. Enclosures:
 - Indoor: NEMA 1 code gauge steel with rust inhibiting primer and baked enamel finish.
 - Outdoor: NEMA 3R code gauge zinc coated steel with baked enamel finish.

2.11 FUSES

- A. Manufacturers:
 - 1. Bussmann.
 - 2. Chase Shawmut.
 - 3. Or equal.
- B. 250 v Fuses:
 - Class RK-1, 1-end rejection or to fit mountings specified, 0 to 600 amps, 200,000-amp interrupting rating.
 - a. Bussmann Low-Peak. LPN-R, dual element, time delay with short circuit protection for motor, transformer, welder, feeder, and main service protection.
 - C. 600 v Fuses:
 - Class RK-1, 1-end rejection or to fit mountings specified, 0 to 600 amps, 200,000-amp interrupting rating.
 - a. Bussmann Low-Peak. LPS-R, dual element, time delay with short circuit protection for motor, transformer, welder, feeder and main service protection.
 - Class CC, fast acting, single element, 0 to 30 amps, 200,000-amp interrupting rating.
 - a. Bussmann Limitron. KTK-R, UL listed for motor control circuits, lighting ballasts, control transformers, and street lighting fixtures.

D. Spare Fuses:

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1. 10%, minimum of 3, of each type and rating of installed fuses.

- 2.12 PANELBOARDS
 - A. Manufacturers:
 - 1. Cutler-Hammer.
 - 2. Square D.
 - 3. Or equal.



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B. Panelboard Ratings:

1. UL listed short circuit rating (integral equipment rating):

a. Up to 240 v: 10,000 RMS symmetrical amp minimum.
b. Up to 480 v: 14,000 RMS symmetrical amp minimum.
c. As shown on Drawings.

C. Panelboard Construction:

- 1. Main breaker or main lugs only, in accordance with panelboard schedule.
- 2. Branch Breaker Details: As specified in Article 2.13.
- 3. Terminals:

a. UL listed for type of wire specified.b. Anti-turn solderless type.

4. Bussing:

- a. Distributed phase sequence type.
- b. 225 amps or as shown on panelboard schedule or Drawings.
- c. Plated copper.
- d. Behind usable space, with mounting hardware.
- Gutters adequate for wire size used, 4-in. minimum.
 Boxes:

a. Code gauge galvanized steel.

- b. Without knockouts.
- 7. Fronts:
 - a. Rust inhibiting primer, baked enamel finish.
 - b. Dead front safety type.
 - c. Concealed hinges.
 - d. Flush stainless steel cylinder tumbler type locks with spring loaded door pulls.
 - e. Circuit Directory:
 - 1) Suitable for complete descriptions.
 - 2) Clear plastic cover.
 - 3) Typewritten card.

2.13 MOLDED CASE CIRCUIT BREAKERS

- A. Manufacturers:
 - 1. Cutler-Hammer.
 - 2. Square D.
 - 3. Westinghouse.
 - 4. Or equal.

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- B. Permanent Trip Circuit Breakers:
 - 1. Lighting Panel Circuit Breakers:
 - a. Thermal and magnetic protection.
 - b. Single-handle common trip, 2 and 3 poles (handle ties not acceptable).
 - c. Bolt-on type unless otherwise noted on Drawings.
 - d. Quick make and break toggle action.
 - e. Handle trip indication.
 - f. Handle position indication, On, Off, and Tripped centered.
 - g. UL listed for type of wire specified.
 - h. UL listed short circuit rating (integrated equipment rating).
 - 1) Up to 240 v: 25,000 RMS symmetrical amp minimum.
 - 2) Up to 480 v: 18,000 RMS symmetrical amp minimum.
 - 2. Power Panel Circuit Breakers:
 - a. Thermal and magnetic protection.
 - b. Magnetic protection only in combination with motor starters and motor circuit protectors (MCP).
 - c. Single magnetic trip adjustment.
 - d. Single-handle common trip, 2 and 3 poles (handle ties not acceptable).
 - e. Push-to-trip test button.
 - f. Bolt-on type.
 - g. Quick make and break toggle action.
 - h. Handle trip indication.
 - i. Handle position indication, On, Off, and Tripped centered.
 - j. UL listed for type of wire specified.
 - k. UL listed short circuit rating (integrated equipment rating).
 - 1) Up to 240 v: 25,000 RMS symmetrical amp minimum.
 - 2) Up to 480 v: 18,000 RMS symmetrical amp minimum.

2.14 GROUND-FAULT CIRCUIT INTERRUPTER RECEPTACLES

- A. Ratings:
 - 1. 120 vac.
 - 2. 20 amp.
- B. Tripping Requirement:
 - 1. UL Class A.

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- C. Construction:
 - 1. Shallow depth.
 - 2. Line and load terminal screws.
 - 3. Noise suppression.
 - 4. Feed through.
 - 5. Standard duplex wall plates shall fit.
 - 6. NEMA 5-20R configuration.
- D. UL Listed:
 - 1. Meet requirements of UL 943 ground-fault circuit interrupters.
- PART 3 EXECUTION

3.01 GENERAL

- A. Install products in accordance with NEC, manufacturer's instructions, applicable standards, and recognized industry practices to ensure products serve intended function.
- 3.02 CONDUITS AND CONDUIT FITTINGS
 - A. Install conduit and tubing products in accordance with NEC, manufacturer's written instructions, applicable standards, and recognized industry practices to ensure products serve intended function.
 - B. Complete conduit installation prior to installing cables.
 - C. Unless specifically indicated otherwise on Drawings, use rigid galvanized steel conduit for general wiring.
 - D. Install galvanized rigid conduit when conduit installed in concrete.
 - ⁹ E. Provide watertight conduit system.
 - F. Use PVC coated rigid steel conduit when conduit is run below slabs on grade or in earth, unless otherwise noted on Drawings.
 - 1. Exterior underground conduit shall be minimum of 1 in. dia, buried at depth of not less than 24 in. below grade.
 - 2. Provide conduits or ducts terminating below grade with means to prevent entry of dirt or moisture.
 - G. Conduit shall be run concealed except exposed surface conduit may be installed where noted on Drawings or where concealment found to be impractical or impossible, and only with approval of DESIGNER.
 - H. Continuous from outlet to outlet and from outlets to cabinets, junction or pull boxes.

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- I. Enter and secure to boxes ensuring electrical continuity from point of service to outlets.
- J. Conduit runs extending through areas of different temperature or atmospheric conditions or partly indoors and partly outdoors shall be sealed, drained, and installed in manner preventing drainage of condensed or entrapped moisture into cabinets, motors or equipment enclosures.
- K. Secure conduit in-place with not less than 1 malleable corrosionproof alloy strap or hanger/8 ft of conduit.

1. Do not use perforated strapping.

- L. Connections to Motors and Equipment Subject to Vibration:
 - Flexible steel conduit not over 3 ft long or where exposed in mechanical and utility areas and not subjected to moisture, dirt, and fumes.
 - 2. Liquidtight flexible conduit not over 3 ft long where exposed in finished areas or where subject to moisture, dirt, fumes, oil, corrosive atmosphere, exposed or concealed, with connectors to ensure liquidtight, permanently grounded connection. Locate where least subject to physical abuse.
- M. Use double lock nuts and insulated bushings with threads fully engaged.
- N. Connectors at fixture bodies and boxes shall be rigidly secured with galvanized lock nut and bushing.
- O. Cap conduits after installation to prevent entry of debris.
- P. Use explosionproof fittings and seals in hazardous areas in accordance with NEC.
- Q. Install conduit expansion fittings complete with bonding jumper in following locations.
 - 1. Conduit runs crossing structural expansion joint.
 - 2. Conduit runs attached to two separate structures.
 - 3. Conduit runs where movement perpendicular to axis of conduit may be encountered.

3.03 WIRE AND CABLE

- A. Run wire and cable in conduit unless otherwise indicated on Drawings.
- B. On branch circuits, use standard colors.

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- C. Each tap, joint or splice in conductors No. 8 AWG and larger shall be taped with 2 half-lap layers of vinyl plastic electrical tape and finish wrap of color coding tape, where required by code.
- 3.04 BOXES
 - A. Install knockout closures to cap unused knockout holes where blanks have been removed.
 - B. Locate boxes to ensure accessibility of electrical wiring.
 - C. Secure boxes rigidly to subsurface upon which being mounted or solidly embed boxes in concrete or masonry. Do not support from conduit.
 - D. Do not burn holes, use knockout punches or saw.
 - E. Provide outlet box accessories as required for each installation such as mounting brackets, fixture studs, cable clamps, and metal straps for supporting outlet boxes compatible with outlet boxes being used and meeting requirements of individual wiring situations.
 - F. Location of outlets and equipment as shown on Drawings is approximate, and exact location to be verified.
 - G. Minor modification in location of outlets and equipment considered incidental up to distance of 10 ft with no additional compensation, provided necessary instructions given prior to roughing in of outlet.
 - H. Mounting Height:
 - 1. Switches: 48 in. above floor.
 - 2. ac Receptacles: 48 in. above floor in unfinished areas.
 - 3. Wall Bracket Lighting Fixtures: 6 ft-6 in. above floor.
 - 4. Pushbuttons: 48 in. above floor.
 - 5. Motor Starters and Disconnect Switches: 60 in. above floor.
 - 6. Thermostats: 60 in. above floor.
 - 7. Bells and Horns: 8 ft-0 in. above floor.

3.05 WIRING DEVICES

- A. Do not install devices until wiring complete.
- B. Do not use terminals on wiring devices (hot or neutral) for feed-through connections, looped or otherwise. Make circuit connections via wire connectors and pigtails.
- C. Install gasket plates for devices or system components having light emitting features such as switch with pilot light and dome lights. Where installed on rough textured surfaces, seal with black self-adhesive polyfoam.

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- D. Ground receptacles with insulated green ground wire from device ground screw to bolted outlet box connection.
- 3.06 MOTOR STARTERS
 - A. Examine area to receive motor starters to ensure adequate clearance for starter installation.
 - B. Install on equipment rack in MCC or anchor firmly to wall or structural surface.
- 3.07 MOTOR AND CIRCUIT DISCONNECTS
 - A. Locate disconnect switches as shown on Drawings and required by NEC.
 - B. Provide control circuit interlock as required by NEC.
- 3.08 OVERCURRENT PROTECTIVE DEVICES
 - A. Install fuses just prior to energizing equipment.
 - B. Locate circuit breakers as shown on Drawings.
 - C. Install GFCI receptacles as required by NEC.
- 3.09 PANELBOARDS
 - A. Surface mount as specified on Drawings and schedules.
 - B. Support panel cabinets independently to structure with no weight bearing on conduits.
 - C. Install panelboards so top breaker not higher than 6 ft-0 in. above floor.
 - D. Adjacent panel cabinets shall be same size and mounted in horizontal alignment.
 - E. Install typewritten directory in each panelboard, accurately indicating rooms or equipment being served.
- 3.10 FIELD QUALITY CONTROL
 - A. Control Circuits, Branch Circuits, Feeders, Motor Circuits, and Transformers:
 - Megger check of phase-to-phase and phase-to-ground insulation levels.
 - a. Do not megger check solid state equipment.

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- 2. Continuity.
- 3. Short circuit.
- 4. Operational check.
- B. Wiring Devices:
 - Test receptacles with Hubbell 5200, Woodhead 1750 or equal tester for correct polarity, proper ground connection, and wiring faults.
- 3.11 ADJUSTMENT AND CLEANING
 - A. Motor Starters and Disconnects:
 - Adjust covers and operating mechanisms for free mechanical movement.
 - 2. Tighten wire and cable connections.
 - 3. Verify overcurrent protection thermal unit size with motor nameplate to provide proper operation and compliance with NEC.
 - 4. Clean interior of enclosures.
 - 5. Touch up scratched or marred surfaces to match original finish.
 - B. Circuit Breakers:
 - 1. Adjustable settings shall be set to provide selective coordination, proper operation, and in compliance with NEC.

* * * END OF SECTION * * *



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SECTION 16150 ELECTRIC MOTORS

- PART 1 GENERAL
- 1.01 SUMMARY
 - A. Motors furnished under other sections of these Specifications as part of equipment items shall conform to requirements of this section except as noted otherwise in that section or indicated otherwise on Drawings or schedules.
- 1.02 REFERENCES
 - A. Anti-Friction Bearing Manufacturers Association (AFBMA):
 - 1. AFBMA Standards for Ball and Roller Bearings and Balls.
 - B. Institute of Electrical and Electronic Engineers (IEEE):
 - 1. IEEE 112-84 Standard Test Procedure for Polyphase Induction Motors and Generators.
 - C. National Electrical Contractors Association (NECA):
 - 1. Standard of Installation.
 - D. National Electrical Manufacturers Association (NEMA):

1. NEMA MG 1-87 - Motors and Generators.

- 1.03 SUBMITTALS
 - A. Include motor submittal as part of equipment submittal for equipment specified in other sections.
 - B. Include identification of equipment by name and tag number as indicated in Specifications or on Drawings.
 - 1. Complete nameplate data in accordance with NEMA standards.
 - Full load power factor and maximum correction capacitor kVa for motors 5 hp and larger.
 - 3. Nominal efficiency in accordance with IEEE Standard 112 for motors 5 hp and larger.
 - 4. Motor dimensions and frame size.
 - 5. Manufacturer's printed data on each motor type being provided to indicate compliance with specified performance and construction.
 - 6. Service manual to include storage and alignment instructions.
 - C. Submit in accordance with Section 01340.

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- D. Operation and Maintenance (O&M) Data:
 - 1. Submit in accordance with Section 01730.

1.04 QUALITY ASSURANCE

- A. Source Quality Control:
 - 1. Perform individual motor test on motors over 1 hp.
 - 2. Test shall be standard NEMA routine production test in accordance with MG 1-12.51 consisting of following.
 - a. No load running current.
 - b. Locked rotor current.
 - c. High potential test.
 - d. Bearing inspection.
- B. Regulatory Requirements:
 - 1. National Fire Protection Association (NFPA):
 - a. NFPA No. 70 National Electrical Code (NEC) and New York amendments thereto.
 - 2. Underwriters Laboratories, Inc. (UL).
 - 3. Local codes and ordinances.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Use of manufacturer's name and model or catalog number is for purpose of establishing standard of quality and general configuration desired.
- 2.02 MANUFACTURERS
 - A. Louis Allis.
 - B. General Electric.
 - C. Or equal.
- 2.03 GENERAL
 - A. Unless otherwise specified, meet or exceed following.
 - 1. High efficiency, equivalent to Louis Allis Spartan for motors 3 hp and above.

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- 2. Motors 1/2 hp and Larger: 3-ph, 60 Hz, 230/460 v.
 - a. Squirrel cage type, NEMA B.
 - b. Motor Housing and Bearing Brackets: Cast grey iron with tensile strength of 30,000 psi. Do not provide rolled steel and aluminum.
 - Secure bearing brackets to motor cast iron housing. Do not use bolt clamping methods.
- 3. Motors Less than 1/2 hp: 1-ph, 60 Hz, 115/230 v.
- 4. Suitable for continuous operation with line voltage variation within ±10% of rated voltage.
- 5. Suitable for continuous operation in 40°C ambient.
- 6. Copper motor windings.
- . B. Design for frequent starting when specified in other sections.
- 2.04 ENCLOSURES
 - A. Totally Enclosed Fan Cooled (TEFC): Indoor or outdoor areas where exposed to moisture or dirt.
 - 1. Waterproof conduit box.
 - 2. Cast brass or polypropolene external ventilation fan.
 - 3. Automatic breather/drain.
 - 4. Ground wire.
 - 5. External water slinger on shaft extension.
 - 6. Lip seals on both ends of motor.
 - B. Explosionproof (EP): Indoor or outdoor areas where exposed to flammable volatile liquids, flammable gases or mixtures or combustible flyings are handled, manufactured, stored or used.
 - 1. Waterproof conduit box.
 - 2. Cast brass or polypropolene external ventilation fan.
 - 3. Automatic drain breather.
 - 4. Ground wire.
 - 5. External water slinger on shaft extension.
 - 6. Lip seals on both ends of motor.
 - C. Submersible (SUB): Underwater conditions.
 - 1. As specified under equipment section.

2.05 INSULATION

- A. Total Enclosed Fan Cooled: Class F, 1.15 service factor.
 - 1. Two extra dips and bakes of epoxy varnish.

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B. Explosionproof: Class F, 1.15 service factor.

1. Two extra dips and bakes of epoxy varnish.

C. Submersible: Class F, 1.10 service factor.

2.06 BEARINGS

- A. Ball or roller bearing type at manufacturer's option, unless specified in equipment sections of Specifications.
- B. Support side thrust loadings.
- C. Regreasable with alamite fittings extended to accessible location for Frame 250 and larger.
- D. AFBMA B10 bearing life rated (flexible coupled) at 50,000 hrs.
- 2.07 SPEED
 - A. As specified under equipment section.
- 2.08 TORQUE
 - A. Breakdown torque shall be 200% or more of maximum torque load placed on motor shaft.
 - B. Provide necessary \mathtt{WK}_2 curves for special loads to coordinate with motors.
 - C. Supply special motors where load requirements exceed standard design.
- 2.09 SLIDE RAILS AND SOLE PLATE
 - A. As required for application.
- 2.10 SINGLE PHASE FRACTIONAL HP MOTORS
 - A. Capacitor or open split phase start, unless otherwise specified.
- 2.11 3-PH MOTORS
 - A. Provide horizontal or vertical squirrel cage induction motors for standard duty.
 - B. Full voltage starting or as specified in equipment sections of Specifications or on Drawings.
 - C. Design in conformance with Article 2.08.

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- PART 3 EXECUTION
- 3.01 GENERAL
 - A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC, NECA "Standard of Installation," and recognized industry practices.
- 3.02 ALIGNMENT
 - A. Contractor furnishing motor shall be responsible for alignment.
 - B. Check alignment of motors prior to startup.

* * * END OF SECTION * * *

- PART 1 GENERAL
- 1.01 REFERENCES
 - A. National Electrical Contractors Association (NECA):
 - 1. Standard of Installation.

1.02 SUBMITTALS

- A. Test Data:
 - 1. Ground resistance at each ground rod.
 - a. Rod location.
 - b. Resistance.
 - c. Soil conditions.
 - 2. Building water service resistance.
- B. Submit in accordance with Section 01340.
- 1.03 QUALITY ASSURANCE
 - A. Regulatory Requirements:
 - 1. National Fire Protection Association (NFPA):
 - a. NFPA No. 70 National Electrical Code (NEC) and New York amendments thereto.
 - 2. Niagara Mohawk Power Company standards.
 - 3. Local codes and ordinances.
- PART 2 PRODUCTS
- 2.01 MATERIALS
 - A. Ground Clamp Fittings:
 - Interlocking clamp type fabricated from high strength corrosionresistant metal with high strength silicon bronze U-bolt, nuts, and lock washers.
 - B. Cable Connections and Joints:
 - 1. Thermoweld.

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C. Ground Rods:

- 1. Thick copper covering inseparably welded to strong steel core.
- 3/4 in. dia minimum and 10 ft long unless otherwise shown on Drawings.
- D. Ground Wires:
 - 1. Copper.
 - 2. Do not use aluminum.
 - 3. Size as shown on Drawings or required by NEC.
 - 4. No. 6 AWG minimum.
- PART 3 EXECUTION
- 3.01 INSTALLATION
 - A. General:
 - 1. Ground electrical systems and equipment as required by code, utility, local ordinances, and requirements herein.
 - 2. Install separate code-rated grounding conductors to special equipment and activity areas as required by code.
 - Bond metallic piping systems and service equipment as required by NEC.
 - B. System Ground:
 - 1. Attach ground wire to building steel and ground rods.
 - Augment piping systems ground with two supplemental NEC approved electrodes to achieve effective ground resistance as required by NEC.
 - C. Main Grounding Conductor:
 - 1. Continuous without splice.
 - 2. Install in rigid metal conduit.
 - 3. Attach nonferrous metal tag to warn against removal.
 - D. Bond metallic conduits, supports, cabinets, and other equipment so ground will be electrically continuous from service to outlet boxes.
 - E. Locate grounding conductor in nonmetallic or flexible conduit to complete equipment ground continuity.
 - F. Where ground conductor runs through metallic conduit, bond to conduit at entrance and exit with bolted clamp.
 - G. Install separate equipment grounding conductor in each conduit containing branch circuit or feeder without neutral conductor and to special equipment as shown on Drawings.



- H. Green ground bar in panels to be similar to neutral bar, except tinted green and bonded to panel tub.
- I. Connections shall be accessible for inspection and checking. No insulation shall be installed over ground connections.
- J. Clean ground connection surfaces.
- K. Drive ground rod as shown on Drawings.

1. Drive top of ground rod to depth 4 in. below finished grade.

- L. Make connections to ground electrodes with bolted clamp or approved molded exothermic weld process.
- M. Attach grounds permanently before permanent building service energized.
- N. Install green ground conductor from 1-ph motors or equipment frames to first junction box beyond flexible conduit.
- 3.02 MANHOLES AND HANDHOLES
 - A. Drive ground rod at convenient point close to wall.
 - B. Connect ground rod to metal cable supports, groundable end bushings on ducts and conduits, and metallic cable sheaths and armor with No. 4 AWG, tinned, stranded or equivalent braided copper cable.
 - C. Attach ground wire neatly and firmly to walls.
- 3.03 FIELD QUALITY CONTROL
 - A. Resistance Measurements:
 - 1. Measure at each ground rod.
 - 2. Measure at each connection to building water service.
 - 3. Measure in normally dry conditions.

a. Not less than 48

4. Isolate ground under test from other grounds.

* * * END OF SECTION * * *

SECTION 16471 FEEDER CIRCUITS

- PART 1 GENERAL
- 1.01 REFERENCES
 - A. National Electrical Contractors Association (NECA):
 - 1. Standard of Installation.

1.02 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. National Fire Protection Association (NFPA):
 - a. NFPA No. 70 National Electrical Code (NEC) and New York amendments thereto.
 - 2. Local codes and ordinances.
- PART 2 PRODUCTS
- 2.01 FEEDERS
 - A. Materials shall comply with other sections of Specifications.
 - B. Size and protect in accordance with NEC 215.
- PART 3 EXECUTION
- 3.01 INSTALLATION
- A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC, NECA "Standard of Installation," and recognized industry practices.
 - B. Extend feeders at full capacity from origin to termination.
 - C. Each conduit raceway shall contain only those conductors constituting single feeder circuit.
 - D. Where multiple raceways are used for single feeder, each raceway shall contain conductor of each phase and neutral if used.
 - E. Where feeder conductors run in parallel, conductors shall be of same length, material, circular-mil area, insulation type, and terminated in same manner.

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- F. Where parallel feeder conductors run in separate raceways, raceways shall have same physical characteristics.
- G. Feeders shall follow most accessible routes exposed to minimum temperature gradient and fluctuation.
- H. Trapped runs without facilities for continuous drainage not acceptable.
- I. Where impractical to do otherwise and with approval of DESIGNER, feeder conduits may be installed in ground floor slabs subject to requirements they be totally encased in concrete or through use of PVC jacketed rigid conduit if in direct contact with earth.
- J. Do not draw conductors into conduits until building enclosed, watertight, and Work causing cable damage complete.
- K. Identify main feeders with heavy tags.
- L. On network systems, neutral shall be run with phase wires. Unbalanced neutral current shall not exceed normal or derated conductor capacity.

* * * END OF SECTION * * *

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SECTION 16857 ELECTRIC PIPE TRACING

- PART 1 GENERAL
- 1.01 SUMMARY
 - A. System consists of self-regulating heat tapes and control equipment to provide complete UL listed system to prevent pipelines from freezing, installed and tested in-place.
- 1.02 SUBMITTALS
 - A. Shop Drawings:
 - Submitted by supplier of electrical pipe tracing systems as specified in other sections.
 - 2. Submit manufacturer's product data sheets.
 - 3. Submit Shop Drawings showing isometric layout of pipe tracing cables over customer's piping layout. Drawings shall also include installation details and connection diagrams sufficient to install pipe tracing cable system.
 - B. Submit in accordance with Section 01340.
- 1.03 QUALITY ASSURANCE
 - A. Design Criteria:
 - Provide pipe tracing cable system capable of maintaining pipe contents at temperature of 40°F when outside ambient temperature is -20°F with 20 mph wind.
- B. Regulatory Requirements:
 - 1. National Fire Protection Association (NFPA):
 - a. NFPA No. 70 National Electrical Code (NEC) current edition, and New York amendments thereto.
 - 2. Underwriters Laboratories, Inc. (UL).
 - 3. Local codes and ordinances.
- PART 2 PRODUCTS
- 2.01 MANUFACTURERS
 - A. Chemelex, Division of Raychem Corporation.
 - B. Nelson Electric, Division of General Signal.
 - C. Or equal.

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- 2.02 CABLE DESIGN
 - A. Voltage: 120 v, 60 Hz, 1-ph as shown on Drawings for electrical connection.
 - B. Parallel design, current flow across cable.
 - C. Heat output/ft constant, independent of length.
 - D. Capable of overlapping without creation of hot spots.
 - E. Cut to any length in field.
 - F. Self-regulating heat output.
- G. Braided metallic shield.
 - H. Outer Fluoropolymer jacket.
- 2.03 MATERIAL AND EQUIPMENT
 - A. Furnish electrical pipe tracing system as shown on Drawings.
 - B. Thermostatic ambient sensing control on each type set at 40°F.
 - 1. Provide non-adjustable thermostats, calibrated and tested at factory to operate pipe heating system when temperature of pipe drops to 40°F.
 - Provide adjustable thermostats, calibrated and tested at factory to close alarm contracts when temperature of pipe drops to 35°F at its coldest location.
 - 3. Thermostats to have repeatability and maximum temperature differential of ±2°F.
 - 4. Provide thermostats with NEMA 4X enclosures.
 - C. Provide each cable with proper fittings and appurtenances for field connection of system to conduit and wiring without need for procurement of special fittings or wiring devices.
- PART 3 EXECUTION
- 3.01 INSTALLATION
 - A. Install pipe tracing cables where specified or indicated on Drawings in accordance with manufacturer's written instructions.
 - B. Coordinate circuit connection points and voltages with Drawings.
 - C. Apply "electrical traced" signs to outside of thermal insulation.

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3.02 FIELD QUALITY CONTROL

- A. Examine material for defects prior to installation.
- B. Examine final installation for damage and defects in workmanship prior to startup and installation of insulation.
- C. Prior to installation of insulation, start pipe tracing system and check for temperature increase over full length of each tracing cable.
- D. Prior to and after installation of insulation, heat trace circuits shall be tested with minimum 1,000 vac megger and readings recorded. Readings shall be minimum of 20 megohms regardless of circuit length. Take megger test between outer braid and 2 bus wires.

* * * END OF SECTION * * *



SECTION 16915 MISCELLANEOUS INSTRUMENT PANELS

- PART 1 GENERAL
- 1.01 SUMMARY
 - A. Provide instrumentation and control (I&C) panels as shown on Drawings.
- 1.02 DEFINITIONS
 - A. Systems House: Organization whose principal function is design, manufacture, and servicing of I&C systems.

1.03 SUBMITTALS

- A. Summit following information for each panel in accordance with Section 01340, tabulate in booklet form, and provide in one submittal.
 - Panel fabrication and dimension drawings, nameplate legends, and wiring and piping schematic diagrams.
 - 2. Equipment dimension drawings.
 - 3. Component specification sheets.
 - 4. Equipment terminal and piping connections.
 - Loop-by-loop system electrical schematic including terminal-toterminal interconnections between panel and field equipment.
 - 6. Instruction manuals including detailed operating sequence descriptions and controller I/O charts.
 - 7. Parts list.
- B. Operation and Maintenance (O&M) Data:
 - 1. Submit in accordance with Section 01730.

1.04 QUALITY ASSURANCE

- A. Standardization:
 - 1. Equipment shall be latest and most modern design at time of bidding.
 - 2. I&C equipment components shall be end product of one manufacturer to achieve standardization for maintenance, spare parts, operation, and service.
- B. Systems House's Services:
 - 1. Systems House shall provide services of qualified service engineer to supervise and inspect equipment installation to ensure it is installed in accordance with System House's recommendations.

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- Systems House's engineer for equipment specified herein shall be present at job site or classroom designated by OWNER for minimum of 7 mandays, travel time excluded, for assistance during construction startup, equipment adjustment, and training of OWNER'S personnel.
- Systems House shall provide, during first year after substantial completion of system, one 8-hr service call for preventive maintenance and to make necessary adjustments on no-charge basis.

1.05 RESPONSIBILITY AND COORDINATION

- A. Install, adjust, and place into satisfactory operation.
- B. Drawings and Specifications intended to identify overall system functions. Provide equipment necessary to provide complete and operable system whether specifically identified or not.
- C. Inspect and test at factory prior to shipment.
- D. Assume responsibility for additional costs resulting from deviations from Specifications.
- E. Coordinate startup with startup services for equipment furnished under other sections.
- 1.06 GUARANTEE
 - A. During guarantee period, furnish and install replacement parts for defective component at no additional cost, except for those items normally consumed in service.
- PART 2 PRODUCTS
- 2.01 ISC EQUIPMENT
 - A. Provide I&C system as shown on Drawings and specified herein.
 - B. Equipment provided in this section shall conform to following.
 - 1. Instrument and Control Panel Construction: Section 16930.
- PART 3 EXECUTION
- 3.01 INSTALLATION
 - A. Install panels in locations indicated on Drawings and in accordance with manufacturer's written instructions and approved submittals.

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B. Touch up paint on panels after installation.

* * * END OF SECTION * * *

SECTION 16930 INSTRUMENT AND CONTROL PANEL CONSTRUCTION

- PART 1 GENERAL
- 1.01 SUMMARY
 - A. Section Includes:
 - 1. Panel and enclosure requirements for entire instrumentation and control (I&C) system.
- 1.02 REFERENCES
- A. Instrument Society of America (ISA).
 - B. National Electrical Manufacturer's Association (NEMA).
- 1.03 QUALITY ASSURANCE
 - A. Test wiring and plumbing prior to shipment.
- PART 2 PRODUCTS
- 2.01 CONTROL PANELS
 - A. Factory fabricate, install instruments, plumb and wire in factory.
 - B. Make external connections except for data highway cables by way of numbered terminal blocks.
 - C. Conform to ISA standards.
- 2.02 PANEL CONSTRUCTION FOR OTHER THAN FREE-STANDING
 - A. Enclosures shall conform to NEMA requirements as follows.
 - 1. Inside Buildings: NEMA 12.
 - 2. Outside Buildings: NEMA 4X.
 - 3. Class I, Division 1 or 2 Areas: NEMA 7.
 - B. In addition to NEMA standards, conform to following requirements.
 - 1. Minimum Metal Thickness: 14 ga.
 - 2. Doors: rubber-gasketed with continuous hinge.
 - Wherever practical, enclosures shall be manufacturer's standard product.
 - 4. Size to adequately dissipate heat generated by equipment mounted in or on panel.

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5. Equip panels mounted outside buildings with thermostatically controlled space heaters capable of maintaining internal temperature of 10° C, $\pm 2^{\circ}$ C, with 20 mph wind at ambient temperature of -30° C. Heaters shall operate on 110 vac, 60 Hz power.

2.03 STANDARD SIGNAL INTERFACES

- A. Unless otherwise specified, discrete input and output signals shall conform to following.
 - 1. Isolated unpowered (dry) contact closures.
 - 2. Power contact from panel receiving signal or device receiving signal.
- 2.04 PANEL FINISH
 - A. Sand panel and remove mill scale, rust, grease, and oil. Fill imperfections and sand smooth.
 - B. Paint interior and exterior with one coat of epoxy coating metal primer, 2 finish coats of 2-component type epoxy enamel.
 - C. Sand surfaces lightly between coats.
 - D. Dry film thickness shall not be less than 3.0 mils.
 - E. Color: Selected by OWNER.

2.05 NAMEPLATES

- A. Provide nameplates for I&C panels and each front-of-panel instrument and device with designations as shown on Drawings and as listed in Specifications.
- B. Panel Designation: Engraved with DESIGNER'S panel tag number and description with 1/2 in. high characters.
- C. Application/Function Nameplate: Locate 3/16 in. characters above or near panel mounted instrument or device consisting of descriptive phrase using nomenclature as listed in Specifications (when available).
- D. Tag Number: Include DESIGNER'S tag number as shown on P&ID and in Specifications on each nameplate.
- E. Laminated white plastic inscribed with black characters.
- F. Provide aluminum decal with black 3/16 in. characters on top side at rear of instrument on or near each device on rear side of panel using tag number or device designation.

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- G. Secure front-of-panel and front-of-instrument nameplate with drive screws or self-tapping fasteners.
- 2.06 SPARE PARTS
 - A. Provide minimum of 5 or 10%, whichever greater, for each type of fuse used on Project.
 - B. Provide minimum of 30% spare terminals; to be shown as such on panel drawings.
- PART 3 EXECUTION
- 3.01 INSTALLATION
 - A. Install panels in locations indicated on Drawings and in accordance with manufacturer's written instructions and approved submittals.
 - B. Touch up panel after installation.

* * * END OF SECTION_ * * *

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