

- D. Install welded wire fabric in as long lengths as practical. Lap adjoining pieces at least one full mesh and lace splices with 16 gauge wire and tie.
- E. Provide sufficient numbers of supports of strength required to carry reinforcement without sagging. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
- F. Splices: Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown for minimum lap of spliced bars.
- G. Dowels to be embedded a minimum of 8 inches into existing concrete unless otherwise specified on the drawings. Grout with an approved epoxy grout, per Section 03600 of these Specifications.
- H. Existing concrete which is shown to remain but is removed in error or must be removed to install new work is to be reinforced to the extent as required and approved by the Engineer. This work will be performed with no additional compensation to the Contractor.
- I. Do not straighten or rebend reinforcing.
- J. Reinforcement Around Openings: Place an equivalent area of steel around the pipe or openings and extend on each side sufficiently to develop bond in each bar. See the Details on the Drawings for bar extension length each side of openings. Where welded wire fabric is used, provide extra reinforcing using fabric or deformed bars.
- K. Welded Reinforcement: Welding shall not be permitted unless the Contractor submits detailed shop drawings, qualifications, and radiographic nondestructive testing procedures for review by the Engineer. Reinforcing bars to be welded shall conform to ASTM A706; other bars shall not be welded. The Contractor shall obtain the Engineer's approval prior to proceeding. The basis for the Contractor submittals shall be The Structural Welding Code, Reinforcing Steel, AWS D1.4-79, published by the American Welding Society and the applicable portions of ACI 318, current edition. The Contractor shall test 10 percent of all welds using radiographic, nondestructive testing procedures referenced in this code.

3.02 INSPECTION OF REINFORCEMENT

- A. After the rebar, appliance, anchors and embedment have been installed and checked, the Contractor shall review all aspects of the pending concrete pour and initial those items on its pour card. Contractor shall notify the Engineer no less than 24 hours prior to the pour, so that the Engineer may check the area and pour. No concrete shall be placed until this is complete.
- B. Concrete shall not be placed until the reinforcing steel is inspected and permission for placing concrete is granted by the Engineer. All concrete placed in violation of this provision will be rejected. Rejected concrete shall be removed and replaced at no cost to the County.

+++ END OF SECTION 03200 +++

**SECTION 03250
CONCRETE JOINTS****PART 1 - GENERAL****1.01 SCOPE**

- A. Contractor shall furnish all labor, materials, equipment and incidentals required to provide concrete joints as shown and specified.
- B. The types of concrete joints required include the following:
 - 1. Construction joints.
 - 2. Expansion joints and fillers.
 - 3. Waterstops.
- C. General: All joints subject to hydrostatic pressure shall be provided with continuous waterstop.
- D. Related Work specified elsewhere:
 - 1. Section 03100 - Concrete Formwork.
 - 2. Section 03200 - Concrete Reinforcement and Dowelling
 - 3. Section 03300 - Cast-In-Place Concrete.

1.02 SUBMITTALS

- A. Prior to delivery of materials, submit the following for review and approval:
 - 1. Product data for all materials stating the location where product is to be used.
 - 2. Certification that materials meet the specifications.
 - 3. Manufacturer's application and installation instructions.
 - 4. Samples of water stops, concrete roughener, joint fillers, caulk and bonding agent if requested by the Engineer.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
 - 1. ACI 301, Specifications for Structural Concrete for Buildings, Chapter 6, Joints and Embedded Items.
 - 2. ACI 350, Environmental Engineering concrete structures, Chapter 2.8, Joints.
 - 3. ASTM D 1752, Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
- B. All manufactured items shall be installed in accordance with manufacturer's instructions.

- C. Construction and expansion joints shall not be added or relocated without the approval of the Engineer.

PART 2 - PRODUCTS

2.01 JOINT SEALER

- A. Materials shall be two component, polyurethane meeting ASTM-C-920 and FED SPEC TT-S-00227E specifications. Materials shall have \pm 50% movement.
- B. Manufacturer and Product shall be:
1. Horizontal Joint - Sikaflex 2C Self Leveling by Sika Corp or equal.
 2. Vertical Joint - Sikaflex 2C Non-Sag by Sika Corp or equal.

2.02 CONSTRUCTION JOINTS

- A. Bonding Agent - Shall meet ASTM C 881 with a bond strength of 1500 psi minimum. Agent shall be capable of spraying in inaccessible locations, if necessary.
1. Manufacturer and Product shall be:
 - a. Sika Armatic 110 by Sika Corp.
 - b. Sikadur 32 Hi-Mod by Sika Corp.
 - c. Or equal.

2.03 JOINT FILLER

- A. Expansion Joint Material: Type I, preformed sponge neoprene expansion joint filler conforming to AASHTO Designation M-153.

2.04 WATERSTOPS

- A. Waterstop shall be PVC (Polyvinylchloride) meeting ASTM D-638 test method for tensile strength of 2020 psi and ultimate elongation of 370.
1. Construction joints:
 - a. Serrated with center bulb, 3/8" thick by 6" minimum width, Greanstreak #706 or equal.
 - b. Preformed plastic adhesive waterstop, Synko-Flex Products or equal. Use only where shown on Drawings.
 2. Expansion Joints: Serrated with center bulb, 3/8" thick by 9" minimum width, Greanstreak #738 or equal.

PART 3 - EXECUTION

3.01 CONSTRUCTION JOINTS

- A. General:
1. Comply with ACI 301, Chapter 6, and ACI 350, Chapter 2.8.3 and as specified below.
 2. Provide waterstops in construction joints as shown and as specified in this Section.

3. All joints between new and existing concrete to comply with Article 3.01 of this Section.

B. Installation:

1. Brush blast new and existing concrete surfaces at joint and surrounding area. Dry, oil-free air to be used for blasting operation. Blasting to be sufficient to remove laitance and solid contaminants, open up surface voids, bugholes, air pockets and other subsurface irregularities but not expose underlying aggregate. The abrasive to be dry and clean and will pass through a 16 mesh screen. After blast cleaning is completed, residual abrasive dust and loose particles are to be removed from the surface by vacuuming or by compressed air. Blasting operation is to be repeated if requested by the Engineer at no additional compensation to the Contractor.
2. Install waterstop and bonding agent per manufacturer recommendations and this Section. Spray on epoxy bonding agent in inaccessible areas per manufacturer's recommendations.
3. Place a 6-inch grout charge of similar proportions to the cement in the concrete, over the damp, clean horizontal contact surface of the old concrete. Place fresh-concrete before the grout has attained its initial set. Grout shall be ordinary cement-sand grout as specified in Section 03600.
4. When concrete has been placed and the form removed, wash loosened material off with high pressure water spray to obtain roughened surface subject to approval by Engineer, prior to rub finish.
5. Cure concrete sufficiently prior to placement of joint filler and epoxy coating to obtain optimum bond as per manufacturer's recommendations.
6. Apply approved epoxy coating per. Section 09900.
7. Install appliances per drawings and specifications.

3.02 WATERSTOPS

A. General:

1. Comply with ACI 301, Chapter 6, Section 3.01 B and as specified below. All joints shall be made in accordance with manufacturer's instructions.
2. Obtain Engineer's approval for waterstop locations not shown.

B. Polyvinyl Chloride Waterstop:

1. Tie waterstop to reinforcement so that it is securely and rigidly supported in the proper position during concrete placement to insure their proper positioning. Puncturing waterstop with tire wire to secure it to reinforcement is prohibited.
2. Waterstops shall be fused using equipment as supplied by or recommended by the manufacturer. Heat welded at all splice points.
3. Provide sufficient bed of epoxy grout, after sandblasting, cleaning roughening and priming the surface, so as to fill all voids including the "V" at the split.
4. Install split-bulb PVC waterstop onto the non-shrink, non-metallic grout bed. Mount

waterstop to wall using two (2) 1/4" x 2" type 316 stainless steel strips on either side of the waterstop anchored with 1/2" diameter type 316 stainless steel anchor bolts on 12" centers.

5. Fill all voids between the waterstop and the concrete with approved epoxy grout with no additional compensation to the Contractor if injection method is used.
6. Obtain final Engineer's approval of the waterstop installation prior to placing concrete.

+ + + END OF SECTION 03250 + + +

**SECTION 03300
CAST-IN-PLACE CONCRETE****PART 1 - GENERAL****1.01 SCOPE****A. General**

1. Contractor shall furnish all labor, materials, equipment and incidentals needed to provide form work, reinforcement, concrete including all concrete joints, grout and incidentals required to complete the Work as shown and specified.
2. The Work includes providing concrete consisting of portland cement, fine and coarse aggregate, water, and approved admixtures combined, mixed, transported, placed, finished and cured. The Work also includes:
 - a. Providing openings in concrete to accommodate the Work under this and other Sections and building into the concrete all items such as sleeves, frames, anchor bolts, inserts and all other items to be embedded.
 - b. Providing openings in concrete to accommodate the work under other contracts and building into the concrete all items such as sleeves, frames, anchor bolts, inserts and all other items required to be embedded under other contracts.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed in the concrete as a prime responsibility of the Contractor.
2. Notify other contractors in advance of the placing of concrete to provide the other contractors with sufficient time for furnishing of items included in their contracts that must be installed in the concrete.
3. Required County formal pour card with all required signatures.

C. Classes of Concrete:

1. Class "A" concrete 4,000 psi compressive strength at 28 days shall be steel reinforced and includes the following:
 - a. Foundations.
 - b. Walls.
 - c. Slab on grade.
 - d. Beams.
 - e. Elevated concrete floors.
 - f. Columns.
2. Class "B" concrete 3,000 psi compressive strength at 28 days shall be placed without forms or with simple forms, with little or no reinforcing, and includes the following:
 - a. Sidewalks.
 - b. Curbs.
 - c. Pavement
 - d. Thrust blocking.

- e. Fence Post footing.
- f. Mud Slabs.
- g. Fill concrete.

D. Related Work specified elsewhere:

- 1. Section 01000, General Specifications
- 2. Section 02200, Earthwork
- 3. Section 02575, Removing and Replacing Pavement
- 3. Section 03100, Concrete Formwork
- 4. Section 03250, Concrete Joints
- 5. Section 03200, Concrete Reinforcement & Dowelling

1.02 SUBMITTALS

- A. Samples: Submit samples of materials as specified and as otherwise may be requested by the Engineer, including names, sources and descriptions.
- B. Shop Drawings: Submit for approval the following:
 - 1. List of concrete materials and concrete mix designs proposed for use. Include the results of all tests performed to qualify the materials and to establish the mix designs.
 - 2. Copies of manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
- C. Laboratory Test Reports: Submit copies of laboratory test reports for concrete cylinders, materials and mix design tests. ENGINEER'S review will be for general information only. Production of concrete to comply with specified requirements is the responsibility of the Contractor. Submit the testing lab's average strength curve from the design mix proportions of the approved materials.
- D. Submit notarized certification of conformance to referenced standards to the Engineer and a copy of the batch plant's most recent scale calibration.
- E. Delivery Tickets: Furnish to Engineer copies of all delivery tickets for each load of concrete delivered to the site. Provide items of information as specified in ASTM C 94, Section 14.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with the applicable provisions and recommendations of the latest edition following, except as otherwise shown or specified.
 - 1. ACI 301-81, Specification for Structural Concrete for Buildings, (includes ASTM Standards referred to herein).
 - 2. ACI 304-83, Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
 - 3. ACI 305-82, Recommended Practice for Hot Weather Concreting.
 - 4. ACI 306-78, Recommended Practice for Cold Weather Concreting.
 - 5. ACI 308-81, Standard Practice for Curing Concrete.
 - 6. ACI 309-82, Recommended Practice for Consolidation of Concrete.
 - 7. ACI 318-89, Building Code Requirements for Reinforced Concrete.
 - 8. ACI 350-88.
 - 9. ACI 347-78, Recommended Practice for Concrete Formwork.
 - 10. ASTM C31-85, Standard Method of Making and Curing Concrete Test Specimens in the Field.

11. ASTM C33-86, Standard Specification for Concrete Aggregates.
12. ASTM C39-86, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
13. ASTM C40-86, Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
14. ASTM C42-84a, Standard Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
15. ASTM C94-86a, Standard Specification for Ready-Mixed Concrete.
16. ASTM C138-81, Standard Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Concrete.
17. ASTM C143-78, Standard Test Method for Slump of Portland Cement Concrete.
18. ASTM C150-85a, Standard for Portland Cement.
19. ASTM C157-86, Standard Test Method for Length Change of Hardened Cement Mortar and Concrete.
20. ASTM C171-69, (1986) Standard Specification for Sheet Materials for Curing Compounds.
21. ASTM C172-82, Standard Method of Sampling Freshly Mixed Concrete.
22. ASTM C173-78, Standard Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
23. ASTM C192-81, Standard Method of Making and Curing Concrete Test Specimens in the Laboratory.
24. ASTM C231-82, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
25. ASTM C260-86, Standard Specification for Air-Entraining Admixtures for Concrete.
26. ASTM C494-86, Standard Specification for Chemical Admixtures for Concrete.
27. ASTM C827-82, Standard Test Method for Early Volume Change of Cementitious Mixtures.
28. Federal Specification CCC-C-467C: Cloth, Burlap Jute or Kenaf.

B. Concrete Testing Service:

1. By Contractor's Testing Laboratory:
 - a. Contractor shall employ, at its own expense, a testing laboratory, approved by the Engineer and experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes.
 1. Testing agency shall meet the requirements of ASTM E 329.
 2. Selection of a testing laboratory must be approved by the Engineer.
 3. Submit a written description of the proposed concrete testing laboratory giving qualifications of personnel, laboratory facilities and equipment, and other information which may be requested by the Engineer.
 - b. Materials and installed Work may require testing and retesting, as directed by the Engineer, at any time during the progress of the Work. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be done at the County's expense, including the retesting of rejected materials and installed Work, shall be done at the Contractor's expense.
2. By Independent Testing laboratory
 - a. Testing for concrete field quality control as specified under Paragraph 3.07 of this Specification, shall be performed by an independent testing laboratory approved by the Engineer. The cost of all concrete testing for field quality control, except as otherwise specified, shall be paid from the Concrete Testing Allowance included in this contract and shall not be included in the Contractor's base bid. The Contractor shall be responsible for notifying the independent testing laboratory to schedule the testing as specified.

C. Qualifications of Water-Reducing Admixture Manufacturer:

1. Water-reducing admixtures shall be manufactured under strict quality control in facilities operated under a quality assurance program. Contractor shall furnish copy of manufacturer's quality assurance handbook to document the existence of the program. Manufacturer shall maintain a concrete testing laboratory which has been approved by the Cement and Concrete Reference Laboratory at the Bureau of Standards, Washington, D.C.
2. Provide a qualified concrete technician employed by the admixture manufacturer to assist in proportioning the concrete for optimum use of the admixture. The concrete technician, when requested, shall advise on proper addition of the admixture to the concrete and on adjustment of the concrete mix proportions to meet changing job site conditions.

D. Test for Concrete Materials:

1. Submit written reports to the Engineer, for each material selected and tested, prior to the start of Work. Provide the Project identification name and number, date of report, name of Contractor, name of concrete testing service, source of concrete aggregates, material manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material, and test results. Indicate acceptability of materials for intended use.
2. Have the approved testing lab run a sample load of the design mix and make a minimum of 12 test cylinders. Then have lab do cylinder breaks at 3,7,21 and 28 days and plot an average strength curve for the mix design. Submit it to Engineer prior to any concrete pour.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All materials used for concrete must be kept clean and free from all foreign matter during transportation and handling and kept separate until measured and placed in the mixer. Bins or platforms having hard clean surfaces shall be provided for storage. Suitable means shall be taken during hauling, piling and handling to insure that segregation of the coarse and fine aggregate particles does not occur and the grading is not affected.

PART 2 - PRODUCTS**2.01 CONCRETE MATERIALS**

A. Cement:

1. Portland cement, ASTM C 150, Type II.
2. Use portland cement made by a qualified, acceptable manufacturer and produced by not more than one plant.
3. Do not use cement which has deteriorated because of improper storage or handling.
4. Type I cement NOT PERMITTED.

B. Aggregates: ASTM C 33 and as herein specified.

1. Do not use aggregates containing soluble salts or other substances such as iron sulfides, pyrite, marcasite, ochre, or other materials that can cause stains on exposed concrete surfaces. Slag materials are not allowed.

2. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.
 - a. Dune sand, bank run sand and manufactured sand are not acceptable.
 3. Coarse Aggregate: Clean granitic, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter as follows:
 - a. Crushed stone, processed from natural rock or stone.
 - b. Coarse Aggregate Size: Size to be ASTM C 33, Nos. 57 or 67, except that No. 467 may be used for footings, foundation mats and walls 16 inches or greater in thickness.
- C. Water: Clean, free from injurious amounts of oils, acids, alkalis, organic materials or other substances that may be deleterious to concrete or steel.

2.02 CONCRETE ADMIXTURES

- A. Provide admixtures produced by established reputable manufacturers, and use in compliance with the manufacturer's printed instruction. Do not use admixtures, which have not been incorporated and tested in the accepted mixes, unless otherwise authorized in writing by the Engineer.
- B. Air-Entraining Admixtures: ASTM C 260.
1. Product and Manufacturer: Provide one of the following:
 - a. Daravair as manufactured by Grace Construction Products.
 - b. MB-VR as manufactured by Master Builders Company.
 - c. Sika AER as manufactured by Sika Chemical corporation.
 - d. Air Entraining Agent as manufactured by W. R. Meadows.
 - e. Or equal.
 2. Air entrainment required for all concrete used on this project.
- C. Water-Reducing Admixture: ASTM C 494, Type A.
1. Proportion all concrete with non-air entraining, normal setting, water-reducing, aqueous solution of a modification of the salt of polyhydroxylated organic acids. The admixture shall not contain more chloride ions than are contained in municipal drinking water. Provide one of the following:
 - a. WRDA-86 as manufactured by Grace Construction Products.
 - b. Pozzoloth by Master Builders Company.
 - c. Plastocrete 161 as manufactured by Sika Chemical corporation
 - d. Approved Equal.
 2. Water-reducing admixture required for all type A and B concrete unless directed otherwise by the Engineer.
- D. Calcium Chloride: Do not use calcium chloride in concrete.
- E. Do not use a retarder in the concrete, unless written permission is given by Engineer.

2.03 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes of concrete. Use the same design mix for both classes of concrete. Mixes

subject to the following limitations:

1. Specified 28-day Compressive Strength:
 - a. Class A - 4,000 psi.
 - b. Class B - 3,000 psi.
2. Maximum Water-Cement Ratio by Weight: .45.

Coarse Aggregate Number	Minimum Cement Content, Pounds Per Cubic Yard	Percent Air Content
57,67	564	6 ± 1%
467	517	5 1/2 ± 1%

- B. Use an independent testing facility approved by the Engineer for preparing and reporting proposed mix designs.
 1. The testing facility shall not be the same as used for field quality control testing.
 2. Calibration charts on the lab equipment must be submitted.
- C. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the Project for concrete required. Comply with ACI 211.1 and report to the Engineer the following data:
 1. Complete identification of aggregate source of supply.
 2. Tests of aggregates for compliance with specified requirements.
 3. Scale weight of each aggregate.
 4. Absorbed water in each aggregate.
 5. Brand, type and composition of cement.
 6. Brand, type and amount of each admixture.
 7. Amounts of water used in trial mixes.
 8. Proportions of each material per cubic yard.
 9. Gross weight and yield per cubic yard of trial mixtures.
 10. Measured slump.
 11. Measured air content.
 12. Compressive strength developed at 3, 7, 21 and 28 days, from not less than 3 test cylinders cast for each 7-day and 28-day test, and for each design mix.
- D. Submit written reports to the Engineer of proposed mix of concrete at least 15 days prior to start of Work. Do not begin concrete production until mixes have been approved by the Engineer.
- E. Laboratory Trial Batches: When laboratory trial batches are used to select concrete proportions,

prepare test specimens and conduct strength test as specified in ACI 301, Chapter 3 - Proportioning, Method 1. 4,000 psi concrete mixes need not be designed for greater than 4,600 psi regardless of the production facilities standard deviation.

- F. Field Experience Method: When field experience methods are used to select concrete proportions, establish proportions as specified in ACI 301, Chapter 3, Method 2.
- G. Water-Cement Ratio Methods: If suitable data from field experience or laboratory trial batches cannot be obtained, concrete proportions may be established as specified in ACI 301, Chapter 3, Method 3.
- H. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to the County and as accepted by Engineer. Laboratory test data for revised mix designs and strength results must be submitted to the Engineer for acceptance before using the revised mixes.
- I. Admixtures:
 - 1. Use air-entraining and water reducer admixtures in all concrete. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at the point of placement having air content within the prescribed limits.
 - 2. Use amounts of admixtures as recommended by the manufacturer for climatic conditions prevailing at the time of placing. Adjust quantities and types of admixtures as required to maintain quality control.
- J. Slump Limits:
 - 1. Proportion and design mixes to result in concrete slump at the point of placement as follows:
 - a. For footings and substructure walls, not less than 1 inch and not more than 3 inches.
 - b. For slabs on grade, elevated concrete floor, beams, walls and columns, not less than 1 inch and not more than 4 inches.

2.04 CHEMICAL HARDENER

- A. Unless otherwise specified, all interior concrete floors shall be treated with a liquid hardener composed of magnesium and zinc fluorosilicates combined with an anionic surfactant for improved wetting penetration. Liquid hardener shall be colorless, nontoxic, nonflammable, and compatible with and providing good adhesion for subsequent toppings and/or coatings. Liquid hardener shall be suitable for use on new or old concrete floors and shall comply with Corps of Engineer Specification 204.

2.05 EPOXY FLOOR SEALER

- A. Epoxy floor sealer shall be two-component, 100 percent solids, epoxy coating that provides a smooth, tough, flexible, wear abrasion, and chemical resistant surface. Sealer shall be U.S.D.A. approved for use in food processing plants. Epoxy floor sealer shall be applied on the operating floor, screening areas (except where concrete coatings are specified), storage area, truck entrance, MCC room and mechanical room. Unless otherwise specified, sealer shall be colored gray.

2.06 CONCRETE COATINGS

- A. Provide concrete coating TNE MEC Series 61, TNE MEC Liner or equal.

2.07 EPOXY BONDING AGENT

- A. Provide an epoxy-resin bonding agent as specified in Section 03250 of the Specifications, everywhere new concrete is poured against old or when the new concrete has been left 30 days or more without the following new pour place against it.

2.08 CONCRETE CURING MATERIALS

- A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 10 ounces per square yard and complying with AASHTO M 182, Class 3.
- B. Moisture-Retaining Cover: One of the following, complying with ASTM C 171:
 - 1. Waterproof paper.
 - 2. 4 mil polyethylene.
- C. Curing and Sealing Compound: ASTM C-309:
 - 1. Product and Manufacturer: Provide one of the following:
 - a. Res-X curing compound as manufactured by the Burke Company.
 - b. Masterkure as manufactured by Master Builders Company.
 - c. Concrete Curing Compounds as manufactured by W. R. Meadows, Inc.
 - d. Or equal.

PART 3 - EXECUTION

3.01 CONCRETE MIXING

- A. General:
 - 1. Concrete may be produced at batch plants or it may be produced by the ready-mixed process. Batch plants shall comply with the recommendations of ACI 304, and shall have sufficient capacity to produce concrete of the qualities specified, in quantities required to meet the construction schedule. All plant facilities are subject to testing laboratory inspection and acceptance of the Engineer.
 - 2. Mixing:
 - a. Mix concrete with an approved rotating type batch machine, except where hand mixing of very small quantities may be permitted.
 - b. Remove hardened accumulations of cement and concrete frequently from drum and blades to assure acceptable mixing action.
 - c. Replace mixer blades when they have lost 10 percent of their original height.
 - d. Use quantities such that a whole number of bags of cement is required, unless otherwise permitted.
- B. Ready-Mix Concrete:
 - 1. Comply with the requirements of ASTM C 94, and as herein specified. Proposed changes in mixing procedures, other than herein specified, must be accepted by the Engineer before implementation.

- a. Plant equipment and facilities: Conform to National Ready Mix Concrete Association "Plant and Delivery Equipment Specification".
 - b. Mix concrete in revolving type truck mixers which are in good condition and which produce thoroughly mixed concrete of the specified consistency and strength.
 - c. Do not exceed the proper capacity of the mixer.
 - d. Mix concrete for a minimum of two minutes after arrival at the job site, or as recommended by the mixer manufacturer.
 - e. Do not allow the drum to sit while in transit.
 - f. Mix at proper speed until concrete is discharged.
 - g. Maintain adequate facilities at the job site for continuous delivery of concrete at the required rates.
 - h. Provide access to the mixing plant for the Engineer at all times.
- C. Maintain equipment in proper operating condition, with drums cleaned before charging each batch. Schedule rates of delivery in order to prevent delay of placing the concrete after mixing, or holding dry-mixed materials too long in the mixer before the addition of water and admixtures.

3.02 TRANSPORTING CONCRETE

- A. Transport and place concrete not more than 60 minutes after water has been added to the dry ingredients.
- B. Take care to avoid spilling and separation of the mixture during transportation.
- C. Do not place concrete in which the ingredients have been separated.
- D. Do not retemper partially set concrete, and do not add any water at the jobsite.
- E. Use suitable and approved equipment for transporting concrete from mixer to forms.

3.03 CONCRETE PLACEMENT

- A. General: Place concrete continuously so that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. Where new concrete is placed next to existing, or a section cannot be placed continuously, provide construction joints as specified in Section 03250 of these Specifications. Apply approved epoxy bonding agent and waterstop as close as possible to time of actual concrete placement. Do not allow epoxy bonding agent to dry. Deposit concrete as nearly as practical in its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which will cause segregation.
 1. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.
 2. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from the job site and dispose of it in an acceptable location.
 3. Do not place concrete until all forms, bracing, reinforcement, and embedded items are in final and secure position.
 4. Unless otherwise approved, place concrete only when Engineer is present.
- B. Concrete Conveying:

1. Handle concrete from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit as rapidly as practical by methods which will prevent segregation and loss of concrete mix materials.
 2. Provide mechanical equipment for conveying concrete to ensure a continuous flow of concrete at the delivery end. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, snow, ice and other deleterious materials.
 3. Do not use chutes for distributing concrete unless approved in writing by the Engineer.
 - a. Provide sketches showing methods by which chutes will be employed when requesting such approval.
 - b. Design chutes, if permitted, with proper slopes and supports to permit efficient handling of the concrete.
 4. Pumping of concrete is permitted however; do not use aluminum piping to convey the concrete.
- C. Placing Concrete into Forms:
1. Deposit concrete in forms in horizontal layers not deeper than 18 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place concrete at such a rate that concrete which is being integrated with fresh concrete is still plastic with adequate vibration.
 2. Do not permit concrete to free fall within the form from a distance exceeding 4 feet. Use "elephant trunks" and tremies to prevent free fall and excessive splashing on forms and reinforcement.
 3. Remove temporary spreaders in forms when concrete placing has reached the elevation of such spreaders.
 4. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with the applicable recommended practices of ACI 309. Vibration of forms and reinforcing will not be permitted, unless otherwise accepted by the Engineer.
 5. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the layer of concrete and at least 6 inches into the preceding layer. So not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.
 6. Force concrete under pipes, sleeves, openings and inserts from one side until visible from the other side to prevent voids.
- D. Placing Concrete Slabs and Sidewalks:
1. Deposit and consolidate concrete slabs in a continuous operation, within the limits of expansion joints, until the placing of a panel or section is completed.
 2. Consolidate concrete during placing operations using mechanical vibrating equipment, so

that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

3. Bring slab surfaces to the correct level. Smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations. Coordinate applying contraction joint, per Section 03250, with finishing operations.
- E. Bonding for Next Concrete Pour: Comply with Division 03250 and 03300 of these Specifications.
- F. Quality of Concrete Work:
1. Make all concrete solid, compact and smooth, and free of laitance, cracks and cold joints.
 2. All concrete for liquid retaining structures, and all concrete in contact with earth, water, or exposed directly to the elements shall be watertight.
 3. Cut out or chip out and properly replace to the extent ordered by the Engineer, or repair to the satisfaction of the Engineer, surfaces which contain cracks or voids, are unduly rough, or are in any way defective. Thin patches or plastering will not be acceptable.
 4. All leaks through concrete, and cracks, holes or other defective concrete in areas of potential leakage, shall be repaired and made watertight by the Contractor.
 5. Repair, removal, and replacement of defective concrete as ordered by the Engineer shall be at no additional cost to the County.
- G. Cold Weather Placing:
1. Protect all concrete Work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 306 and as herein specified.
 2. When the air temperature has fallen to or may be expected to fall below 40 F, provide adequate means to maintain the temperature, in the area where concrete is being placed, at between 50⁰ F and 70⁰ F for at least seven days after placing. Provide temporary housings or coverings including tarpaulins or plastic film. Maintain the heat and protection, if necessary, to insure that the ambient temperature does not fall below 30⁰ F in the 24 hours following the seven-day period. Avoid rapid dry-out of concrete due to overheating, and avoid thermal shock due to sudden cooling or heating.
 3. When air temperature has fallen to or is expected to fall below 40 F uniformly, heat all water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 55⁰ F and not more than 90⁰ F at point of placement.
 4. Do not use frozen materials containing ice or snow. Ascertain that forms, reinforcing- steel, and adjacent concrete surfaces are entirely free of frost, snow and ice before placing concrete.
 5. Do not use salt and other materials containing anti freeze agents or chemical accelerators, or set-control admixtures, unless approved by the Engineer, in mix designs.
- H. Hot Weather Placing:
1. When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

2. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90° F when the temperature is rising and below 85° F when the temperature is falling. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated by the Engineer in the total amount of mixing water.
3. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
4. Wet forms thoroughly before placing concrete.
5. Do not place concrete at a temperature so as to cause difficulty from loss of slump, flash set, or cold joints.
6. Do not use set-control admixtures unless approved by the Engineer in mix designs.
7. Obtain ENGINEER'S approval of other methods and materials proposed for use.

3.04 FINISH OF FORMED SURFACES

A. Rough Form Finish:

1. Standard rough form finish shall be the concrete surface having the texture imparted by the form material used. For vertical surfaces, all tie holes and defective areas to be repaired and patched with mortar of 1 part cement to 1 1/2 parts sand and all fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.
2. Use rough form finish for the following:
 - a. Exterior vertical surfaces up to 1 foot below grade.
 - b. Interior exposed vertical surfaces of liquid containers up to operating floor level except areas to receive sealers and/or coatings.
 - c. Undersides of breakaway of slabs.
 - d. Other areas shown.

B. Smooth Form Finish:

1. Produce smooth form finish by selecting form materials which will impart a smooth, hard, uniform texture. Arrange panels in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas as above with all fins or other projections completely removed and smoothed.
2. Use smooth form finish for surfaces that are to be covered with a coating material. The material may be applied directly to the concrete or may be a covering bonded to the concrete such as waterproofing, damp proofing, painting or other similar system.

C. Smooth Rubbed Finish:

1. Provide smooth rubbed finish in accordance with ACI 301-84, to concrete surfaces which have received smooth form finish and receive as follows:
 - a. Rubbing of concrete surfaces not later than the day after form removal.
 - b. Moistening of concrete surfaces and rubbing with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that

created by the rubbing process, unless the Engineer review and approves.

2. Except where surfaces have been previously covered as specified above, use smooth rubbed finish for the following:
 - a. Exterior exposed walls and other vertical surfaces down to 1 foot below grade.
 - b. Exterior horizontal surfaces, except exterior exposed slabs and sidewalks.
 - c. Interior exposed vertical surfaces.
 - d. Other areas shown.

D. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces, unless otherwise shown.

3.05 MONOLITHIC SLAB FINISHES

A. Float Finish:

1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently. Use a wood float only. Check and level the surface plane to a tolerance not exceeding 1/4 inch in 10 feet when tested with a 10 foot straightedge placed on the surface at not less than 2 different angles. Cut down high spots and fill all low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat the surface to a uniform, smooth, granular texture.

B. Trowel Finish:

1. After floating, begin the first trowel finish operation using a power-finish trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.
2. Consolidate the concrete surface by final hand troweling. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8 inch in 10 feet when tested with a 10 foot straight edge, and all edges adjacent to walls will have a struck, tooled intersection joint. Apply to operating floor slab.

C. Non-Slip Broom Finish:

1. Apply non-slip broom finish to exterior concrete platforms, sidewalks, drives, interior drive areas and elsewhere as shown on the Drawings or in schedules.
2. Immediately after trowel finishing, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use fiber-bristle broom unless otherwise directed. Coordinate the required final finish with the Engineer before application.

3.06 CONCRETE CURING AND PROTECTION

A. General:

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.
2. Start initial curing after placing and finishing concrete as soon as free moisture has

disappeared from the concrete surface. Keep continuously moist for not less than 72 hours.

3. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7 days and in accordance with ACI 301 procedures. Avoid rapid drying at the end of the final curing period.

B. Curing Methods:

1. Perform curing of all concrete by moist curing or by moisture-retaining cover curing. Use curing compound when approved by the ENGINEER and as herein specified. For curing, use water that is free of impurities which could etch or discolor exposed, natural concrete surfaces.
2. Provide moisture curing by any of the following methods:
 - a. Keeping the surface of the concrete continuously wet by covering with water.
 - b. Continuous water-fog spray.
 - c. Covering the concrete surface with the specified absorptive cover, thoroughly saturating the cover with water, and keeping the absorptive cover continuously wet with sprinklers or porous hoses. Place absorptive cover so as to provide coverage of the concrete surfaces and edges, with a 4-inch lap over adjacent absorptive covers.
3. Provide moisture-retaining cover curing as follows:

Cover the concrete surfaces with the specified moisture-retaining cover for curing concrete, placed in the widest practical width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during the curing period using cover material and waterproof tape.

4. Provide liquid curing compound as follows:

Apply the specified curing and sealing compound to all exposed slabs not receiving chemical hardener or epoxy floor sealer. The compounds shall be applied immediately after final finishing in a continuous operation by power spray equipment in accordance with the manufacturer's directions. Recoat areas which are subjected to heavy rainfall within 3 hours after initial application. Maintain the continuity of the coating and repair damage to the coat during the entire curing period. For concrete surfaces which will be in contact with potable water, the manufacturer shall certify that the curing compound used is nontoxic. Liquid curing compound will only serve as the initial step. Final cure by providing a moisture-retaining cover. Curing compound with petroleum or wax bases are not acceptable.

C. Curing Formed Surfaces:

1. Cure formed concrete surfaces, including the walls, supported slabs and other similar surfaces by moist curing with the forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as approved by the Engineer.

D. Curing Unformed Surfaces:

1. Initially cure unformed surfaces, such as slabs, sidewalks and other flat surfaces by applying the specified curing compound.
2. Final cure unformed surfaces, unless otherwise specified, by moisture-retaining cover curing.

3. Provide moisture curing for surfaces receiving chemical hardener or epoxy floor sealer.

E. Temperature of Concrete During Curing:

1. When the atmospheric temperature is 40⁰ F and below, maintain the concrete temperature between 50⁰ F and 70⁰ F continuously throughout the curing period. When necessary, make arrangement before concrete placing for heating, covering, insulation or housing as required to maintain the specified temperature and moisture conditions continuously for the concrete curing period. Provide cold weather protection complying with the requirements of ACI 306.
2. When the atmospheric temperature is 80⁰ F and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation of wind breaks or shading, and for fog spraying, wet sprinkling, or moisture-retaining covering. Protect the concrete continuously for the concrete curing period. Provide hot weather protection complying with the requirements of ACI 305, unless otherwise specified.
3. Maintain concrete temperature as uniformly as possible, and protect from rapid atmospheric temperature changes. Avoid temperature changes in concrete which exceed 5⁰ F in any one hour and 50⁰ F in any 24 hour period.

F. Protection from Mechanical Injury:

1. During the curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations.

3.07 FIELD QUALITY CONTROL

- A. Testing for concrete field quality control shall be performed by an Owner provided agency. Engineer will direct the number of slump tests and cylinders required. Contractor shall make standard compression test cylinders and entrained air tests as specified below, under the direct inspection by the Engineer. Contractor shall furnish all necessary assistance required by the Engineer. Contractor shall also furnish all labor, material and equipment required including cones, rods, molds, air tester, thermometer, curing in a insulated storage box that is heated if necessary and all other incidentals required. Above will be subject to approval by Engineer. Contractor shall furnish all necessary storage, curing, and transportation required by the testing.
- B. Quality Control Testing During Construction:
1. Perform sampling and testing for field quality control during the placement of concrete, as follows:
 - a. Sampling Fresh Concrete: ASTM C 172.
 - b. Slump: ASTM C 143; one for each set of compressive strength test specimens.
 - c. Air Content: ASTM C 231; one for each set of compression cylinders cast.
 - d. Compressive Strength Tests: ASTM C 39; one set of compression cylinders for each 50 cubic yards of fraction thereof, of each mix design placed in any one day; 1 specimen tested at 3 and 7 days, and 2 specimens tested at 28 days.
 1. Adjust mix if test results are unsatisfactory and resubmit for ENGINEER'S approval.
 2. Concrete which does not meet the strength requirements is subject to rejection and removal from the Work, or to other such corrective measures as directed by the Engineer, at the expense of the Contractor.

- e. Compression Test Specimens: ASTM C 1; make one set of 4 standard cylinders for each compressive strength test, unless otherwise directed.
 - f. Concrete Temperature: Test hourly when air temperature is 40 F and below, and when 80 F and above; and each time a set of compression test specimens is made.
2. The testing laboratory shall submit certified copies of test results directly to the Engineer and the Contractor within 24 hours after tests are made.
- C. Evaluation of Quality Control Tests:
1. Do not use concrete delivered to the final point of placement which has slump temperature or total air content outside the specified values.
 2. Compressive strength tests for laboratory-cured cylinders will be considered satisfactory if the averages of all sets of three consecutive compressive strength tests equal or exceed the 28 day design compressive strength of the type or class of concrete; no individual strength test falls below the required compressive strength by more than 500 psi.
 3. Where questionable field conditions may exist during placing concrete or immediately thereafter, strength tests of specimens cured under field conditions will be required by the Engineer to check the adequacy of curing and protecting of the concrete placed. Specimens shall be molded at the same time and from the same samples as the laboratory cured specimens.
 4. Provide improved means and procedures for protecting concrete when the 28 day compressive strength of field-cured cylinders is less than 85 percent of companion laboratory cured cylinders.
 5. When laboratory-cured cylinder strengths are appreciably higher than the minimum required compressive strength, field-cured cylinder strengths need not exceed the minimum required compressive strength by more than 500 psi even though the 85 percent criterion is not met.
 6. If individual tests of laboratory-cured specimens produce strengths more than 500 psi below the required minimum compressive strength, or if tests of field-cured cylinders indicate deficiencies in protection and curing, provide additional measures to assure that the load-bearing capacity of the structure is not jeopardized. If the likelihood of low-strength concrete is confirmed and computations indicate the load-bearing capacity may have been significantly reduced, tests of cores drilled from the area in question will be required at the Contractor's expense.
 7. If the compressive strength tests fail to meet the minimum requirements specified, the concrete represented by such tests will be considered deficient in strength and subject to replacement, reconstruction or to other action approved by Engineer, and shall be done at the Contractor's expense.
- D. Testing Concrete Structure for Strength:
1. When there is evidence that the strength of the in-place concrete does not meet specification requirements, Contractor shall employ at his expense the services of a concrete testing service to take cores drilled from hardened concrete for compressive strength determination. Tests shall comply with ASTM C 42 and the following:
 - a. Take at least 3 representative cores from each member or suspect area at locations directed by Engineer.
 - b. Strength of concrete for each series of cores will be considered satisfactory if their

- average compressive strength is at least 85 percent and no single core is less than 75 percent of the 28 day required compressive strength, and at least 100% by 56 days.
- c. Report test results in writing to Engineer on the same day that tests are made. Include in test reports the Project identification name and number, date, name of Contractor, name of concrete testing service, location of test core in the structure, type of class of concrete represented by core sample, nominal maximum size aggregate, design compressive strength, compression breaking strength and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plane of the concrete as placed, and the moisture condition of the core at time of testing.
2. Fill core holes solid with patching mortar, and finish to match adjacent concrete surfaces.
 3. Conduct static load test and evaluations complying with ACI 318 if the results of the core tests are unsatisfactory, or if core tests are impractical to obtain, as directed by Engineer.
- E. Testing for Watertightness of Concrete Structures.
1. All concrete structures designed to contain or convey fluid shall be tested for watertightness by the Contractor prior to earth backfilling by filling with water to levels approximating what will be attained during operation and measuring the drop in level due to leakage, if any. These tests shall be made under the direction of the Engineer, and if necessary the tests shall be repeated until watertightness is insured. Perform tests prior to backfilling below grade structures and prior to installations of any coating.
 2. Rate of filling shall be limited to minimize shock-effect to new concrete construction. Water shall be held under each condition long enough to satisfy the Engineer that the structures are watertight. Structures shall be free of internal or external water leakage.
 3. The total loss of water-level in any basin or flume shall not exceed 1/2 in. (13 mm) depth in 24 hours. Leakage shall be located and stopped and the structure again tested until this requirement is met. If the structure does not meet the test, the Contractor shall repair or replace at his own expense, such part of the work as may be necessary to secure the desired results, as approved by the Engineer.
 4. Regardless of the rate of leakage there shall be no visible leakage from any concrete structure.

3.08 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In:

1. Fill-in holes and openings left in concrete structures for the passage of work by other contractors and as indicated on drawings, with non-shrink nonmetallic grout per Section 03250 of this Specifications.
2. Dry packing will be approved by the Engineer on case by case basis.

3.09 CONCRETE REPAIRS

A. Repair of Formed Surfaces:

1. Repair exposed-to-view formed concrete surfaces that contain defects which adversely affect the appearance of the finish. Surface defects that require repair include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, and holes left by the tie rods and bolts; fins and other projections on the surface; and stains and other discolorations that cannot be removed by cleaning.

2. Repair concealed formed concrete surfaces that may contain defects that adversely affect the durability of the concrete. Surface defects that require repair include cracks in excess of 0.01 inch wide, cracks of any width and other surface deficiencies which penetrate to the reinforcement or completely through non-reinforced sections, honeycomb, rock pockets, holes left by tie rods and bolts, and spalls except minor breakage at corners.
 3. Pressure grout structural cracks, and cracks in water-holding structures, using one of the following:
 - a. Sikadur 35, Hi-Mod LV Gel by Sika Chemical Company.
 - b. 881 LPL Epoxy by the Burke Co.
 - c. Or equal.
 4. Repair and patch defective areas with sand cement mortar immediately after removal of forms and as directed by Engineer.
 5. Cut out or chip out honeycomb, rock pockets, voids over 1/2-inch diameter, and holes left by tie rods and bolts, down to solid concrete but, in no case, to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water, and brushcoat the area to be patched with the specified bonding agent.
 - a. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, the patching mortar color will match the color of the surrounding concrete.
 - b. Contractor shall impart texture to repaired surfaces to match texture of existing adjacent surfaces. Provide test areas at inconspicuous locations to verify mixture, texture and color match before proceeding with the patching. Compact mortar in place and strike off slightly higher than the surrounding surface.
 6. Fill holes extending through concrete by means of a plunger-type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to insure complete filling.
 7. Sandblast exposed-to-view surfaces that require removal of stains, grout accumulations, sealing compounds, and other substances marring the surfaces. Use sand finer than No. 30 and air pressure from 15 to 25 psi.
- B. Repair of Unformed Surfaces:
1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to the tolerances specified for each surface and finish. Correct low and high areas as herein specified.
 2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope. Correct high and low areas as herein specified.
 3. Repair finish of unformed surfaces that contain defects which adversely affect the durability of the concrete. Surface defects, as such, include crazing, cracks in excess of 0.01-inch wide or which penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
 4. Grout structural cracks, and cracks in water holding structures, using one of the following:

- a. Sikadur 35, Hi-Mod LV Gel by Sika Chemical Company.
 - b. 881 LPL Epoxy by the Burke Co.
 - c. Or equal.
5. Correct high areas in unformed surfaces by grinding, after the concrete has cured sufficiently so that repairs can be made without damage to adjacent area.
 6. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Use one of the following:
 - a. Mastertop MP by Master Builders.
 - b. Sikatop by Sika Chemical Company.
 - c. Or equal.
 7. Repair defective areas, except random cracks and single holes not exceeding 1-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cut, and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen all concrete surfaces in contact with patching concrete and brush with the specified bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same materials and proportions to provide concrete of the same type or class as the original adjacent concrete. Place, compact and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
 8. Repair isolated random cracks and single holes not over 1-inch diameter, by the dry-pack method. Groove the top of cracks, and cut out holes to sound concrete and clean of dust, dirt and loose particles. Dampen all cleaned concrete surfaces and brush with the specified bonding agent. Place dry-pack before the cement grout takes its initial set. Mix dry-pack, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours.
 9. Repair methods not specified above may be used if approved by the Engineer.

3.10 CONCRETE COATINGS

- A. All areas listed below shall receive concrete coating:
 1. All exposed surfaces.
 2. Containment sumps and diked areas for all chemical storage tanks.
 3. Chemical truck unloading area up to ground elevation.
- B. Surface preparation, application, dry film thickness and curing shall be in strict conformance with the manufacturer's published recommendations

+ + + END OF SECTION 03300 + + +

**SECTION 03600
GROUT****PART 1 - GENERAL****1.01 SCOPE**

- A. Contractor shall furnish all labor, materials, equipment, and incidentals required to provide grout as shown and specified.
- B. Grout shall be placed at the following locations:
 - 1. Pipe Railing.
 - 2. Dowelling.
 - 3. Sluice Gates.
 - 4. Grating.
 - 5. Concrete Patchwork.
 - 6. Anchor Bolts.
 - 7. Waterstops.
 - 8. Precast to concrete structures.
 - 9. Under baseplates.
- C. The types of grout include the following:
 - 1. Non-shrink, epoxy type.
 - 2. Non-shrink, non-metallic type.
 - 3. Ordinary cement-sand.
 - 4. Refer to Section 03300 for pressure grouting applications.
- D. Related Work specified elsewhere:
 - 1. Section 01000 - General Specifications.
 - 2. Section 03200 - Concrete Reinforcement and Dowelling.
 - 3. Section 03300 - Cast-In-Place Concrete.
 - 4. Section 05500 - Miscellaneous Metal.

1.02 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit copies of manufacturer's specifications and installation instructions for all proprietary materials.

- B. Reports and Certificates: Materials, Testing and Inspection.
- A. For proprietary materials, submit copies of reports on quality control tests.
- B. For nonproprietary materials, submit certification that materials meet specification requirements.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. ASTM C 150, Portland Cement.
 - 2. ASTM C 109, Compressive Strength of Hydraulic Cement Mortars (using 2-in. or 50 mm. Cube Specimens).
 - 3. ASTM C 191, Time of Setting of Hydraulic Cement by Vicat Needle.
 - 4. CRD-C 588, Specifications for Non-Shrink Grout.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Grout materials from manufacturers shall be delivered in unopened containers and shall bear intact manufacturer's labels.
- B. Storage of Materials: Grout materials shall be stored in a dry shelter and shall be protected from moisture.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Non-metallic, cartridge style, 100 percent solids, high strength epoxy grout.
 - 1. Product and Manufacturer: Speed Bond #1 as manufactured by Prime Resins Inc.
 - 2. Or Equal.
- B. Non-Shrink, Non-Metallic Grout:
 - 1. Pre-mixed non-staining cementitious grout requiring only the addition of water at the jobsite meeting ASTM C-827 and CRD C-621.
 - 2. Product and Manufacturer:
 - a. Sikagrout 212 by Sika Corp.
 - b. Masterflow 713 by Master Builders Company.
 - c. Non-Ferrous Non-Shrink Grout by the Burke Company.
 - d. Non-Shrink, Non-Metallic Grout as manufactured by W. R. Meadows.
 - e. Or Equal.
- C. Ordinary Cement-Sand Grout:
 - 1. Except where otherwise specified use 1 part cement to 3 parts sand complying with the following:

- a. Cement: ASTM C 150, Type II.
 - b. Sand: ASTM C 33.
2. For water repelling and shrinkage reducing requirements use admixtures.
 - a. Product and Manufacturer:
 1. Integral Waterpeller by The Euclid Chemical Company.
 2. Omicron, Type OM by Master Builders Company.
 3. Hydrocide Powder by Sonneborn-Contech.
 4. Or Equal.
 3. For use at horizontal waterstops only.
- D. Water:
1. Use clean, fresh, potable water free from injurious amounts of oils, acids, alkalies or organic matter.
- E. Epoxy Resin Adhesive:
1. Two part mix 1:1.
 2. Manufacturer: Sika Corp - Sikadur 32, Hi-Mod (Horizontal joints), Sikadur 31 Hi-Modgel (Vertical joints) or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General:
1. Place grout as shown and in accordance with manufacturer's instructions. If manufacturer's instructions conflict with the Specifications do not proceed until Engineer provides clarification.
 2. Drypacking will not be permitted unless approved by the Engineer.
 3. Manufacturers of proprietary products shall make available upon 72 hours notification the services of a qualified, full time employee to aid in assuring proper use of the product under job conditions.
 4. Placing grout shall conform to temperature and weather limitations in Section 03300.
 5. Surface to be grouted is to be adequately cured, cleaned dampened and roughened per manufacturer recommendations to insure adequate bonding.
- B. Pipe Railings:
1. After posts have been properly inserted into the holes or sleeves, fill the annular space between posts and sleeve with the non-shrink, non-metallic grout. Bevel grout at juncture with post so that moisture flows away from post.
 2. Do not grout railing designated as "removable sections".

C. Grout for Dowelling and Anchor Bolts:

1. Grout shall be introduced at the bottom of the drill holes using a caulking tube or other injection means. The hole shall be blown out or pumped dry prior to the introduction of grout into the hole. Care shall be taken to adequately fill the hole with grout before the dowel or anchor rod is inserted, to insure complete contact with the anchor for its full length.
2. A plug shall be placed in the top of the hole to hold the bars securely until the grout sets. Special care shall be taken to insure against any movement of the bars, which have been placed.
3. Epoxy resin Adhesive may be used in accordance with manufacturer's recommended application.

D. Grouting for Waterstops:

1. Grout for PVC waterstops to be the non-shrink, non-metallic type. Refer to Section 03250 for installation procedures.
2. Grout from Redi-mix plant conforming to applicable requirements of Section 03300 may be substituted at no additional compensation to the contractor.

E. Grouting for Sluice Gates:

1. Provide minimum of 1" thickness of non-shrink, non-metallic grout under frames. Gates to be coated with an approved epoxy coating per Section 09900 prior to installing and grouting.

F. Grouting for Bearing Plates and Equipment:

1. Use non-shrink, non-metallic grout for setting bearing plates and equipment. Provide a minimum grout thickness of 1".

G. Patchwork at Demolition Areas:

1. Furnish and install non-shrink, non-metallic grout for dry packing as required to patch all mechanical, electrical and miscellaneous penetrations which are either designated to be patched or are the result of abandoned, removed or relocated material and equipment. Prepare surface and place grout as recommended by manufacturer and as specified. Finish grout off flush with existing surface.
2. Reinforce with approved wire mesh and use approved structural concrete for penetrations larger than 1/2 square feet. Conform to requirements of Sections 03100, 03200 and 03300.

+ + + END OF SECTION 03600 + + +

**SECTION 05120
STRUCTURAL STEEL****PART 1 - GENERAL****1.01 SCOPE**

- A. Work Included: This section covers the work necessary to furnish and install, complete, the structural steel, and shall include all metal parts required for permanent connection of the structural steel.
- B. General: Like items of materials provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, maintenance, and replacement.
- C. Related Work specified elsewhere:
 - 1. Section 05500 - Miscellaneous Metal.
 - 2. Section 09900 - Painting.

1.02 SUBMITTALS

- A. Submittals during construction shall be made in accordance with the General Conditions of the Contract Documents.
- B. Shop Drawings, complete with all information and sections.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with the current provisions of the following, except as otherwise indicated:
 - 1. AISC "Code of Standard Practice for Steel Buildings and Bridges".
 - 2. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings" and including the "Commentary of the AISC Specification".
 - 3. AISC "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts" approved by the Research Council on Structural Connections of the Engineering Foundation, August 14, 1985; endorsed by the American Institute of Steel Construction and the Industrial Fasteners Institute.
 - 4. AWS Structural Welding Code AWS D1.1-90 and "Standard Qualification Procedure".
 - 5. ASTM A 36-61, Structural Steel (Rev. A).
 - 6. ASTM A 53-83, Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - 7. ASTM A 325-83, High Strength Bolts for Structural Steel Joints (Rev. C) (*A325M-83).
 - 8. ASTM A 490-83, Heat-Treated Steel Structural bolts, 150 ksi Minimum Tensile Strength (Rev. A) (*A490M-82).
 - 9. ASTM A 500-82, Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes (Rev. A).

10. ASTM A 501-83, Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
11. AWS D1.1-90 (83), Structural Welding Code – Steel.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Load structural members in such a manner that they may be transported and unloaded without being excessively stressed, deformed, and otherwise damaged.
- B. Material Storage:
 1. Protect structural steel members and packaged materials from corrosion deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground.
 2. Do not place materials on the structure in a manner that might cause distortion or damage to the members or the supporting structures. Repair or replace damaged materials or structures as directed.

1.05 WARRANTY

- A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. ROLLED PLATES, SHAPES, AND BARS: ASTM A 36 unless otherwise shown.
- B. STRUCTURAL STEEL PIPE: ASTM A 501, or ASTM A 53, Type E or S, Grade B.
- C. STRUCTURAL TUBING: ASTM A 501, or A 500, Grade B. All members shall be furnished full length without splices unless otherwise noted or approved.
- D. BOLTS FOR CONNECTIONS: ASTM A 325 or A 490; use A 325 unless otherwise shown.
- E. WELDED STUDS: Welded anchor studs shall be headed concrete anchor studs (HAS), or deformed bar anchors (DBA), or threaded studs (TAS), as indicated on the Drawings and as supplied by Nelson Stud Welding Company, Lorain, OH; Omark Industries, KSM Fastening Systems Division, Seattle, WA, or Portland, OR; or equal.
- F. SHOP PAINT PRIMER: Structural steel shall be cleaned and coated with shop paint primer. Surface preparation and primer shall be as specified in Division 9 - Finishes. Shop prime coat shall be applied within 8 hours after surface preparation.

PART 3 - EXECUTION

3.01 WORKMANSHIP

- A. MEASUREMENT: The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.
- B. SHOP DRAWINGS: Shop drawings shall conform to AISC recommendations and specifications

and shall show all holes, etc., required for other work. Include complete details showing all members and their connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams showing the sequence of erection.

3.02 FABRICATION

A. General

1. Fabricate items of structural steel in accordance with the Drawings, AISC Specifications, and as indicated on the final reviewed shop drawings.
2. Properly mark and match mark materials for field assembly.
3. Where finishing is required, complete the assembly, including bolting and welding of units, before start of finishing operations.

B. Connections: Weld or bolt shop connections, as shown. Bolt field connections, except where welded connections or other connections are shown or specified. All connections unless shown otherwise shall develop full strength of members joined and shall conform to AISC standard connections.

C. Welded Construction:

1. Comply with AWS Current D1.1-90 Code for procedures, appearance, and quality of welds and welders, and methods used in correcting welding work.
2. Submit welder certifications for shop and field welders in triplicate, directly to the Engineer from a recognized testing laboratory, with copies to the Contractor and others as required.
3. Unless otherwise shown, all butt welds are complete penetration.

D. Holes for Other Work: Provide holes as necessary or as indicated for securing other work to structural steel framing, and for the passage of other work through steel framing members. Provide threaded nuts welded to framing, and other specialty items as shown to receive other work. No torch cut holes are permitted.

E. Shop Paint Primer: Apply shop paint primer in accordance with Division 9 - Finishes. Omit at welds, bolts, and where embedded in concrete. Remove all slag from welds before painting.

F. Inspection: Shop inspection may be required by the Owner at his own expense (except for weld inspection as mentioned herein). The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop and inspectors shall be allowed free access to the necessary parts of the works. Inspectors shall have the authority to reject any materials or work which does not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but it is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship under these Specifications.

3.03 ERECTION

A. General: Comply with the AISC Specifications and Code of Standard Practice, and with specified requirements.

B. Anchor Bolts:

1. Furnish anchor bolts and other connectors required for securing structural steel to in-place work.
 2. Furnish templates and other devices for presetting bolts and other anchors to accurate locations.
- C. Setting Bases and Bearing Plates:
1. Clean concrete surfaces of bond reducing materials and roughen to improve bond to surfaces. Clean the bottom surface of base and bearing plates.
 2. Set loose and attached base plates and bearing plates for structural members on wedges, leveling nuts, or other adjustable devices.
 3. Tighten the anchor bolts after the supported members have been positioned and plumbed.
 4. Grouting of base plates shall be as specified in Section 03600 - Grout. Grout prior to placing loads on structure.

3.04 FIELD ASSEMBLY

- A. Set structural frames accurately to the lines and elevations indicated. Align and adjust the various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces, which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
- B. Level and plumb individual members of the structure within specified AISC tolerances. Contractor shall provide and install all temporary bracing required until structure is complete.
- C. Establish required leveling and plumbing measurements on the mean operating temperature of the structure.

3.05 MISFITS AT BOLTED CONNECTIONS

- A. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified and shall select an industry acceptable method to remedy such as:
 1. Ream holes that must be enlarged to admit bolts and use oversized bolts.
 2. Plug weld misaligned holes and re-drill holes to admit standard size bolts.
 3. Drill additional holes in the connection, conforming with AISC Standards for bolt spacing, and end and edge distances and add additional bolts.
 4. Reject the member containing the misfit, mis-sized, or misaligned holes and fabricate a new member to ensure proper fit.
- B. Mis-sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins.

3.06 MISFITS AT ANCHOR BOLTS

- A. Any misalignment between anchor bolts and bolt holes in steel members shall be resolved by submitting a request to the Engineer for review. The request shall show an industry acceptable method. Flame cutting to enlarge holes shall not be acceptable.

3.07 GAS CUTTING

- A. Do not use gas cutting torches in the field for correcting fabrication errors in the structural framing, except on secondary members which are not under stress and will be concealed in the finished structure and when approved by the Engineer. Finish gas-cut sections equal to a sheared appearance.

3.08 TOUCHUP PAINTING

- A. Immediately after section, clean field welds, bolted connections, and abraded areas of the shop paint primer. Apply touchup paint primer by brush or spray which is the same thickness and material as that used for the shop paint.

3.09 QUALITY CONTROL TESTING

- A. The Engineer may engage inspectors to inspect bolted connections and welded connections and to perform tests and prepare test reports.
- B. Weld Inspection:
 - 1. All butt welds shall be 100 percent tested in accordance with AWS D1.1-90, Part B, Radiographic Testing of Welds.
 - 2. The examination, report, and disposition of radiographs shall be in accordance with Section 6.12 of AWS D1.1-90. Payment of this work shall be included in the lump sum bid. All reports shall be submitted to the Engineer for review prior to completion of the work in this section.
 - 3. Welds that are required by the Engineer to be corrected shall be corrected or redone and retested as directed, at the Contractor's expense and to the satisfaction of the Engineer and/or approved independent testing lab.
- C. Finish Painting:
 - 1. Finish painting of all exposed structural steel shall be as indicated on the Finish Schedule in the Drawings and as specified in Division 9 - Finishes.

+++ END OF SECTION 05120 +++

**SECTION 05500
MISCELLANEOUS METAL****PART 1 - GENERAL****1.01 SCOPE**

- A. The contractor shall furnish all labor, materials, equipment and incidentals required and install all miscellaneous metals as shown on the Drawings and specified herein. The miscellaneous metal items include but are not limited to the following:
1. Anchors or anchor bolts except those specified to be furnished with all equipment.
 2. Vault Door.
 3. Watertight Doors.
 4. Plates and angles for grates.
 5. Stainless steel doors and safety gates.
 6. Gratings.
 7. Railings.
- B. Related Work Specified Elsewhere
1. Section 05120: Structural Steel.
 2. Anchor bolts for equipment are included in the respective Sections of Divisions 11, 13, 14 and 15.
 3. Pipe hangers, supports and concrete inserts are included under Division 15.
 4. Fences, and Cast iron for manholes are included under Division 2.

1.02 SUBMITTALS

- A. Manufacturers data on all materials listed in Part 2 of this Section.
- B. Detail drawings, as provided for in the General Conditions, showing sizes of members, method of assembly, anchorage, and connection other members shall be submitted to the Engineer for review before fabrication. Drawings shall include vault and watertight door test results.
- C. Watertight door test results.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Unless otherwise specified, materials shall conform to the following:
1. Life Safety Code - NFPA 1010.
 2. Structural Steel - ASTM A36.
 3. Welded and Seamless Steel Pipe - ASTM A53.
 4. Gray Iron Castings - ASTM A48, Class 30.
 5. Galvanizing, general - ASTM A123.

6. Galvanizing, hardware - ASTM A153.
7. Galvanizing, assemblies - ASTM A386.
8. Aluminum (Extruded Shapes) - 6063 T5 (Al um. alloy).
9. Aluminum (Extruded Pipe) - 6063 T6 (Al um. Alloy.)
10. Aluminum Sheet and Plate - 6061 T6 (Alum. alloy).
11. Bolts and Nuts - ASTM A307.
12. Stainless Steel Bolts, Bars & Shapes - ASTM A276.
13. Stainless Steel Plate and sheet - ASTM A167.
14. Welding Rods for Steel - AWS Spec. for Arc Welding.

1.04 COORDINATION

- A. The work of this Section shall be completely coordinated with the work of other Sections. Verify at the site both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.
- B. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.

1.05 FIELD MEASUREMENTS

- A. Field measurements shall be taken at the site to verify or supplement indicated dimensions and to insure proper fitting of all items.

1.06 WARRANTY

- A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.01 ANCHORS, BOLTS, AND FASTENING DEVICES

- A. Anchors, bolts, etc., shall be furnished as necessary for installation of the work of this Section.
- B. The bolts used to attach the various members to the anchors shall be the sizes shown or required. Aluminum and stainless steel shall be attached to concrete by means of stainless steel machine bolts and iron or steel shall be attached with steel machine bolts unless otherwise specifically noted.
- C. For structural purposes, unless otherwise noted, expansion bolts shall be Wej-it "Ankr-Tite", Phillips Drill Co. "Wedge Anchors", or HILTI-HY 150. When length of bolt is not called for on the Drawings, the length of bolt provided shall be sufficient to place the wedge portion of the bolt a minimum of 1-inch behind the reinforcing steel within the concrete.
- D. Material shall be as noted on the Drawings. If not listed, stainless steel.

2.02 ALUMINUM ITEMS

- A. Vault Door
 1. Vault door shall be of double cover construction in size(s) shown on the Drawings. Doors shall be aluminum 1/4" diamond pattern plate reinforced on the underside to withstand a H-20 wheel load. Channel frame shall be 1/4" aluminum with full anchor flange around the perimeter.

2. Doors shall be equipped with heavy forged brass hinges with stainless steel pins and shall pivot so cover does not protrude into the channel frame. Hinges shall be through bolted to the cover with tamper proof stainless steel lock bolts and shall be through bolted to the frame with stainless steel bolts and lock nuts. Doors shall be equipped with compression springs enclosed in telescopic tubes. Upper tube shall be the outer tube to prevent accumulation of moisture, grit and debris inside the tube assembly. Lower tube shall interlock with a flanged support shoe fastened to a formed 1/4" gusset support plate.
3. Doors shall be fitted with the required number and size of compression spring operators to afford ease of operation through the entire arc of opening and to act as a check in retarding downward motion when being closed. Doors shall be equipped with a hold-open arm, which automatically locks the door in the open position. A conveniently located handle shall release the door(s) for closing.
4. A stainless steel snap lock with a fixed turn handle shall be mounted on the underside of the door. A removable exterior latch shall be provided and the latch release shall be protected by a flush gasketed removable screw plug. Doors shall have a lift handle that is designed to be flush with the walking surface when not in use. A 1-1/2" drain coupling shall be located in the front right corner of the channel frame. Hardware shall be #316 stainless steel.
5. Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of frame. Installation shall be in accordance with manufacturer's instructions and manufacturer shall guarantee satisfactory operation. Manufacturer shall guarantee against defects in material or workmanship for a period of five years.
6. Vault door shall be Type JD as manufactured by the Bilco Company, New Haven, Connecticut or equal.

B. Watertight Door

1. Watertight door shall provide an effective seal against the maximum flood level to top of door. The door shall be 4' x 8' with square corners and the pressure on the door shall be transmitted to the frame and/or dogs.
2. Structural plates and shapes shall be 304 stainless steel.
3. The heavy duty compression joint shall be low maintenance durometer neoprene, molded rather than extruded, with fully molded corners. Mitered joints not allowed.
4. Hinges shall include stainless steel hinge pins, grade 5 or better mounting bolts and slotted hinge blades. The lower hinge shall have a bronze oil-impregnated thrust bearing.
5. The door latch system shall be operated with minimum effort and time by turning of the handwheel from either side. The handwheel shall actuate a minimum of six dogs each of which shall be adjustable for stroke length and position for optimum seal compression.
6. The edge coming contacting the door gasket shall be machined, rather than rolled, to maximize sealing.
7. Door manufacturer shall factory test the finished assembly to verify that the door will withstand the design hydrostatic pressure. test results shall be submitted to the Engineer prior to door installation.
8. Watertight door shall be model D3BQA as manufactured by The Presray Corporation, Pawling, New York or equal.

- C. Miscellaneous aluminum shapes and plates shall be fabricated as shown. Angle frames for hatches, beams, grates, etc., shall be furnished complete with welded strap anchors attached. Furnish all miscellaneous aluminum shown but not otherwise detailed. Structural shapes and extruded items shall conform to the detail dimensions or the plans within the tolerances published by the American Aluminum Association.
- D. Railings (Aluminum)
1. Handrails
 - A. Mounting: Posts welded to stringer.
 - B. Railing to be fabricated from 2" steel tube.
 - C. ADA Guardrail first floor: Same as open-side rails.
 - i. Mounting: Posts set in concrete.
 - D. Wall railings: steel pipe, shape as indicated on drawings.
 - i. Wall brackets to be fabricated from steel plate with recessed head allen head attachment
 - E. Steel finish: Factory primed for painting.
 - F. Finish: Electrostatic paint all exposed ferrous materials.
 2. Guard Rails
 - A. Design as indicated on drawings.
 - i. Number of horizontal rails as required to comply with applicable codes.
 - B. Mounting: Posts set in concrete.
 3. Fabrication - Railings
 - A. General: Construct as indicated.
 - i. Pipe/tube: Nominal wall thickness of 0.125 inch.
 - ii. Connections: Welded and ground.
 - iii. Welding: Fill joints completely and grind off flush.
 - iv. Elbows: Bends, only.
 - v. Tee and cross intersections: Coped and fitted.
 - vi. Exposed ends of hollow members: Close with prefabricated fittings or with 3/16-inch-thick plate fully welded.
 - vii. Bending of members: Use jigs to make each similar configuration the same; make neat bends without other deformation.
 - viii. Close exposed open ends of members using same material as used in member.
 - B. Provide all components necessary for assembly of railings and for attachment to other work.

2.03 STEEL ITEMS

- A. All miscellaneous lintels and closures not shown on the Drawings shall be galvanized steel and shall be provided as a part of this Section.
1. Provide galvanized loose steel lintels for openings and recesses in masonry walls as shown. Weld adjoining members together to form a single unit where indicated. Provide not less than 8" bearing at each side of openings unless otherwise indicated.
- B. Miscellaneous steel shall be fabricated and installed in accordance with the Drawings and shall include: beams, angles, support brackets, splice plates, anchor bolts (except for equipment furnished in Divisions 11, 13, 14 and 15); lintels and any other miscellaneous steel called for on the Drawings and not otherwise specified.
- C. Stainless Steel. Unless otherwise designated or approved, use stainless steel alloy types as

follows which conform to ASTM A-167 and ASTM A-276:

1. Stainless steel plates and bars shall be Type 316 or Type 317 unless otherwise noted.
 2. Stainless steel anchor bolts shall be Type 316.
 3. Stainless steel bolts, nuts and washers shall be Type 316.
- D. Bar Gratings. Manufacture in accordance with "Standard Specifications for Metal Bar Grating and Metal Bar Grating Treads" (part of NAAMM MBG 531), except for specific requirements specified here:
1. Galvanized, where indicated: Minimum 1.5 ounces zinc per square foot of coated surface; galvanized after fabrication.
 2. Manufacture:
 - A. Steel.
 - B. Welded Construction.
 - C. Bearing bars:
 1. Thickness: 3/16 inch
 2. Depth: 2 inches
 3. Spacing: 1-3/16 inches
 - D. Cross bar spacing: 4 inches
 - E. Top surface: Plain.
 - F. Finish: Hot-dip galvanized.
 3. Fabrication
 - A. Banding bars: Cross section not less than bearing bars.
 - B. Provide banding bars welded to perimeter of removable grating sections.
 1. Provide minimum of 4 hold-down fasteners for each removable section.
 2. Fasteners: As recommended by grating manufacturer, or as suitable for the purpose.
 - C. Make no cuts or notches in bearing bars.

PART 3 - EXECUTION

3.01 FABRICATION

4. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability.
5. Connections and accessories shall be of sufficient strength to safely withstand stresses and strains to which they will be subjected. Steel accessories and connections to steel or cast iron shall be steel, unless otherwise specified. Threaded connections shall be made so that the threads are concealed by fitting.
6. Welded joints shall be rigid and continuously welded or spot welded as specified or shown. The face of welds shall be dressed flush and smooth. Exposed joints shall be close fitting and jointed where least conspicuous.
7. Welding of parts shall be in accordance with the Standard Code for Arc and Gas Welding in Building Construction of the AWS and shall only be done where shown, specified, or

permitted by the Engineer. All welding shall be done only by welders certified as to their ability to perform welding in accordance with the requirements of the AWS Code. Component parts of built-up members to be welded shall be adequately supported and clamped or held by other adequate means to hold the parts in proper relation for welding.

8. Welding of aluminum work shall be on the unexposed side as much as possible in order to prevent pitting or discoloration.
9. All aluminum finish exposed surfaces, except as specified below, shall have manufacturer's standard mill finish. A coating of methacrylate lacquer shall be applied to all aluminum before shipment from the factory.
10. Castings shall be smooth, free from scale, lumps, blisters, sand holes, and defects of any kind, which render them unfit for the service for which they are intended. Castings shall be thoroughly cleaned and will be subjected to a hammer inspection in the field by the Engineer. All finished surfaces shown on the Drawings and/or specified shall be machined to a true plane surface and shall be true and seat at all points without rocking. Allowances shall be made in the patterns so that the thickness specified or shown shall not be reduced in obtaining finished surfaces. Castings will not be acceptable if the actual weight is less than 95 percent of the theoretical weight computed from the dimensions shown. The Contractor shall provide facilities for weighing castings in the presence of the Engineer showing true weights, certified by the supplier.
11. All steel finish work shall be thoroughly cleaned, by effective means, of all loose mill scale, rust, and foreign matter before shipment and shall be given one shop coat of primer compatible with finish coats specified in Painting Section after fabrication but before shipping. Paint shall be applied to dry surfaces and shall be thoroughly and evenly spread and well worked into joints and other open spaces. Abrasions in the field shall be touched up with primer immediately after erection. Final painting is specified in Painting Section 09900.
12. Galvanizing, where required, shall be the hot-dip zinc process after fabrication. Following all manufacturing operations, all items to be galvanized shall be thoroughly cleaned, pickled, fluxed, and completely immersed in a bath of molten zinc. The resulting coating shall be adherent and shall be the normal coating to be obtained by immersing the items in a bath of molten zinc and allowing them to remain in the bath until their temperature becomes the same as the bath. Coating shall be not less than 2 oz. per sq. ft. of surface. The galvanized coating shall be chromate treated.

3.02 INSTALLATION

- A. Install all items furnished except items to be imbedded in concrete which shall be installed under Division 3. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown and in accordance with manufacturers instructions and approved shop drawings. All dimensions shall be verified at the site before fabrication is started.
- B. All steel surfaces to come in contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.
- C. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to dissimilar metal.
- D. Where aluminum contacts concrete, apply a heavy coat of approved alkali resistant paint to the concrete.

permitted by the Engineer. All welding shall be done only by welders certified as to their ability to perform welding in accordance with the requirements of the AWS Code. Component parts of built-up members to be welded shall be adequately supported and clamped or held by other adequate means to hold the parts in proper relation for welding.

8. Welding of aluminum work shall be on the unexposed side as much as possible in order to prevent pitting or discoloration.
9. All aluminum finish exposed surfaces, except as specified below, shall have manufacturer's standard mill finish. A coating of methacrylate lacquer shall be applied to all aluminum before shipment from the factory.
10. Castings shall be smooth, free from scale, lumps, blisters, sand holes, and defects of any kind, which render them unfit for the service for which they are intended. Castings shall be thoroughly cleaned and will be subjected to a hammer inspection in the field by the Engineer. All finished surfaces shown on the Drawings and/or specified shall be machined to a true plane surface and shall be true and seat at all points without rocking. Allowances shall be made in the patterns so that the thickness specified or shown shall not be reduced in obtaining finished surfaces. Castings will not be acceptable if the actual weight is less than 95 percent of the theoretical weight computed from the dimensions shown. The Contractor shall provide facilities for weighing castings in the presence of the Engineer showing true weights, certified by the supplier.
11. All steel finish work shall be thoroughly cleaned, by effective means, of all loose mill scale, rust, and foreign matter before shipment and shall be given one shop coat 0 primer compatible with finish coats specified in Painting Section after fabrication but before shipping. Paint shall be applied to dry surfaces and shall be thoroughly and evenly spread and well worked into joints and other open spaces, Abrasions in the field shall be touched up with primer immediately after erection. Final painting is specified in Painting Section 09900.
12. Galvanizing, where required, shall be the hot-dip zinc process after fabrication. Following all manufacturing operations, all items to be galvanized shall be thoroughly cleaned, pickled, fluxed, and completely immersed in a bath of molten zinc. The resulting coating shall be adherent and shall be the normal coating to be obtained by immersing the items in a bath of molten zinc and allowing them to remain in the batch until their temperature becomes the same as the bath. Coating shall be not less than 2 oz. per sq. ft. of surface. The galvanized coating shall be chromate treated.

3.02 INSTALLATION

- A. Install all items furnished except items to be imbedded in concrete which shall be installed under Division 3. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown and in accordance with manufacturers instructions and approved shop drawings. All dimensions shall be verified at the site before fabrication is started.
- B. All steel surfaces to come in contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.
- C. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to dissimilar metal.
- D. Where aluminum contacts concrete, apply a heavy coat of approved alkali resistant paint to the concrete.

+++ END OF SECTION 05500 +++

**SECTION 09900
PAINTING****PART 1 - GENERAL****1.01 WORK INCLUDED**

- A. This Section of the Specifications includes, but is not necessarily limited to, standards for cleaning and painting structures and equipment described in the Drawings and Specifications. Furnish all materials, equipment, and labor necessary to complete the Work.
- B. Section includes:
 - 1. Surface preparation to receive finishes.
 - 2. Priming and back priming interior and exterior finish carpentry.
 - 3. Painting, staining, or otherwise finishing of all surfaces.
 - 4. Finishing millwork.
- C. Related Work specified elsewhere:
 - 1. Section 03300 - Cast-In-place Concrete.
 - 2. Section 05120 - Structural Steel.
 - 3. Section 05500 - Miscellaneous Metal.

1.02 SUBSTITUTIONS

- A. To the maximum extent possible, similar coatings shall be the products of one manufacturer. Guidelines for determination of acceptability of product substitutions are given in Instructions to Bidders. Contractors intending to furnish substitute materials or equipment are cautioned to read and comply strictly with these guidelines.

1.03 SUBMITTALS

- A. All submittals and storage and protection provisions shall be in accordance with the requirements of the General Conditions, and the following.
 - 1. Product data:
 - a. Submit complete list of products for use; indicate compliance with:
 - 1. Mercury-free composition limits.
 - 2. VOC limits, when mixed and thinned.
 - 3. Indicate lead content.
 - b. Indicate manufacturer, brand name, quality, and type paint for each surface to be finished correlate to specified item if from other manufacturer than specified item. Refer to the attached sample Paint Submittal Schedule for required submittal format.
 - c. Include specified manufacturer's data sheets for reference to submitted manufacturer's

- data sheets.
 - d. Manufacturer's Safety Data Sheets (MSDS) for materials.
 - e. Intent of Contractor to use products specified does not relieve him from responsibility of submitting product line.
2. Samples:
- a. Color samples: Submit two sets of color samples from paint manufacturers proposed for use for color selections by Engineer.
 - b. Brush-outs:
 - 1. Prepare actual brush-outs for each color paint, stain, or finish following final color schedule issuance.
 - 2. Submit brush-outs in duplicate: minimum size, 120 sq. in.
 - 3. Apply products in number of coats specified for actual Work.
 - 4. Provide following substrates for brush-outs:
 - a. Concrete unit masonry: Paint one face to simulate concrete and masonry.
 - b. Hardboard to simulate drywall, lumber, board products, and metals for paint finish.
 - c. Actual species and grade of wood specified for transparent finish.
3. Quality control submittals:
- a. Certificates:
 - 1. Indicate interior paints and stains are mercury-free.
 - 2. Indicate lead content. Lead content in excess of 0.06% by weight of nonvolatile content calculated as lead metal is prohibited.
 - 3. Indicate compliance with applicable VOC limits when mixed and thinned.

1.04 PROJECT MEETING

- A. Prior to ordering any of the materials covered under this Section, the Contractor, Engineer, painting subcontractor and paint manufacturer's representative shall attend a progress meeting in accordance with the General Conditions, and review the Work to be performed under this Section.

1.05 PAINTING REQUIREMENTS

- A. Finish paint all exposed surfaces except anodized or lacquered aluminum, fiberglass reinforced plastic, stainless steel and copper surfaces. Items to be left unfinished or to receive other types of finishes are specifically shown on the Drawings or specified.
 - 1. Unpainted Products: Full field cleaning and priming will be performed in accordance with specification requirements for unpainted products. Maintain adequate equipment on the site to assure proper cleaning.
 - 2. Shop Primed Products:
 - a. Manufactured products may be shop cleaned and primed. Shop cleaning must equal or exceed cleaning specified in the Painting Schedule. Clean as specified and reprime all abrasions, weld splatter, excessive weathering, and other defects in the shop prime coating.
 - b. Manufacturers furnishing shop primed products shall certify that cleaning was

performed in accordance with specification requirements and that the specified primer was used.

- c. Fully field clean and prime any shop primed products which the Engineer determines that were not cleaned in accordance with the Specifications prior to priming, that the wrong primer was applied, that the primer was applied improperly, or has excessively weathered, or the product is otherwise unacceptable.

3. Finish Painted Products:

- a. Certain products such as electrical control panels and similar items may, with the approval of the Engineer, be furnished finish painted. Properly protect these products throughout the project to maintain a bright and new appearance. If the finish surfaces are defaced, weathered, or not of the selected color, repaint as necessary in accordance with the paint system manufacturer's written recommendations.

4. Hardware:

- a. Remove all electrical plates, surface hardware, fittings and fastenings prior to painting operations. These items are to be carefully stored, cleaned and replaced upon completion of Work in each area. Do not use solvent to clean hardware that may remove permanent lacquer finish.

1.06 SEQUENCING AND SCHEDULING

- A. Schedule and coordinate this Work with other trades; proceeding until other Work and job conditions are proper to achieve satisfactory results is prohibited.
- B. Examine specification sections for various other trades; be thoroughly familiar with Work required in other sections regarding painting.

PART 2 - PRODUCTS

2.01 MATERIAL SCHEDULE

- A. Material schedules list pretreatment coats, wash coats, seal coats, prime coats, intermediate coats, finish coats and cover coats that comprise a complete and compatible system of surface protection for the particular substrate. Maintain the unity of these systems, making sure all coats applied to any surface are from the same system and same manufacturer. Verify with the manufacturer the compatibility of the materials used.

2.02 APPLICATION DATA

- A. All applicable data currently published by the paint manufacturer relating to surface preparation, coverages, film thickness, application technique, drying and overcoating times is included by reference as a part of this Section. It will be the responsibility of the Contractor to obtain and fully understand the appropriate data sheets for the coatings specified.

2.03 MATERIALS

- A. Paints shall be factory mixed and delivered to the job in unbroken original packages bearing the manufacturer's name and brand designation and shall be applied in strict accordance with the manufacturer's printed specifications. Two-component coatings shall be mixed in accordance with manufacturer's instructions. All two-component coatings, once mixed, shall be applied within the pot-life recommended by the manufacturer.

- B. Unless otherwise specified, paints shall be of the best grade. All thinners, driers, varnish, etc., shall be of the best grade and shall be furnished by the coating manufacturer for use with the specified paints.
- C. Paint thinners and tints: Products of same manufacturer as paints or approved by paint manufacturer for use with paint.
- D. Shellac, turpentine, patching compounds, and similar materials required for execution of Work: Pure, best quality products.

2.04 COLORS

The Engineer will select the colors to be used on the various portions of the Work. Provide color cards for the coatings proposed. Where more than one coat of paint is required, job tint the paint for each undercoat off-shade to show complete coverage.

PART 3 - EXECUTION

3.01 GENERAL

- A. Adequately protect other surfaces from paint and damage. Furnish sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted. Repair damage as a result of inadequate or unsuitable protection.
- B. Protection: Cover finished Work of other trades, surfaces not being painted concurrently, and prefinished items.
- C. Application of materials in spaces where dust is being generated is prohibited.

3.02 PRODUCT HANDLING

- A. Delivery
 - 1. Deliver materials in original, sealed containers of the manufacturer with labels legible and intact.
 - 2. Each container shall be clearly marked or labeled to show paint identification, paint type and color, date of manufacture, batch number, analysis or contents, identification of all toxic substances, and special instructions.
- B. Storage
 - 1. Store only acceptable project materials on the project site.
 - 2. Store material in a suitable location and in such a manner as to comply with all safety requirements including any applicable federal, state and local rules and requirements. Storage shall also be in accordance with the instructions of the paint manufacturer and the requirements of the insurance underwriters.
 - 3. Restrict storage area to paint materials and related equipment.
 - 4. Place any materials, which may constitute a fire hazard in closed metal containers and remove daily from the project site.

5. Maintain neat, clean conditions in storage area; remove used rags from work areas at end of each day's work; store rags in closed containers.
6. Close containers at end of each day's Work. Leave no materials open.
7. Safety precautions:
 - a. Provide temporary fire protection equipment in materials storage area. Mark fire protection equipment location for quick access.
 - b. Prohibit smoking in storage area; post signs in visible location adjacent to and within storage area.

3.03 CLEANING AREA

- A. Construct a temporary shed no smaller than 40 feet wide and 60 feet long for field cleaning, including blasting and priming operations. Maintain this area for all non-fixed painting operations until all such work has been completed and approved. Provide all fixtures and appurtenances required to perform the work including fixtures to support the work off the ground and proper storage facilities.

3.04 ENVIRONMENTAL CONDITIONS

- A. Environmental conditions, which affect coating application include, but are not necessarily limited to, ambient air temperature, surface temperature, humidity, dew point and environmental cleanliness. Comply with the manufacturer's recommendations regarding environmental conditions under which coatings may be applied.

3.05 SURFACE PREPARATION

- A. General: All surfaces shall be thoroughly clean, dry, and free from oil, grease or dust. All fabricated metal products shall have all weld flux and weld spatter removed and sharp peaks in weld ground smooth. The Engineer will inspect the surface preparation prior to the application of coatings. If the preparation is found to be satisfactory, a written order will be given to proceed with coatings.
- B. Ferrous Metals: Standards for the surface preparation of ferrous metals required in the Material Schedules are the standards of the Steel Structures Painting Council (SSPC, SP-1 through SP-10). Inspection of these surfaces will be evaluated by field comparison with visual comparator panels. These panels shall be securely wrapped in clear plastic and sealed to protect them from deterioration and marring.
- C. Galvanized metal: Wash with xylol to remove grease, oil, and contaminants; wipe dry with dry cloth.
- D. Aluminum: Sand to remove oxides. Wash with xylol to remove grease, oil, and contaminants; wipe dry with dry cloth.
- E. Concrete Surfaces:
 1. Fill cracks, holes, and irregularities with cement grout.
 2. Remove laitance, oil, grease, dirt, and debris from surfaces. Verify concrete cure time prior to coating application.
 3. For all concrete surfaces, the following surface preparation shall be employed:

- a. CC-I - Wash: Wash and scrub all surfaces with a solution of 1-1/2 ounces of soap chips and 1-1/2 ounces of trisodium phosphate in each gallon of water used. Flush away all soap and dirt with clean water. After this washing the surface will be rechecked and any rough areas not suitable for painting shall be sand blasted smooth.

3.06 APPLICATION

- A. Conditions: No paint shall be applied upon damp or frosty surfaces, or in wet or foggy weather. No paint shall be applied in temperatures below 40° F. or when freezing (32° F.) is predicted within 24 hours of application, or under temperature or humidity conditions not recommended by the manufacturer.
- B. Surface Preparation: After specified surface preparation, all surfaces shall be brushed free of dust or foreign matter. Surfaces shall be completely dry before any paint is applied.
 1. Apply materials only when moisture content of surfaces is within manufacturer's recommended range.
- C. Application: Paint shall be evenly spread in the proper thickness so that there shall be no drops, runs or sagging of the coating. Where runs and drops do occur, they shall be removed and the surface re-coated to the satisfaction of the Engineer. Sufficient time, as directed by the manufacturer, shall be allowed for the paint to dry before the application of succeeding coats.
 1. Apply materials in accord with manufacturer's approved product data to achieve specified DFT.
 2. Apply materials using clean brushes, rollers, or spray equipment. Limit paint spraying only to those materials recommended by manufacturer to be sprayed with no loss of performance, durability, or color.
 3. Apply materials at rate not exceeding manufacturer's recommendations for surface being coated, less ten percent for losses.
 4. Sand and dust between coats to remove defects visible from 5' - 0" distance. Tint primer and intermediate coats slightly to provide slight contrast.
 5. Finish coats: Smooth, free of brush marks, streaks, laps or pile-up of paint, skips, or missed areas.
 6. Make coating edges adjoining other materials or colors sharp and clean without overlapping.
 7. Primer coats may be omitted for surfaces specified to receive factory applied primer if finish coats are compatible with primer. Substitute bond coat recommended by paint manufacturer for specified primer coat if finish coats are not compatible.
 8. Refinish entire partition surface where portion of finish on gypsum board partition is damaged or unacceptable.
 9. Backprime exterior and interior finish carpentry and millwork with material specified for prime coat without runs on face; finish cut edges just prior to installation.
 10. Seal interior doors' tops and bottoms of with prime coat only; side edges same as faces.
 11. Finish exterior door edges same as exterior faces.

- D. Protection of Work Area: Use drop cloths or other suitable means to protect other surfaces of the structure or equipment in place. Upon completion of the Work, remove all paint spots from surfaces as directed by the Engineer.
- E. Inspection: The Engineer will inspect each coat prior to the application of subsequent coats. If the work is found to be satisfactory, a written order will be given to proceed. Application of additional coats until completed coat has been inspected is prohibited. Only inspected coats of paint will be counted in determining the number of coats applied.
- F. Defective Work: Remove and replace, at the direction of the Engineer, any painting work found to be defective or applied under adverse conditions.

3.07 PAINTING SCHEDULE

- A. The Painting Schedule summarizes the painting systems to be applied to the various surfaces.

1. PAINT SUBMITTAL SCHEDULE for Marsh Creek Pump Station

System	Specification	Item	Surface Prep	Primer	Finish & Touch Up	Color
A	SS 3300-2.06	Concrete Walls Above Flow Elevation	SSPC-7	Self Priming	2 Coats of Valspar 76 Series at 4-6.0 mils per coat	Gray
B	SS 5500	Misc. Metals	SSPC 6 for Non-Immersion	Tnemec 90-97	2 Coats of 89 Series for Non-Immersion at 4-6.0 mils	Warm Gray M3759
C	SS 5500	Misc. Metals	SSPC 10 of Immersion	Not Required	2 Coats of 78 Series for Immersion at 4-6.0 mils	Gray
D	SS 15060	Dip Pipe	SSPC 6 for Non-Immersion	Tnemec 90-97	2 Coats of 89 Series for Non-Immersion at 4-6.0 mils	Buff D4608
E	SS 15060	Dip Pipe	SSPC 10 for Immersion	Not Required	2 Coats of 78 Series for Immersion at 4-6.0 mils	Gray
I	SS 15060	Plastic Pipe	Lightly Sand	Not Required	2 Coats of 89 Series, 4-6.0 mils per coat	Warm Gray M3759
I	SS 15100	Valves & Operator	Lightly Sand	Not Required	2 Coats of 89 Series, 4-6.0 mils per coat	OSHA Orange
I	SS 11199	Pumps & Drives	Lightly Sand	Not Required	2 Coats of 89 Series, 4-6.0 mils per coat	Vale Green P2402

MATERIAL SCHEDULE

2. THESE PRODUCTS HAVE BEEN SELECTED TO ACHIEVE SPECIFIC RESULTS. NO SUBSTITUTIONS WILL BE ALLOWED.

MATERIAL SCHEDULE
131

TYPE: EPOXY

USE: INTERIOR MASONRY AND CONCRETE

SURFACE PREPARATION: CC-I

TNEMEC

FIRST COAT: EPOXY-POLYIMIDE FILLER

SECOND COAT: SERIES 66 HI-BUILD EPOXOLINE - 4.0 MILS DRY

THIRD COAT: SERIES 66 HI-BUILD EPOXOLINE - 4.0 MILS DRY

* MINIMUM 8.0 MILS DRY

KOPPERS

FIRST COAT: CONCRETE AND MASONRY FILLER

SECOND COAT: HI-GARD EPOXY - 4.0 MILS DRY

THIRD COAT: HI-GARD EPOXY - 4.0 MILS DRY

* MINIMUM 8.0 MILS DRY

NOTES:

1. IF MINIMUM MIL THICKNESS IS NOT ACHIEVED IN NUMBER OF COATS SHOWN, ADDITIONAL COATS WILL BE APPLIED AT NO ADDITIONAL EXPENSE TO COUNTY.

2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:

- a. Sherwin-Williams Company.
MATERIAL SCHEDULE
140

TYPE: POLYAMIDE EPOXY

USE: FERROUS METAL SURFACES AND STRUCTURAL STEEL LOCATED INSIDE A BUILDING WHICH ARE NOT SUBMERGED OR LOCATED ABOVE A LIQUID. NOT FOR USE WITH PROCESS EQUIPMENT.

SURFACE PREPARATION: SSPC SP-6

TNEMEC

PRIMER: CHEM-PRIME 37-77 - 2.5 MILS*

FIRST COAT: SERIES 69 EPOXOLINE II - 6.0 - 8.0 MILS*

SECOND COAT: SERIES 69 EPOXOLINE II - 6.0 - 8.0 MILS*

* MINIMUM DRY FILM THICKNESS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS OF 14.5 MILS IS NOT ACHIEVED IN THE NUMBER OF COATS SPECIFIED, ADDITIONAL COATS SHALL BE APPLIED AT NO ADDITIONAL COST TO THE OWNER.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:
 - a. Koppers.
 - b. Sherwin-Williams Company.

MATERIAL SCHEDULE

141

TYPE: HIGH BUILD EPOXY

USE: PROVIDE THE FOLLOWING COATING SYSTEM FOR FERROUS METAL SURFACES ON ALL MECHANICAL EQUIPMENT AND ACCESSORIES INCLUDING BUT NOT LIMITED TO: PUMPS, VALVING AND OTHER PROCESS EQUIPMENT AND EXTERIOR STRUCTURAL STEEL AND EXPOSED STEEL PIPE.

SURFACE PREPARATION: SSPC-SP10 NEAR WHITE BLAST-IMMERSION SERVICE

TNEMEC

FIRST COAT: SERIES 90-97 TNEME-ZINC 2.5-3.5 MILS DRY

SECOND COAT: SERIES 66 HI-BUILD EPOXOLINE 4.0-6.0 MILS DRY

THIRD COAT: SERIES 66 HI-BUILD EPOXOLINE 4.0-6.0 MILS DRY

* MINIMUM TOTAL DRY FILM THICKNESS 10.5 MILS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS IS NOT ACHIEVED IN THE NUMBER OF COATS SHOWN, ADDITIONAL COATS SHALL BE APPLIED AT NO ADDITIONAL COST TO THE OWNER.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO

APPROVAL OF PRODUCT LIST AND SAMPLES:

- a. Koppers.
- b. Sherwin-Williams Company.

MATERIAL SCHEDULE
150

TYPE: ACRYLIC LATEX

USE: ALL PVC SURFACES TO BE PAINTED, AS SPECIFIED OR SHOWN ON DRAWINGS.

SURFACE PREPARATION: CLEAN AND DRY.

GLIDDEN

FIRST COAT: GLID-GUARD LIFEMASTER NO. 6900 SERIES - 2.0 MILS*

SECOND COAT: GLID-GUARD LIFEMASTER NO. 6900 SERIES - 2.0 MILS*

* MINIMUM DRY FILM THICKNESS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS OF 4.0 MILS IS NOT ACHIEVED IN THE NUMBER OF COATS SPECIFIED, ADDITIONAL COATS SHALL BE APPLIED AT NO COST TO THE OWNER.

2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:

- a. Benjamin Moore Company.
- b. Devoe and Reynolds Company, Inc.
- c. Pratt and Lambert Inc.
- d. PPG Industries Inc.
- e. Sherwin-Williams.

SURFACE PREPARATION: SP-10

TNEMEC

FIRST COAT (SHOP PRIMER): SERIES 66-1211 EPOXOLINE PRIMER - 2.0 MILS DRY*

SECOND COAT (SHOP COAT): SERIES 66 HI-BUILD EPOXOLINE - 6.0 MILS DRY*
THIRD COAT: SERIES 104 HS EPOXY - 10.0 MILS DRY*

* MINIMUM 18.0 MILS DRY

KOPPERS

FIRST COAT (SHOP PRIMER): 654 EPOXY PRIMER 2.0 MILS DRY*

SECOND COAT (SHOP COAT): HI-GARD - 6.0 MILS DRY*

THIRD COAT: SUPER HIGH SOLIDS EPOXY - 10.0 MILS DRY*

* MINIMUM 18.0 MILS DRY

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS IS NOT ACHIEVED IN NUMBER OF COATS SHOWN, ADDITIONAL COATS WILL BE APPLIED AT NO ADDITIONAL EXPENSE TO COUNTY.

2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:

- a. Sherwin-Williams Company.

+++ END OF SECTION 09900 +++

**SECTION 11199
SUBMERSIBLE PUMPS****PART 1 - GENERAL****1.01 SCOPE**

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of all submersible pumps. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications and the manufacturer's recommendations and as shown on the Drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.
- C. Related work specified elsewhere:
 - 1. Section 09900 - Painting.
 - 2. Section 15060 - Piping and Appurtenances.
 - 3. Division 3 - Concrete.
 - 4. Division 13 - Instrumentation & Control.
 - 5. Division 16484 - Integrated Pump Control System

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Relevant experience references.
 - 2. Manufacturer's Certification, factory testing procedures and sketch of test setup, and startup reports.
 - 3. Manufacturer's data: performance curves; dimensions; materials; operating conditions; size and location of all loads imposed on supporting structures; size and location of any concrete blackouts; size and location of anchor bolts and any required clearances.
 - 4. Operation and maintenance manuals.
 - 5. Control panel layout and detail.

1.03 QUALITY ASSURANCE

- A. Reference Standards. Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
 - 1. NEC, National Electric Code.
 - 2. NEMA, Standards of National Electrical Manufacturers Association.

3. OSHA, Occupational Safety and Health Act.
 4. ANSI, American National Standards Institute.
 5. ASTM, American Society for Testing Materials.
 6. AISI, American Iron and Steel Institute.
 7. HI, Hydraulic Institute Standards.
 8. AFBMA, Anti-Friction Bearing Manufacturer's Association.
 9. NFPA, National Fire protection Association.
 10. ACI, American Concrete Institute.
- B. Experience: Equipment furnished under this Section shall be of a design and manufacture that has been successfully used in similar applications. The manufacturer shall have furnished equipment for a minimum of five similar applications that have a demonstrated record of successful operation for a minimum period of 5 years. Provide a list of such installations complete with installation description contact names, addresses, telephone numbers. This reference list shall be submitted with the shop drawings.

1.04 QUALITY STANDARDS

- A. All submersible pumps specified in this Section shall be furnished by a single manufacturer who shall assume sole responsibility for providing complete, operating systems designed for long life with a minimum of required maintenance meeting the requirements specified herein and as shown on the Drawings. The Contractor shall assign unit responsibility as specified in Section 01600, General Material and Equipment Requirements, to the equipment manufacturer for the equipment specified in this section. A certificate of unit responsibility shall be provided.
- B. Manufacturer shall provide written certification that the equipment provided under this Specification has been amply designed and is a suitable application for these service conditions.
- C. Manufacturers offering products that comply with these specifications include:
1. Flyght Corporation.
 2. Fairbanks Morris

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Pumps and accessories shall be stored and protected in accordance with the manufacturer's recommendations.
- B. Pump suction and discharge ports shall be provided with plugs or wooden bolted blind flanges. Each pump shall be secured to a wooden skid to facilitate handling and storage.

1.06 WARRANTY

- A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

1.07 EQUIPMENT NUMBERS PUMP-1 and PUMP-2

PART 2 - PRODUCTS**2.01 GENERAL**

- A. Pumps shall be of the heavy duty, submersible, centrifugal non-clog type and shall be supplied with motor, discharge elbow, guide bar system and accessories.
- B. Pumps shall be suitable for pumping raw sewage and shall be designed and fully guaranteed for this use. The fluid temperature range shall be from 40^o to 104^o F. The pumps supplied under this specification shall be suitable for continuous operation under submerged or partially submerged conditions. Without derating the motor, the pumps shall be able to pump continuously with the minimum water level at the top of the motor housing, under full load, without the need of spray system or air moving equipment.
- C. The pumps shall be automatically connected to the discharge connection elbow when lowered into place. Pumps shall be easily removable for inspection or service, requiring no bolts, nuts or other fasteners to be removed for this purpose and no need for personnel to enter the pump well. Sealing of the pumping unit to the discharge elbow shall be accomplished by a simple linear downward motion of the pump with the entire weight of the pumping unit guided to and pressed tightly against the discharge elbow with a metal to metal watertight contact. Sealing of the discharge interface by means of a diaphragm, O-ring or other device will not be acceptable.
- D. The pump systems and appurtenances, including the pump, motor, guide system and wiring, shall be suitable for operation in the State of Georgia for explosion proof service. The system shall be rated for Class 1, Division 1, Group D service as determined by the National Electrical Code and approved by a nationally recognized testing agency (U.L. or F.M.) at the time of bidding of this project
- E. A 2 ton manual hoist and chain furnished under Specification Section 14300 will be used for loading and unloading pumps
- F. The pump manufacturer shall be responsible for the design and furnishing the material handling system (loading and unloading pumps) for pumps specified under 2.04.

2.02 MATERIALS

- A. Major pump parts, such as the stator casing, oil casing, sliding bracket and discharge connection shall be of ASTM A48, Class 35 minimum gray iron. All exposed bolts and nuts shall be AISI type 304 stainless steel or brass construction. All metal surfaces coming into contact with the pumped liquid, other than stainless steel or brass, shall be protected by a factory applied spray coating of alkyd primer with a chlorinated rubber paint finish on the exterior of the pump.
- B. All mating surfaces of major parts shall be machined and fitted with Nitrile or Viton rubber O-ring seals where watertight sealing is required, except at discharge elbow connection. All parts shall be interchangeable and watertight sealing shall not require additional machining of replacement parts, sealing compounds, or the application of specific torques to connectors. Fittings shall be the result of controlled compression of rubber O-rings in two planes and O-ring contact on four sides without the requirement of a specific torque limit.
- C. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall not be used.

2.03 SERVICE CONDITIONS

- A. The fluids pumped will contain organic and inorganic solids, rags, strings, small sticks, industrial solvents, petroleum products, industrial wastes, vegetable and animal fats and grit. Fluid temperature will range from 55° F to 70° F. Fluid pH will range from 6 to 7.
- B. The equipment specified herein is for underwater use and for continuous service, and shall be capable of passing a 3-inch spherical solid.

2.04 OPERATING CONDITIONS

- A. Refer to the accompanying Drawings for general arrangements and dimensional limitations. Provide complete submersible pump units designed for the indicated service and free of excessive vibration or hydraulic instability from minimum TDH to shutoff head when operating continuously under the following conditions: Variable frequency drives shall provide stable pump operation at 70 percent speed.
- B. The operating range of the pump shall include the duty points, minimum head, maximum head and shut-off head conditions. The pumps shall be non-overloading throughout this operating range.

Equipment Number	<u>Pump-1</u>	<u>Pump-2</u>
Condition A		
Guaranteed Performance		
Capacity gpm	3150	3150
Total head, feet	14	14
Condition B		
Capacity gpm	3550	3550
Total head, feet	10	10
Condition C		
Capacity gpm	2750	2750
Total head, feet	17.5	17.5

Pump Data:

Discharge connection (inches)	10	10
Electrical Supply (V/PH/Hz)	460/3/60	460/3/60
Maximum motor size	25 horse power	25 horsepower
Accessories	Guide rails, stainless steel chains, discharge connection, brackets, access hatch with lock, portable hoist...	Guide rails, stainless steel chains, discharge connection, brackets, access hatch with lock, portable hoist.

2.05 COMPONENTS**A. Impeller:**

1. A wear ring system shall be installed to provide efficient sealing between the volute and impeller. The wear ring shall consist of a stationary ring, made of nitrile rubber molded with a steel ring insert, which is drive fitted to the volute inlet and of a rotating, stainless steel ANSI 304 ring, which is drive fitted onto the impeller eye.
2. The impeller shall be gray cast iron, of non-clogging design, capable of handling solids, fibrous material, heavy sludge and other matter found in normal sewage applications. The impeller shall be constructed with a long through let without acute turns. The impeller shall be dynamically balanced. Static and dynamic balancing operations shall not deform or weaken it. The impeller shall be keyed to the shaft. Non-corroding fasteners shall be used.

B. Abrasion Resistance:

1. All parts exposed to abrasive wear, case and impeller shall have a minimum Brinell hardness of 200.

C. Shaft Seals:

1. Each pump shall be provided with a mechanical, rotating shaft seal system running in an oil reservoir having separate, constantly hydro-dynamically lubricated, lapped seal faces. The lower seal unit between the pump and oil chamber shall contain one (1) stationary and one (1) positively driven, rotating tungsten-carbide ring. The upper seal unit between the oil sump and motor housing shall contain one (1) stationary tungsten-carbide ring and one (1) positively driven rotating carbon ring.
2. Each interface shall be held in contact by its own independent spring system, supplemented by external liquid pressures. The seals shall require neither maintenance nor adjustment, but shall be easily inspected and replaceable. No seal damage shall result from operating the pumping unit out of its liquid environment. The seal system shall not rely upon the pumped media for lubrication. The oil reservoir shall have a drain and inspection plug, with positive seal, which shall be easily accessible from outside the pump.

D. Guide Bars System:

1. Stainless steel guide bars shall schedule 40 pipe attached to the automatic discharge connection at the lower end and to an upper guide bar bracket at the upper end. Intermediate guide bar supports shall be provided as required to insure a secure installation. Two guide bars shall be provided for each pump. Guide bars shall not support any of the weight of the pump. Guide bars, upper and intermediate supports, and anchor bolts shall be provided by the Contractor. Cable type guide systems shall not be acceptable.

E. Pump Motor:

1. Pump motors shall be designed in accordance with the standards of NEMA. Refer to paragraph 2.02 of this Specification for additional pump characteristics. Motors shall be suitable for operation in Class 1, Division 1, Group D hazardous areas provided the provisions of 2.01.D are met.
2. The motor shall be a squirrel cage, induction, shell type design housed in a watertight casing. The pump shaft shall be a one-piece, solid shaft of AISI Type C1035 carbon steel and shall be completely isolated from the pumped liquid.

3. The shaft shall be supported above and below the rotor by anti-friction bearings designed to provide long life and minimize shaft deflection. Bearings shall have a minimum AFBMA L-10 life of 50,000 hours.
4. The design may, if required, incorporate a positive, circulated cooling system to cool the motor. Passages for cooling media, where used, shall be amply dimensioned to prevent clogging. Thermal sensors shall be provided to monitor stator temperature. Three switches, one in each phase shall be provided and wired to shut down the motor for high stator temperature.
5. Any other alarm or control devices, including any additional wiring, conduit, controls, etc. which the pump manufacturer recommends or requires for warranty, shall be furnished by the Contractor, at no additional cost to the County.
6. Each motor shall be provided with an electronic moisture detecting system. The leakage sensor shall be located in the motor housing and wired through the junction box to the control panel. Any indication of moisture present shall activate a signal warning that a leakage has occurred. Moisture sensor/switch shall be Warrior or equal.

F. Cable

1. Power and control cables shall be suitable for submersible pump applications and shall be indicated by a code or legend permanently embossed on the cable. Cable sizing shall conform to NEC specifications. Provide continuous, splice-free length of cable from pump to connections at the cable reels as shown on the Drawings. Cable shall be approved by F. M. for NEC Class I, Div. I, Group C and D services.
2. The cable entry sealing fitting shall relieve stress on conductors and provide a watertight and submersible seal, without the use of sealing compounds and without the application of specific torques to connectors. The conductors shall connect to a terminal board which shall be provided with a moisture-tight seal between the cable entry junction chamber and the motor.
3. The cable entry water seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall be comprised of a dual cylindrical elastomeric grommet, flanked by stainless steel washers all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body containing a strain relief function, separate from the function of sealing the cable. The assembly shall bear against a shoulder. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the motor interior from foreign material gaining access through the pump top. Epoxies, silicones or other secondary sealing systems shall not be considered acceptable.

2.06 ACCESSORIES

- A. Grip-Eye System: Furnish with each submersible pump system one complete ITT Flygt-Lift System or approved equal. The system shall consist of 35 feet of nylon line; short length of high tensile strength proof tested chain and forged steel Grip-Eye for use with mechanical lifting device furnished under section 14300. System shall be sized to lift the weight of the pump with a minimum safety factor of (2) two.
- B. Sequence of Operation is shown on Drawing M-02.

PART 3 - EXECUTION**3.01 INSTALLATION**

- A. Equipment Installation: All equipment shall be installed in accordance with approved shop drawings and manufacturer's recommendations.
- B. Anchorage: Stainless steel anchor bolts, nuts and washers, as well as any templates necessary for setting the anchorage, shall be furnished by the equipment manufacturer. Placement of the anchor bolts shall be done by the Contractor from certified dimension shop drawings supplied by the equipment manufacturer.
- C. Leveling and Grouting
 - 1. Level and align pump and guide bars in accordance with the respective manufacturer's published data.
 - 2. Grout pump mounting base and guide rails as required with non-shrink grout in accordance with the ACI, equipment manufacturer's and grout manufacturer's published specifications.

3.02 PAINTING

- A. The Contractor shall clean and touch-up paint all equipment in accordance with the requirements as specified in Section 09900, Painting, using paint furnished with equipment.

3.03 INSPECTION AND TESTING

- A. The pump manufacturer shall conduct full scale, full range factory performance tests with respect to capacity, head and horsepower. The Engineer shall have the option to witness the pump tests and certified test reports shall be submitted for approval, prior to shipment of the pumps. Tests shall be conducted in accordance with applicable Hydraulic Institute standards.
- B. Each pump shall be tested for performance at the factory where the system was manufactured and assembled to determine head vs. capacity, efficiencies, and kilowatt draw required for the operating points that are specified. All tests shall be run in accordance with the latest edition of the American Hydraulic Institute Standards. Testing shall include the following:
 - 1. Impeller, motor rating and electrical connections shall first be checked for compliance to specific requirements.
 - 2. Motor and cable insulation test for moisture content or insulation defects.
 - 3. After a submerged test run of 30 minutes, item 2 shall be retested.
 - 4. If any deviation of above is found, the pump shall be rejected.
- A. The Contractor shall provide for witnessing of the factory performance testing by the three representatives of the Engineer, and shall provide all transportation (economy class), lodging, meals and miscellaneous expenses necessary for the Engineer's representatives to attend the factory performance tests.
- B. The pumps shall be tested at start-up by the pump manufacturer or its authorized representative. The pump manufacturer shall provide a formal test procedure and forms for recording the test data. The person designated and provided by the manufacturer for start-up services shall be authorized by U.L or F.M. for the service.

3.04 SERVICE CAPABILITY

- A. The manufacturer shall have maintained prior to Bid an in-State service facility for a minimum of two (2) years and shall maintain an in-state, factory certified, regional service facility that is staffed with proper tools and equipment for servicing the pumps for a minimum of ten years following completion of the Contract. The staff shall include manufacturer's certified maintenance personnel. The facility shall be accessible to the Engineer for inspection during any working hour of a normal business day.
- B. The facility shall stock complete sets of spare parts to enable a maximum of 24 hour repair after receipt of pump for maintenance or repair.
- C. The facility shall have U.L. or F.M. certified mechanics on staff to service the pumps.

+ + + END OF SECTION 11199 + + +

**SECTION 11203
SLUICE GATES****PART 1 - GENERAL****1.01 SCOPE**

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of heavy duty sluice gates. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings. Each gate shall be furnished and installed complete with wall thimbles, operating stem, gate lift operator and other appurtenances as specified or needed to make a complete and operable installation.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the work shown and specified.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Relevant experience references.
 - 2. Manufacturer's Certification, test and startup reports.
 - 3. Manufacturer's data (performance curves, dimensions, materials, operating conditions)
 - 4. Operation and maintenance manuals.
 - 5. Certificate of unit responsibility.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
 - 1. NEC, National Electric Code.
 - 2. NEMA, Standards of National Electrical Manufacturers Association.
 - 3. OSHA, Occupational Safety and Health Act.
 - 4. ANSI, American National Standards Institute.
 - 5. ASTM, American Society for Testing Materials.
 - 6. AISI, American Iron and Steel Institute.
 - 7. HI, Hydraulic Institute Standards.

8. AFBMA, Anti-Friction Bearing Manufacturer's Association.
9. AWWA, American Water Works Association.

- B. Experience: Equipment furnished under this Section shall be of a design and manufacture that has been successfully used in similar applications. The manufacturer shall have furnished equipment for a minimum of five similar applications that have a demonstrated record of successful operation for a minimum period of 5 years. Provide a list of such installations complete with installation description contact names, addresses, telephone numbers. This reference list shall be submitted with the shop drawings.

1.04 QUALITY STANDARDS

- A. The sluice gates shall be furnished by a single manufacturer who shall assume full responsibility for providing a complete, operating system designed for long life with a minimum of required maintenance meeting the requirements specified herein and as shown on the drawings.
- B. Manufacturers shall provide written calculations and other data demonstrating that the equipment provided under this Specification has been amply designed and is a suitable application for these service conditions.
- C. Manufacturers offering products that comply with these specifications include:
1. Rodney Hunt Company.
 2. Waterman Industries, Inc.
 3. Hydrogate.
 4. Or equal.

1.05 STORAGE AND PROTECTION

- A. All gates and accessories shall be stored and protected in accordance with the requirements of manufacturer.

1.06 WARRANTY

- A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Sluice Gates:
1. Gates, stems, lifts and other appurtenances shall be the size, type, material and construction as shown on the Drawings and specified herein. Gates shall meet the requirements of AWWA Specifications C501 (latest revision) or as modified per these Specifications.
 2. Sluice gates shall be heavy-duty single rising stem type, unless otherwise specified, and shall

meet the design requirements shown in Table 1 of this Section.

- B. Wall Thimbles: Unless otherwise specified or indicated each gate shall be provided with one-piece, F-section cast iron wall thimble where E-section thimble is specified, the back flange shall extend 6 inches off the wall. The vertical centerline of the wall thimble shall be shown by permanent marks at the top and bottom of the mechanical face with the word "top" marked near the top center of the thimble opening.

2.02 MATERIALS

- A. All materials used in the construction of the gates and appurtenances shall be the best suited for the application and, unless specified otherwise, shall be as follows:

1. Sluice gate.

Gate Part or Item	ASTM Standard Material Number
Wall Thimble	Cast Iron, ASTM A126, Class B
Slide, Guide and Frame	Cast Iron, ASTM A126, Class B
Seating Faces	Naval Bronze ASTM B21, Alloy 464
Wedges and Thrust Nut	Manganese Bronze ASTM B584, Alloy 865
Adjusting bolts and Fasteners	Stainless Steel (Bolts) ASTM A193, Grade B8, Type 304 (Nuts) ASTM A194 Grade 8, Type 304
Stem Block	Manganese Bronze B584, Alloy 865
Sill Plate	Ni-Resist Cast Iron A436
Seal	Rubber ID 2000, Grade R-62
Retainer	Stainless Steel ASTM A276, Class B
Yoke	Cast Iron ASTM A126, Class B
Stem	Stainless Steel ASTM A276, Type 304

2. Flap gate.

Gate Part or Item	ASTM Standard Material Number
Frame and cover	Cast iron, ASTM A126, Class B
Pivot lugs	Ductile Iron, ASTM A536
Hinge links	Galvanized structural steel, ASTM A36 and ASTM A123
Assembly hardware and hinge pins	Stainless steel, ASTM A276, Type 304
Seating faces	Naval bronze, ASTM B21
Wall thimble	Cast iron, ASTM A126, Class B

2.03 PERFORMANCE REQUIREMENTS

- A. General:

1. All parts and accessories in each gate shall be accurately machined on mating and bearing surfaces. All like parts, except the bronze seating surfaces, shall be interchangeable so that replacement parts can be furnished at any time and attached in the field with a minimum of fitting, chipping or re-machining. All parts shall conform to the design dimensions and shall

be free of defects of material and workmanship. All attaching bolt holes shall be drilled accurately to the layout indicated on the Drawings.

2. All casting shall be clean and sound without defect capable of impairing their functions.
3. The seating facings shall be machined to a finish of 63-microinches. The applicable standard is ANSI B46.1. All mating surfaces, such as guides-to-frame and frame-to-wall thimble, shall be machined flat.

B. Sluice Gates:

1. All sluice gates, including lift, shall be designed for the heads shown in Table 1.
2. Component sizing:
 - a. Operating forces used for determining the strength of gate components including yokes, frames, discs, stems, disc nut pockets, and other load-bearing members shall be based on the sum of the guide friction force (computed using an opening breakway friction factor of 0.70) and the weight of disc and stem.
 - b. For gates with openings larger than 700 square inches, a safety factor of 1.5 shall be applied to the weight of the disc in calculations for the determination of operator size.
 - c. For activated gates actuator shall raise and lower the gate at a minimum speed of 1.0 feet per minute.

2.04 SLUICE GATES

A. Frame and Guide Rails:

1. For conventional gates, guides shall be of such length as to support at least one-half of the vertical height of the slide when in the full-open position. The self-contained sluice gate shall have extended side guides to allow the gate to fully open.

B. Slide:

1. The slide shall be one-piece with integrally cast strengthening ribs where required and a reinforced section to receive the seating faces.
2. The slide shall have tongues on each side extending its full length. These tongues shall be accurately machined on contact surfaces. Surfaces of the slide that come in contact with the seat facings shall be accurately machined. The maximum allowable clearance between the slide and slide guide shall be 1/16-inch.
3. A thrust nut pocket shall be provided above the horizontal center line of the slide reinforced by ribs. The thrust nut pocket shall be drained.

C. Seating Faces:

1. Seating faces shall be made of strips of rolled or extruded bronze and shall be firmly secured in finished grooves in frame and slide faces in such a way as to ensure that they will remain in place, free from distortion and loosening during the life of the sluice gate.

2. These faces shall be of ample section and so finished that the maximum clearance between the seating surfaces, with the slide in the closed position, shall be 0.004-inch.

D. Seals:

1. Resilient seals for flush bottom gates shall be of natural or synthetic rubber; reclaimed rubber shall not be used.
2. Rubber compounds shall contain no more than 1.5 parts of wax per 100 parts of rubber hydrocarbon.
3. Rubber compounds shall be free of vegetable oils, vegetable oil derivatives, animal fats and animal oils.
4. Rubber seals shall be resistant to microbiological attack, copper poisoning and ozone attack.
5. The design of the seal should be as to provide tight shut-off.
6. Seals shall be mounted on the slide or frame and shall be securely held in place with a retainer bar leaving an unobstructed flush invert. The seal shall be replaceable without removal of the gate slide.

E. Thrust Nut:

1. Gate shall be provided with a thrust nut for connecting the stem to the slide. It shall be of ample design to take the thrust developed during gate operation, in opening and closing direction under the maximum operating head condition loads shown in Table 1, Sluice Gate Schedule and the requirements of article 11203-2.03. The thrust nut and slide shall be constructed to prevent turning off the thrust nut in a pocket in the slide.

F. Wedging Devices:

1. Sluice gate shall be equipped with adjustable side-wedging devices to provide contact between the slide and frame facings when the gate is in closed position. All faces shall be accurately machined to give maximum contact and wedging action. Wedges shall be fully adjustable and so designed that they will remain in the fixed position after adjustment. On all gates larger than 24-inches in size that will be subject to unseating heads, top and bottom wedging devices shall be provided, unless the gates are specified flush bottom closure. If the gates are flush bottom closure gates and are larger than 24-inches, they shall be provided with top wedges only. Individual parts of each wedging device shall be removable and replaceable without complete disassembly of the gate or guide.

- G. Assembly Bolts, Studs, Nuts and Anchor Bolts: All assembly bolts, studs, nuts and anchor bolts shall be of such size and spacing as required for proper design. Bolting on circular, flanged-back gates shall mate with 125 pound drilling as specified in ANSI/ASME B16.1. An adequate number of holes shall be provided in the flange on the back of the gate to prevent leakage under the design heads and to resist the shearing action caused by closing and opening forces.

- H. Stems and Stem Couplings: Operating stems shall be of a size to safely withstand, without buckling or permanent distortion, stresses induced by normal operating forces. Stems shall be fabricated from round bar stock provided with 29 degree acme threads. Stems composed of two

or more sections shall be joined by bronze couplings, threaded and keyed to stems, or couplings of the same material as the stems, pinned, bolted or welded and pinned to the stems. Provide a clear, plastic stem cover with mylar position indicator strip.

- I. Stem Guides: Stem guides shall be cast, with bronze bushings, mounted on cast brackets. Guides shall be adjustable in two directions and shall be so constructed that when properly spaced they will hold the stem in alignment and still allow enough play to permit easy operation. Stem guide spacing shall be as recommended by the manufacturer, but in no case shall it exceed a l/r ratio of 200. Brackets shall be attached to the wall by stainless steel anchor bolts of sufficient strength to prevent twisting or sagging under load.
- J. Operators:
 1. General:
 - a. Operators provide under this Section include geared and non-geared manual operators.
 - b. Operators shall be sized in accordance with paragraph 11203-2.03B2.
 - c. Operators shall meet AWWA Specification C501, except as otherwise specified, and shall be designated to meet the operating requirements specified in Table 1, Sluice Gate Schedule.
 - d. Unless otherwise indicated, operators shall be located 36 inches above the operating floor.
 2. Geared operator:
 - a. Operator shall be the manual, geared, crank type. The operator shall be either pedestal or bench mounted as specified. Pedestal type floor stands shall be the offset type or the standard type with wall mounting bracket. The crank shall be 15 inches long.
 - b. Gears and bearings shall be enclosed in a weatherproof cast iron housing, and pressure type fittings shall be provided for grease lubrication of the bearings and gears. A maximum effort of 40 pounds pull on the crank shall operate the gate under the specified operating conditions.
 - c. The geared floor or bench stand shall have a weatherproof, cast iron housing, with a bronze operating nut, mounted on a high-strength cast iron pedestal baseplate. The operating nut shall be internally threaded with 29-degree acme bearings corresponding to stem threading. Tapered roller bearings or ball bearings shall be located above and below the bronze operating nut to support the output thrust of the floor stand. The pinion shaft shall be mounted on tapered roller or needle bearings to resist axial and radial thrusts. Mechanical seals shall be provided around the operating nut and the pinion shaft to prevent lubrication from leaving the unit and moisture from entering the sealed housing. The reduction gear case shall be precision machined and equipped with tapered roller or needle bearings and sealed about the reduction shafts.
 - d. Operators shall be self-locking at any position of the stem travel. The input shaft shall be fitted with an AWWA nut.

2.05 FACTORY TESTING

- A. Sluice Gates:

1. Before final assembly, all seating and wedging surfaces shall be thoroughly cleaned of all foreign materials and final adjustments made. With the gate fully closed, the clearance between the seating faces shall be checked with a 0.004-inch thickness gauge. If this thickness gauge can be inserted between seating faces, wedging devices must be readjusted or the gate slide or cover or gate frame or both re-machined, until insertion is no longer possible. In the event of re-machining, clearances will again be checked as stated above.
2. After completion, all seating and wedging surfaces shall be thoroughly cleaned of all foreign materials and final adjustments made. The gate shall then be shop operated from the fully closed to the fully open position to verify that the assembly is workable.

2.06 SHOP PAINTING

- A. Gates: Cast iron parts of the gates and associated cast iron equipment shall be shop cleaned and painted in accordance with the requirements of Section 09900 Painting.
- B. Thimbles: Wall thimbles shall receive the same treatment as described in paragraph 11203-2.07A, except surfaces that will contact concrete shall remain uncoated.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Sluice gates and equipment shall be installed in accordance with the installation manual furnished by the gate manufacturer.

3.02 INSPECTION AND TESTING

- A. Following installation, operating tests will be performed to demonstrate to the Engineer that each gate will function in a satisfactory manner. The Contractor shall make, at Contractor's own expense, all necessary changes, modifications and/or adjustments required to ensure satisfactory operation.
- B. Each sluice gate shall be subjected to leakage tests and pass the standard requirements for maximum leakage as specified in AWWA C501.

3.03 CLEANING

- A. Prior to acceptance of the work of this Section, thoroughly clean all installed materials, equipment and related areas.

TABLE 1 - SLUICE GATE SCHEDULE

Equipment Number	Size Inches	Gate Type	Operator Type
SLG1	30"x30"	UCRFBFG	Manual
SLG2	30"x30"	UCRFBFG	Manual

Notes:

1. Gate Type Abbreviations:
 - a. Opening: U = upward opening; D downward opening
 - b. Frame Type: SC = self-containing; C = conventional
 - c. Stem: R = rising; NR = non-rising
 - d. Closure: FB = flush bottom; S = standard
 - e. Mounting: TM = thimble mounted; WM = wall mounted; PFM = pipe flange mounted

2. Thimble Type:
 - a. Type: F = "F" thimble
 - b. E = "E" thimble
 - c. U = "U" thimble
 - d. G = type G penetration with flush mounted flange on gate side and mechanical joint on other end, unless otherwise indicated
 - e. Size: Listed size indicates the thimble/pipe length.

3. Operator Type Abbreviations:
 - a. G = geared
 - b. NG = non-geared
 - c. P = pedestal
 - d. GP = geared pedestal
 - e. Hand = manually removed and installed
 - f. EM = electric motor
 - g. HC = hydraulic cylinder
 - h. PC = pneumatic cylinder

+++ END OF SECTION 11203 +++

**SECTION 13620
INSTRUMENTATION AND CONTROLS****PART 1 GENERAL****1.1 GENERAL DESCRIPTION**

- A. The instrumentation and controls system shall be furnished by a single system supplier, who shall provide all of the equipment, accessories, and services regardless of the manufacturer. The instrumentation supplier shall be responsible for the satisfactory operation of the entire system.
- B. The warranty period for this system shall be for 1 year and shall begin upon acceptance of the system by the Owner. During this warranty period, the system supplier shall provide, at no additional cost to the Owner, the services of a trained, competent field service engineer who shall arrive on site within 24 hours of notification by the Owner or by the Engineer, to repair and/or replace any faulty device or equipment supplied by the system supplier as part of this instrumentation system.
- C. The system supplier shall be capable of providing, after the warranty period for this system, a 1-year, renewable service contract whereby a trained, competent field service engineer shall arrive on site within 24 hours of notification by the Owner. Information relative to charges for such service and availability of such service shall be provided to the Owner and the Engineer as part of any bid or proposal submitted on this project.

1.2 SCOPE

- A. The scope of work in this section applies to the instrumentation and controls system, including but not limited to the following:
 - 1. A new RTU to add to Fulton County's existing Radio Telemetry SCADA System as shown on the P&ID drawings and as specified in this specification section. This shall include all necessary appurtenances for a completely functional SCADA system. The existing Master Telemetry Unit Computer MMI package shall also be modified as required to add the new RTU, including existing SCADA system graphics.

1.3 QUALITY ASSURANCE

- A. The Contractor's attention is directed to the fact that the Pump station project shall be an integrated system and shall require an Instrumentation and Control Systems Integrator who shall provide instruments, control equipment and software modifications. The Controls Systems Integrator shall be responsible to the Contractor for the complete and satisfactory operation of the entire system.
- B. The specifications cover the intended functionality of the equipment, but do not necessarily cover all the details necessary for a complete, operable and functional system. The Instrumentation and Control System Integrator shall supply all devices and appurtenances necessary to provide a complete, operable system as indicated or specified.
- C. The Contractor shall be fully and solely responsible for the work of the Instrumentation and Control System Integrator and solely responsible to the Owner for having supplied to the Owner the complete instrumentation and controls upgrade.

1.4 I&C SYSTEMS INTEGRATOR

- A. The Contractor's attention is directed to the fact that a single subcontractor shall be employed to furnish and install instrumentation and appurtenant equipment, piping, and accessories as indicated on the drawings and specified herein.
- B. The system's manufacturer shall be responsible for detailed design and proper functioning of the instrumentation and control systems to be furnished under these Specifications. The same instrumentation and control subcontractor shall be responsible for preparation of required submittal data to be provided under these Specifications, including operation and maintenance manuals, complete documentation including "as built" drawings, and other documentation required under this and other related specification sections. In addition, the I&C subcontractor shall be responsible for conducting all tests including calibration and operational demonstrations either in the factory and/or the field, to demonstrate final compliance with these Specifications as required. The appropriate technical supervision for installation and connections to the existing and new equipment shall be provided during construction as well as during final termination verifications, testing, quality control, and field acceptance tests.
- C. The Contractor is also responsible for coordinating interfaces between the instrumentation and control equipment provided under these sections and the equipment provided under other sections of the Specifications. The Contractor shall verify and coordinate process equipment power supply and voltage, process equipment control power supply and voltage, compatibility of control signals, details of equipment installation and interconnection. Coordination shall include distribution of approved shop drawings to all vendors, subcontractors, etc. involved in the control interface.
- D. The Instrumentation and Controls System Integrator shall design and furnish a complete, integrated, and functionally operating system warranted to perform the intended functions as specified herein.
- E. The Instrumentation and Controls System Integrator shall coordinate with the Owner and the Engineer and obtain approval before designing the new pump control panels, programming the new PLC, or designing the operator interface.
- F. The Instrumentation and Control System Integrator shall provide or supply all hardware and software as required by the system including, testing, calibration, start-up, operation and maintenance manuals, and operator training at no cost to the Owner.
- G. The system Integrator shall be Dexter Fortson.

1.5 SUBMITTALS

- A. Component manufacturing data sheet indicating pertinent data identifying each component by number and nomenclature as indicated on the drawings in the specifications.
- B. Component drawings are required showing dimensions, mounting, and external connection details.
- C. System wiring schematics are necessary with each on a single drawing with full description of operation. Component identification on the schematic shall be identified.
- D. A system schematic of the hardware with the component manufacturing data sheets for each item, including the peripherals.

- E. A printed copy of each touch screen interface shall be required.
- F. Loop Diagrams
- G. Operations and Maintenance Manuals as described below:
 - 1. Operating instructions shall incorporate a functional description of the entire system, including schematics that reflect the final "as-built" modifications.
 - 2. Special maintenance requirements particular to the system shall be clearly defined along with special calibration and test procedures.
 - 3. As part of the operation and maintenance manuals, provide a hard copy of the PLC program.

PART 2 PRODUCTS

2.1 INSTRUMENTS

- A. Ultrasonic Level Transmitter
 - 1. General:
 - a. Function: Provide continuous non-contacting level measurement with output proportional to level being sensed.
 - b. Type: Ultrasonic
 - c. Parts: Level sensor, transmitter, interconnection cables, mounting hardware.
 - 2. Service: Waste Water applications. Provide sensors for Class 1, Division 1, Group D areas per NFPA 820 in accordance with the NEC.
 - 3. Transducer
 - a. Operating Principle: Acoustic impulses emitted from an ultrasonic transducer are reflected back from the material surface and are received by the transducer. The transit time of pulse travel from generation to echo is measured. The elapsed time is proportional to the distance between the transducer face and material surface.
 - b. Primary sensor: The acoustic transducer shall offer continuous level monitoring and operate reliably in tank conditions with obstructions such as foam or minor turbulence.
 - 1) The range of the transducer shall be as required for the application.
 - 2) Transducer housing shall be suitable for highly corrosive environments.
 - 3) Process connection shall be 1" or 2" NPT.
 - 4) Operating temperature shall be -40° to 163°F.
 - 4. Transmitter
 - a. Enclosure shall be NEMA 4X polycarbonate.
 - b. Power supply shall be 100 /115/200/230 VAC ±15% @ 50/60 Hz.
 - c. Power consumption shall be 36 VA
 - d. Operating temperature shall be -5° to 122°F. Internally mounted heater and thermostat assemblies shall be enclosed at temperatures below -5°F.
 - e. Outputs: Two isolated outputs of 4-20mA into 750 ohms, four Form-A and two Form-C SPDT multi-purpose relays rated at 5A/220 VAC, non-inductive.
 - f. Control and programming: All parameters and commands shall be entered via a hand held programmer from outside the enclosure.
 - g. Accuracy shall be ±0.25% of range.
 - h. Resolution shall be 0.1% of range.
 - i. Indication
 - 1) Display shall be a 4 digit LCD
 - 2) Individual alarm status lights
 - j. The controller shall have an EEPROM memory and shall not require a battery to ensure protection of stored data
 - 5. Manufacturer and Model Number:

- a. The level transmitter shall be a Milltronics HydroRanger 200 or engineer approved equal.
 - b. Provide a handheld programmer for the transmitter.
 - c. The transducer shall be Milltronics Echomax Series XRS-5 (for 25-foot range), and factory mounted flange with Teflon facing for highly corrosive environments.
 - d. Provide all mounting brackets and accessories required.
- B. Magnetic Flow Meters
1. General:
 - a. Function: Measure, Indicate, and transmit the process flow in a full pipe. Meter must be a full bore meter with the magnetic field traversing the entire cross-section of the flow tube. Insert magmeters or multiple single point probes inserted into a spool piece are not acceptable.
 - b. Type: Magnetic flowmeter, operating based on Faraday's law, using a pulsed dc type coil excitation with high impedance electrodes.
 - c. Parts: Flow tube, transmitter, interconnection cables, mounting hardware.
 2. Service: Water and wastewater applications as specified. Magnetic flow meter shall have a minimum operating pressure of 220 psi.
 3. Performance
 - a. Range: 1000 to 1 6" and smaller, 1500 to 1 8" and larger
 - b. Accuracy: 1/2" to 6", 0.2% of rate, 8" and larger 0.15% of rate
 - c. Repeatability: $\pm 0.05\%$ or $\pm 0.0008\text{ft/s}$, whichever is greater
 - d. Calibration: 3 point
 - e. Flow range: As required for application
 4. Process Connection
 - a. Meter Size: As required for application
 - b. Connection Type: 1/10" to 4" Wafer design
6" to 24" ANSI 150 flanges
30" and larger, AWWA Class E flanges
 - c. Flange Material: Carbon steel
 5. Flow Tube:
 - a. Meter Tube Material: 304 stainless steel
 - b. Liner Material: Wafer style Tefzel, Flanged meters NSF approved Elastomer liner
 - c. Electrode Type: Conical self cleaning
 - d. Electrode Material: 316 stainless steel or as recommended by the manufacturer.
 - e. Enclosure Classification: NEMA 4X
 - f. Housing Material: 1/2" to 6" Epoxy coated cast aluminum
8" to 24" ABS Plastic
30" and larger Epoxy coated steel
 - g. Grounding: Rings or grounding electrodes are required.
 - h. Submergence: Accidental submergence.
 6. Transmitter
 - a. Power: 120 volts ac 60 Hz
 - b. Display: Two line 16 character back-lit display indicating flow and total
 - c. Integral Keypad: Allows for external configuration without removing covers and compromising the integrity of the electrical and environmental classifications.
 - d. Bi-direction flow: Forward and reverse flow indication and totalization.
 - e. Totalizers: Three 9 digit totalizers for forward, reverse and net
 - f. Mounting: 2" Pipe stand or wall.
 - g. Enclosure: NEMA 4X Polypropylene with polycarbonate window
 - h. Input Impedance: 10^{15} ohms.
 - i. Isolation: Galvanic separation to 50 volts dc between analog, pulse/ alarm, and earth/ ground.
 - j. Current Output: One standard 4-20 mA into 0-800 ohms minimum
 - k. Pulse Output: One standard 0-800Hz, <35Vdc for forward and one for reverse.
 - l. Contact Outputs: Two programmable as standard

- m. Empty Pipe Detector: Required
 - n. Remote Communications capability: RS232/ 485, and HART Protocol possible.
 - o. Low flow cut off: Adjustable
 - p. Power consumption: Less than 20 VA
 - q. Cable supplied: As required.
 - r. Maximum Cable length: 330 ft w/ standard cable, longer separation possible.
7. Calibration
- a. Test Mode: Provide the ability to verify the accuracy of the unit and the integrity of the current loop without any external equipment.
 - b. Self diagnostics: Internal checks of all outputs and displays
 - c. Calibration Verification: This system shall be able to verify in a quantifiable manner the meters current conditions versus the meters condition when originally manufactured. This calibration verification of the meter shall be performed without need for physical access to the meter flow tube. The calibration verification shall meet or exceed the following requirements:
 - 1) The verification process shall consist of at least 52-meter conditions pertaining to the primary coils, electrodes, interconnecting cable and signal converter.
 - 2) The coil verification shall include faults of continuity, impedance, resistance to ground, inductance, and magnetic field strength.
 - 3) The electrode verification shall include faults of continuity, impedance and insulation.
 - 4) The cable verification shall include faults of coil, electrode, driven shield, and ground connections, cable cuts, cable damage, and water in the cable.
 - 5) Signal converter verification shall include faults of current supply to coils, zero offset, span forward and reverse, electrode offset, current output, frequency output forward and reverse, driven shield to ground, overall shield to ground and signal ground connection to ground.
 - 6) The calibration verification shall include the following: water ingress into the primary elements, faulty electrodes, dirty electrodes, electrode leakage, corroded electrodes, high process noise, liner failure, conductive coatings on the liner, insulating coatings on the liner, and primary element damage.
 - 7) All tests shall be performed by means of comparison between the absolute values and change in values from the new conditions.
 - 8) Verification standard shall be $\pm 1\%$ of wet calibration for meters produced using the calibration verification service, or $\pm 2\%$ for standard meters.
 - 9) The software shall be windows-based. This software shall be capable of generating a report based upon the result of the forgoing described tests. The software shall be capable of creating and storing an audit trail of the meters conditions and the meters history.
 - 10) The calibration verification and metering system shall meet or exceed the standards established by the National Testing Laboratories.
 - d. Meters to be designed, manufactured, and calibrated in an ISO 9001, NAMAS, NIST, NATA certified facility.
8. Manufacturer: ABB, Krohne or Engineer Approved Equal.
9. Provide sunshield for outdoor instruments..

2.2 RADIO COMMUNICATION AND ANTENNA SYSTEM

- A. General: Furnish an RTU panel at the new pump station to communicate with the existing central RTU station as shown on the P&ID drawings. The RTU panel shall be in a NEMA 4X, stainless steel enclosure.
- B. RTU Controller: The RTU controller shall be a Dexter Fortson with built-in diagnostics.
- C. Radio Transceivers: Transceivers shall be 100% solid-state units operating in VHF or UHF narrow band radio frequency. All radio connections shall be via plug-in connectors. This

requirement applies to the coaxial cable feed line, radio power and data connections. The FM transceivers shall meet the following as a minimum:

1. Transmitter:
 - a. Selectable 1, 2 or 5 watt power output as required per each location and as allowed by the system FCC license
 - b. Spurious and harmonic emissions: -60dB
 - c. Frequency stability: +/-0.0005% over a temperature range of -30 to +60 degrees C
 - d. Transmit rise time: 50mS
 - e. Audio distortion: less than 6%
 - f. FM hum and noise: -50 dB
 - g. Audio frequency response: +1/-3 dB per octave pre-emphasis from 300-3000Hz
 - h. Modulation: 16F3 +/-5KHz
 2. Receiver:
 - a. Sensitivity: 12 dB SINAD: 0.35 microvolts; 20 dB Quieting: 0.50 microvolts
 - b. Selectivity: -65dB at +/- 25KHz
 - c. Spurious and image rejection: -60dB
 - d. Inter-modulation rejection: -60dB
 - e. Audio power output: 500 milliwatts
 - f. Frequency stability: +/-0.0005% over a temperature range of -30 to +60 degrees C
 3. The transceivers shall comply with FCC parts: CP-15, 21, 74, 90, 95; CS-15, 22, 74, 90, 95.
- D. Software
1. Graphics operating software shall be Labview (latest version) or approved equal.
- E. Radio Modem
1. Provide radio modems consistent with the system design and the telemetry system strategy.
- F. Antenna System
1. The existing antennae and tower shall be reused. The Systems Integrator shall be responsible for proper function and operation of this system.
 2. The System Integrator shall be responsible to install the antenna cable. Furnish a bulkhead-type antenna/cable lightning arrestor, one hundred feet (minimum) of RG-8/U coaxial cable and all required connectors.
- G. Licensing and Path Study
1. The system supplier shall be responsible for obtaining the FCC station and operating licenses for the owner, including any other state or local licenses required. This shall include performing a complete onsite path survey to verify proper radio communication. The path study shall determine the height of the antenna tower required and the allowable height will be indicated in the license.
- H. Radio Repeaters: As required.
- I. Modifications to Owner's Existing System and RTU System Coordination
1. The Owner shall be able to control and monitor all the PLC I/O points shown on the P&ID diagrams (status and alarm points and analog signals) from the Central SCADA computer station via the radio telemetry system.
 - a. Identify all I/O addresses and add the data points and supervisory control points into the Owner's SCADA system database.
 - b. Build the new graphic displays in the Owner's existing host computer station
 - c. Make programming changes as required to add the pump station to the central SCADA system.

2. Coordinate specific status and alarm points to be monitored with the Owner and Engineer during construction. Refer to the drawings for a preliminary list of I/O points.
 3. Provide a complete installation, including all hardware and connections necessary.
- J. Installation and Startup Services
1. Provide installation, testing, and startup services as required.

2.3 PIPING, VALVES, AND FITTINGS

- A. All instrument tubing, except as otherwise noted on the drawings or in the Specifications shall be stainless steel, for use with Flareless-Tube fittings. All hydraulic connections to instruments shall be made with separable fittings.
- B. Vertical or horizontal runs of tubing in close proximity shall be bundled in an acceptable manner. All concealed runs shall be run continuously without joints. Installation of tubing to instruments shall be in accordance with the manufacturer's recommendations.
- C. All hydraulic tubing shall be properly tested in accordance with accepted standards.
- D. Tubing shall be mounted to surfaces by means of cadmium plated tubing racks securely mounted to the surface. It shall be possible to remove any single tube without disturbing other tubings. Tubing shall be identified on both ends by function in accordance with the identification number given in the instrument schedule. Identification tags shall be copper and secured to the tubing with stainless steel sealing wires.

2.4 SIGNAL ISOLATORS

- A. The contractor shall furnish and install instrumentation signal isolators as shown on the Plans and Specifications, and where needed if not shown on the Plans and Specifications.
- B. Each isolator shall have a 4-20 mA DC or 1-5 V DC input as tabulated and shall have an output of 4-20 mA DC into 0-1650 ohms. Accuracy shall be 0.10 percent of span. Isolation shall be 1 kV peak to peak between power, input, and output. Isolators shall operate from 120 VAC power source.
- C. Signal isolators shall be AGM Series 4000, Acromag 1822, or approved equal.

2.5 POWER SUPPLIES FOR 4-20MA SIGNAL LOOPS

- A. For each 4-20 mA signal loop which contains a 2-wire transmitter or, for any other reason requires it, a DC power source for the signal loop shall be provided. Each DC signal loop which is powered from the power supply shall be provided with an effective means of limiting the maximum current to that loop so that accidental shorting of the signal leads will not damage the power supply or the other instruments in the signal loop.
- B. Power supplies shall include overcurrent and overvoltage protection.

2.6 SPECIAL REQUIREMENTS FOR INSTRUMENTATION SYSTEM WIRING AND GROUNDING

- A. The following wiring practice guidelines shall be used. In order to minimize ground loops, to minimize EMI/RFI (electromagnetic interference/radio frequency interference) to this equipment, and to provide maximum practical immunity from damage resulting from lightning-induced transients.

1. Common wires or conductors shall not be utilized (either within panels or external to panels or for grounding of field devices) for both signal shield or signal grounding and for safety grounds.
2. Exposed wire lengths extending from within shielded signal cables shall be minimized to reduce pick-up of EMI/RFI by signal circuits. Exposed lengths of less than 1 inch are preferred, and a maximum exposed length of 2 inches may be permitted where necessary. No splicing of signal wires is permitted.
3. All signal wiring shall be shielded, both within panels and external to panels. Unless otherwise specified, all signal wiring shall be No. 16 AWG stranded tinned 2-conductor twisted pair, with 100 percent coverage aluminized Mylar or aluminized polyester shield and tinned copper drain wire.
4. Signal wiring within outdoor or indoor field device enclosures shall conform to the same requirements as panel wiring.
5. Each signal cable shield shall be grounded at only 1 point, as indicated on the instrumentation system drawings. Grounding of signal cable shields shall always be done at the control panel end. The signal cable for no signal shall share a common cable shield grounding wire with the signal cable shield for any other signal, and shall not share a common grounding wire with any other circuit, and the length of no signal cable shield grounding wire shall exceed 2 inches, with less than 1-inch maximum length preferred.
6. All field signal wiring shall be protected at both ends by the use of lightning arresters. Arresters mounted in control panels, field termination panels, or in outdoor instrument enclosures shall be directly and individually grounded to the metal of the cabinet or enclosure. Where outdoor instrument enclosures are not metal, a common ground shall be established within the enclosure for lightning protection and for safety grounding either by the use of a metal grounding plate or by a heavy wire.
7. All outdoor instruments and all outdoor enclosures shall be grounded using the practice defined Section 800-31 of the National Electric Code.

2.7 LIGHTNING ARRESTERS

- A. All field signal circuits, including all wiring outside of buildings and between buildings, shall be protected by lightning arresters, at both ends of each field wire run, which are mounted in control panels, termination panels, or inside of outdoor enclosures for field instruments or analyzers.
- B. Panel-mounted protectors shall be of the type, which is made for mounting on a terminal block rail. Each arrester shall include a moveable grounding link to allow each signal cable shield to be individually grounded to the panel via the mounting rail through the lightning arrester for that cable without the use of any additional grounding wire, or to be isolated from ground at the arrester. Each such mounting rail shall be grounded to the panel by the use of rail mounting screws at approximately 1-foot intervals. Protection shall be from line to line and from each line to ground. Protection shall also be from shield to ground where the shield is not grounded at the protector. Each arrester shall have the ability to protect against surge currents greater than 10,000 amperes. Each arrester shall add no more than 22 ohms per signal wire to the total signal loop resistance of the analog signal loop in which it is installed. Lightning arresters shall not introduce error-producing ground loop currents into the instrumentation signal circuits.
- C. Rail-mounted lightning arresters shall be Joslyn Electronics Systems Division Series 1800 or approved equal.
- D. Signal circuit lightning arresters for field instruments shall also be the same as those described above for mounting in panels and shall be mounted within the field instrument enclosures or housings where practical. Where such mounting is not practical, then these arresters shall be mounted in NEMA 4 enclosures located at the field devices.

- E. AC line lightning arresters shall be provided for all indoor cabinets and enclosures and for all field instrumentation devices and analyzers, which require AC power. These arresters shall be enclosed in moisture-proof housings. The arresters shall be mounted inside the enclosure of the field equipment where practical for field devices. In other locations, the arrester shall be mounted immediately adjacent to the protected device. Each arrester shall have the capability to withstand repeated surge currents of at least 20,000 amps peak at 8 x 20 microsecond wave. Performance shall be equal and reliable for surges of either polarity.
- F. These arresters shall be Joslyn Surgitron Model 1250-32, Square-D J9200-10, or approved equal, single-phase, rated 120V, 60 Hz.

2.8 SPARE PARTS AND TEST EQUIPMENT

- A. The instrumentation system supplier shall furnish a spare parts list with prices and shall be responsible for assisting the plant maintenance personnel in the selection of the required spare parts and test equipment.

2.9 TOOLS AND SUPPLIES

- A. The contractor shall furnish tool kits containing tools and specialized tools necessary for the assembly and disassembly, alignment, and calibration of the instrumentation system equipment.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All wiring, tubing, controls, motors switches, alarms, components, analyzers and accessories shall be of the size and installed per the manufacturer's recommendations.

3.2 FACTORY TESTS

- A. A system test on the instrumentation system panels shall be performed by the system supplier prior to shipment of the panels to the job site. This shall be a functional test and shall demonstrate that:
 1. All analog indicators, recorders, controllers, arithmetic modules, signal converters, isolators, etc. are properly calibrated and that they function properly.
 2. All panel equipment is connected to the proper terminals for connection to field equipment and to other panels and equipment.

3.3 FIELD CALIBRATION AND TESTS

- A. All field instrumentation shall be calibrated in the presence of a representative of the Engineer in accordance with the ranges and accuracies specified herein.
- B. The entire system shall be field tested in the presence of a representative of the Engineer to demonstrate that the system properly performs the functions defined in this Specification and in the Engineer's drawings. A check-off list shall be used on which each instrumentation loop is "signed off" by both the instrumentation system supplier and the representative of the Engineer as that loop is verified to be operating correctly as installed.
- C. The instrumentation system supplier shall provide the Contractor a periodic written report detailing progress of start-up. This report shall include specific tabulations of devices on which start-up has been completed.

- D. No form of energy shall be turned on to any part of the instrumentation system prior to receipt by the Engineer of a certified statement of approval of the installation from the Contractor containing his system supplier's authorization for turning on energy to the system.

3.4 COORDINATION

- A. All the work that affects existing system operation shall be coordinated with the Owner Engineer, and prior approval must be obtained before such work is started.

3.5 TRAINING

- A. System supplier shall provide operation and maintenance training for Owner's personnel to ensure their adequate knowledge of use of the system.
- B. Training shall be conducted on site by instructors thoroughly familiar with operation of the system, and the training shall include the following general areas:
 - 1. Hardware maintenance
 - 2. Software training
 - 3. Instrumentation.
- C. Minimum duration of training shall be eight hours.

3.6 GENERAL EQUIPMENT REQUIREMENTS

- A. All the equipment shall be the latest and proven design. Specifications and drawings call attention to certain features, but do not purport to cover all details entering into the design of the instrumentation system. The completed system shall be compatible with the functions required and the equipment furnished by the Contractor.
- B. All electrical components of the system shall operate on 120 volt, single-phase, 60 Hz power source, except as otherwise noted in the Specifications.
- C. All necessary fuses or switches required by the instrumentation manufacturer for his equipment shall be provided with the equipment. All instruments requiring internal power supply shall have internal on-off switches.
- D. The Drawings and Specifications indicate the energy sources that will be provided. Any other devices necessary to obtain proper operation of the instrumentation system from these energy sources shall be furnished with the instrumentation.

+ + + END OF SECTION 13620 + + +

**SECTION 14300
MONORAIL SYSTEMS****PART 1 - GENERAL****1.01 SCOPE**

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete design and installation of all monorail systems. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.
- C. Related Work specified elsewhere:
 - 1. Section 05120 - Structural Steel.
 - 2. Section 09900 - Painting.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Manufacturer's certification.
 - 2. Design calculations signed by a Professional Engineer registered in the State of Georgia shall be provided for the monorail systems.
 - 3. Submit drawing showing system load and moment points, attachment points and loads that will be transmitted to the structure.
 - 4. Operation and Maintenance Manuals.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
 - 1. NEC, National Electric Code.
 - 2. NEMA, Standards of National Electrical Manufacturers Association.
 - 3. OSHA, Occupational Safety and Health Act.
 - 4. ANSI, American National Standards Institute.
 - 5. ASTM, American Society for Testing Materials.
 - 6. AISI, American Iron and Steel Institute.
 - 7. NFPA, National Fire Protection Association.
 - 8. MMA, Monorail Manufacturer's Association.

- B. Experience: Equipment furnished under this Section shall be of a design and manufacture that has been successfully used in similar applications. The manufacturer shall have furnished equipment for a minimum of five similar applications. Provide a list of such installations complete with installation description contact names, addresses, telephone numbers. This reference list shall be submitted with the shop drawings.

1.04 QUALITY STANDARDS

- B. The monorail systems shall be furnished and installed by a single supplier who shall assume sole responsibility for providing complete, operating system designed for long life with a minimum of required maintenance meeting the requirements specified herein and as shown on the Drawings.
- C. Manufacturer shall provide written certification that the equipment provided under this Specification has been amply designed and is a suitable application for these service conditions.
- D. Manufacturer's offering products that comply with these Specifications include:
 - 1. Yale Hoists
 - 2. Or equal.

1.06 WARRANTY

- A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

1.07 MANUFACTURER'S SERVICE

- A. Furnish the services of a factory representative, having complete knowledge of the operational and maintenance requirements and adjustments of the system, for one 2-hour day. The factory representative shall instruct the County's personnel in the proper operation and adjustments of the equipment.

PART 2 - PRODUCTS

2.01 DESIGN REQUIREMENTS

- A. Net Capacity at Hoist Hook 2 tons.
- B. Trolleys and monorail tracks shall include an impact allowance of one half percent of the rated load for each foot per minute of hoisting speed, but under no circumstances less than a minimum of 15 percent of the rated load.

2.02 MONORAIL TRACKS

- A. The track rails shall be straight, parallel, level and at the same elevation. The distance center to center and the elevation shall be within a tolerance of plus or minus 1/8-inch. The track shall be of special structural sections, manufactured in accordance with the Monorail Manufacturers Association. The total track deflection shall not exceed 1/450 of the span. The runway shall have an operating flange meeting the following minimum requirements:
 - 1. Carbon content: 0.50.
 - 2. Manganese content: 1.00.
 - 3. Ultimate tensile: 115,000 psi.

4. Yield point: 78,500 psi.
 5. Brinell hardness: 225.
 6. Bottom flange width, minimum: 3.33-inches.
 7. Tread thickness: 7/16-inch.
- B. The running tread shall have a uniform, full metal thickness from fillet to edge of flange. The running tread shall be flat to allow use of flat tread wheels on which the wheel radius is uniform across the width of the running surface to prevent tread slip and minimize wear and peening.
- C. The web and top flange shall be computer matched with the high carbon lower flange to minimize weight and maximize load-carrying capability. The runway shall be completely manufactured at the manufacturer's factory, straightened, welded, and fitted with splice holes, hanger holes and electrification holes in place before painting. Standard structural shapes or modifications to structural shapes shall not be acceptable. Runway sections shall be installed with bolted splice plates. The maximum permissible gap between adjacent ends of load carrying flanges shall not exceed 1/16-inch.
- D. Monorail Hanger/Suspension System:
1. The monorail tracks shall be suspended from the supporting steel members shown on the Drawings and provided by the Contractor.
 2. The monorail supplier/installer shall utilize standard manufacturer products for suspension of the monorail tracks.
 3. The monorail supplier shall engineer and design all track suspension connections. Connections, locations and calculations shall be submitted with the shop drawings.
- E. Welding: Welding shall be done by certified welders and shall be in accordance with the American Welding Society. All welds shall be ductile, with a minimum of 15 percent elongation. They shall have good weld penetration free of cracks and undercuts and the welds shall be smooth in appearance.

2.03 TROLLEY

- A. Trolley Frame: The trolley frame shall be built of ductile or steel structural shapes and welded into a stable assembly of sufficient strength to comply with general strength requirements and to provide proper wheel and bearing alignment for trolley wheels and drives during the life of the trolley hoist.
- B. Trolley Wheels: Trolley wheels shall have tread surfaces hardened to 425 Brinell. Tread shall provide suitable running alignment for trolley. Each wheel shall be supported on tapered roller bearings suitable to take radial and thrust loads. The wheels shall be lubricated at the factory with a sodium base grease. Wheel mounting shall be designed so that axles and wheels can be removed without disturbing other truck elements of their alignment. Wheel treads shall be smooth, true and uniform within 0.010-inch tread diameter on all wheels. The trolley wheels shall be designed in accordance with the Monorail Manufacturers Association.
- C. Trolley Gearing: All trolley gears shall be cut from solid blanks with 20 degree pressure angle involute shape for high strength and shall comply with AGMA specifications for load ratings. hardened to RC 40 minimum. The gear train shall provide for a minimum service of 4,000 hours compounded for intermittent operations corresponding to 5 years' minimum industrial use.

2.04 HOISTS

- A. Provide underhung, trolley hoists having two-part, double reaving.
- B. Wire Rope and Hook:
 - 1. The wire rope shall be a minimum of 5/16-inch, 6 x 37 construction preformed improved plow steel with fiber center of XIP steel with steel center and have a minimum factor of safety of 5 to 1. Swagged fittings shall be provided on both ends.
 - 2. The hook shall be a drop-forged, heat-treated steel hook with spring latch. The hook shall swivel 360 degrees on a shielded roller thrust bearing.
- C. Drum: The drum shall be a steel drum with deep machined grooves. At least 2 full turns of rope shall remain on the drum at the lowest rated hook position. Drum shall have right and left hand grooves for true vertical lift and be fitted with flanges to prevent jamming of the wire rope. Drum pitch diameter shall be at least 18 times the diameter of the wire rope.

2.05 PART 3 - EXECUTION**3.01 INSTALLATION**

- A. The Contractor shall furnish and install all equipment required for a complete and operable installation as shown on the Drawings and as specified.

3.02 PAINTING

- A. All surfaces shall be prepared, shop primed and factory painted as part of the work under this Section. Surface preparation, shop priming and painting is specified in the Section 09900, PAINTING, System 247.

3.03 TESTING

- A. All structural steel welds and bolted connections shall be tested in accordance with the requirements of Section 05120, STRUCTURAL STEEL.

+++ END OF SECTION 14300 +++

**SECTION 15060
PIPING AND APPURTENANCES****PART 1 - GENERAL****1.01 SCOPE**

- A. The work covered by this Section includes furnishing all labor, equipment and materials required to furnish, install and test, complete the plant piping including all fittings, sleeves, unions and accessories, as specified herein and/or shown on the Drawings.
- B. Contract drawings show only functional feature and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any specific material. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the material being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.
- C. Related work specified elsewhere:
 - 1. Section 02200 - Earthwork.
 - 2. Section 09900 - Painting.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Manufacturer's certification.
 - 2. Manufacturer's data.
 - 3. Drawings and engineering data on fabricated piping including locations of all piping supports, anchors, expansion joints, mechanical couplings and all other piping appurtenances.
- B. Prior to its incorporation into the work, the Contractor shall submit to the Engineer written evidence that the pipe furnished under this Specification is in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the pipe supplier may be considered evidence of compliance provided such tests are performed in accordance with the appropriate ASTM testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test results from an independent testing laboratory on samples of pipe materials.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
 - 1. American National Standards Institute (ANSI).
 - 2. American Society for Testing Materials (ASTM).

1.04 QUALITY STANDARDS

- A. All such work shall be done by competent workmen in a thorough workmanlike manner according to the best practice and in compliance with all codes and applicable regulations, with proper provisions for uncoupling, draining, expansion and contraction.
- B. See applicable sections of Part 2 - Products for Manufacturer quality standards.

1.05 STORAGE AND PROTECTION

- A. All piping and tubing and accessories shall be stored above ground fully supported so as not to bend or deflect excessively under their own weight. Piping shall be stored with slope so as to be free draining.

1.06 WARRANTY

- A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General:
 - 1. No broken, cracked, deformed, imperfectly coated or otherwise damaged or defective pipe or fittings shall be used. All such materials shall be removed from the site.
- B. Polyvinyl Chloride Pipe and Fittings (PVC pressure piping):
 - 1. Polyvinyl Chloride Pipe shall be of unplasticized compounds suitable for use with chemicals and sewage, as shown on the Drawings and as specified and shall bear the seal of approval to this effect from an accredited testing laboratory. Pipe shall conform to the requirements of ASTM D1784 and D1785, Schedule 80, Type 1, Grade 1, or class 12454-B.
 - 2. Fittings shall conform to the requirements of ASTM Designation D2467, Class 12454-B for socket type and ASTM Designation D2464 for threaded type.
 - 3. Compounds for pipe and fittings shall conform to the requirements of ASTM Designation D1784, Class 12454-B.
 - 4. Joints shall be the solvent-welded socket or flanged type. Flanges, where shown, shall be 150-pound, and shall be of the same material as the pipe.
 - 5. Bolts for use with PVC flanges shall be as follows:

With Flat Ring Gaskets	Carbon steel, ASTM A307, Grade B square head bolts and ASTM A563, Grade A heavy hex head nuts
With Full Face Gaskets or in Corrosive Areas or Buried	Type 316 stainless steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts

6. Gaskets shall be EPDM or Viton, full-faced, and 3/4 inch thick, minimum.
7. All socket connections shall be joined with PVC solvent cement conforming to ASTM D2564. Manufacturer and viscosity shall be as recommended by the pipe and fitting manufacturer to assure compatibility. Provide adequate ventilation when working with pipe joint solvent cement.
8. Provide magnetic tracer tape for all buried PVC piping.

C. Ductile Iron Pipe:

1. Unless otherwise specified elsewhere, ductile iron pipe shall have a minimum wall thickness in accordance with Pressure Class 350, except for sizes 14 inches and larger, which shall have a minimum wall thickness in accordance with Pressure Class 250. All ductile iron pipe supplied shall conform to the requirements of ANSI/AWWA Specifications C150/A21.50-81 and C151/A21.51-1981.
2. Fittings in pipe lines shall conform to the requirements of ANSI/AWWA C110/A21.10-82, Pressure Class 350 for 12 inch and smaller and Pressure Class 250 for 14 inch and larger sizes.
3. Ductile iron pipe and fittings furnished for this project shall be cement lined Type II per ANSI Specification A21.4 (AWWA C104), unless otherwise indicated in the Piping Schedule.
4. Exposed joints shall be flanged or restrained mechanical joints unless otherwise shown on the Drawings. Buried joints shall be push-on or mechanical joints and shall conform to the following requirements:

Flanged	ANSI/AWWA C110 & ANSI B16.1, faced and drilled 125-pound ANSI Standard
Mechanical Joint	ANSI/AWWA C110, ANSI/AWWA C111 and ANSI/AWWA C151
Push-On	ANSI/AWWA C110, ANSI/AWWA C111 and ANSI/AWWA C151, American Cast Iron Pipe Company, or U.S. Pipe and Foundry Tyton joint, or equal

5. Restraining of joints shall be as recommended in the Cast Iron Pipe Research Association (CIPRA) Handbook of Cast Iron Pipe.
6. Mechanical joints with retainer glands are not acceptable.
7. Flanges shall be ductile iron, threaded, rated for 250 psi working pressure, and conform to ANSI A21.15/AWWA C115 and ANSI 125-pound drilling.
8. For Class 125 FF flanges, carbon steel, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts shall be used. For mechanical joints, the manufacturer's standard shall be used.
9. Gaskets for mechanical or push-on joints shall be rubber, conforming to ANSI A21.11, AWWA C111. Gaskets for flanged joints shall be 1/8-inch thick, cloth-inserted rubber conforming to applicable parts of ANSI B16.21 and AWWA C207. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in sewage or potable water lines. Gaskets shall be full-face type for 125-pound FF flanges.