

TEXAS PARKS & WILDLIFE DEPARTMENT

TECHNICAL SPECIFICATIONS

FOR

WILDLIFE MANAGEMENT AREA WELLS
MATADOR & GENE HOWE

BID SET

MARCH 2021



Enprotec / Hibbs & Todd

402 Cedar, Abilene, Texas 79601

Phone: (325) 698-5560 Fax: (325) 690-3240

Website: e-ht.com

PE Firm Registration No. 1151

PG Firm Registration No. 50103

RPLS Firm Registration No. 10011900

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3/8/2021

Scott D. Hay, P.E., #83930



3/8/21

Clois W. Versyp, P.E.
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Texas Parks & Wildlife
Wildlife Management Area Wells – Matador & Gene Howe
PROJECT MANUAL INDEX

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SECTION 01 42 00

STANDARD REFERENCES

Whenever used in the Project Manual, the following abbreviations will have the meanings listed:

When documents are referenced, they are a part of the Specification as specified and modified. In case of conflict between the requirements of these Specifications and those on the referenced documents, these Specifications shall prevail.

AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, Ste. 249 Washington, DC 20001
ACI	American Concrete Institute 38800 Country Club Drive Farmington Hills, MI 48331
AISC	American Institute of Steel Construction One East Wacker Drive, Ste. 700 Chicago, IL 60601-1802
AISI	American Iron and Steel Institute 1140 Connecticut Ave., Ste. 705 Washington, DC 20036
AITC	American Institute of Timber Construction 7012 S. Revere Parkway, Ste. 140 Centennial, CO 80112
ANSI	American National Standards Institute, Inc. 1899 L Street, NW, 11 th Floor Washington, DC 20036
APA	American Plywood Association 7011 S. 19 th Street Tacoma, WA 98466-5333
API	American Petroleum Institute 1220 L Street, NW Washington, DC 20005-4070
ASCE	American Society of Civil Engineers 1801 Alexander Bell Drive Reston, VA 20191
ASCII	American Standard Code for Information Interchange United States of American Standards Institute 25 West 43 rd Street, 4 th Floor New York, NY 10036

ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers United Engineering Center 1791 Tullie Circle, NE Atlanta, GA 30329
ASME	American Society of Mechanical Engineers Three Park Avenue New York, NY 10016
ASTM	American Society for Testing and Materials 100 Bar Harbor Drive West Conshohocken, PA 19428 (http://www.astm.org)
AWPA	American Wood Preservers Association 100 Chase Park South, Ste. 116 Birmingham, AL 35244
AWS	American Welding Society 550 LeJeane Road Miami, FL 33126
AWWA	American Water Works Association 6666 W. Quincy Avenue Denver, CO 80235
CRSI	Concrete Reinforcing Steel Institute 933 North Plum Grove Road Schaumburg, IL 60173
EEl	Edison Electric Institute 701 Pennsylvania Ave., NW Washington, DC 20004
EIA	Electronic Industries Association 2001 Eye Street N.W. Washington, DC 20006
ENGINEER	Enprotec / Hibbs & Todd, Inc. 402 Cedar Street Abilene, Texas 79601
FCC	Federal Communications Commission 445 12 th Street SW Washington, DC 20554
FEDSPEC	Federal Specifications General Services Administration Specification and Consumer Information Distribution Branch 1275 First Street, NE Washington, DC 20417

FEDSTDS	Federal Standards (see FEDSPECS)
HI	Hydraulic Institute 6 Campus Drive, First Floor North Parsippany, NJ 07054
ICEA	Insulated Cable Engineers Association P.O. Box 1568 Carrolton, GA 30112
IEEE	Institute of Electrical and Electronic Engineers, Inc. 3 Park Avenue, 17 th Floor New York, NY 10016
IES	Illuminating Engineering Society c/o United Engineering Center 120 Wall Street, Floor 17 New York, NY 10005
ISA	Instrument Society of America 67 Alexander Drive Research Triangle Park, NC 27709
MILSPEC	Military Specifications Navy Publications and Forms Center 5801 Tabor Avenue Philadelphia, PA 19120
NAAMM	National Association of Architectural Metal Manufacturers 800 Roosevelt Rd., Bldg. C, Ste 312 Glen Ellyn, IL 60137
NACE	National Association of Corrosion Engineers 1440 South Creek Drive Houston, Texas 77084
NEC	National Electrical Code National Fire Protection Association 1 Batterymarch Park Quincy, MA 02169
NEMA	National Electrical Manufacturer's Association 1300 North 17 th Street, Ste. 1752 Rosslyn, VA 22209
NFPA	National Forest Products Association 1111 19 th Street, NW, Ste. 800 Washington, DC 20036
NFPA	National Fire Protection Association 1 Batterymarch Park Quincy, MA 02169

NPCA	National Paint and Coating Association 1500 Rhode Island Ave., NW Washington, DC 20005
NSF	National Sanitation Foundation 789 N. Dixboro Road Ann Arbor, MI 48113
OSHA	Occupational Safety and Health Act Occupational/Safety and Health Administration Lubbock Area Office 1205 Texas Avenue Lubbock, TX 79401
OWNER	Texas Parks and Wildlife Department 4200 Smith School Road Austin, Texas 78744-3291 Matador & Gene Howe Wildlife Management Area Local Contact: Chip Ruthven Project Leader, Panhandle WMAs Texas Parks and Wildlife Department 3036 FM 3256 Paducah, Texas 79248 (806) 492-3405
SBCC	Southern Building Code Congress 900 Montclair Road Birmingham, AL 35213
SPCC	The Society for Protective Coatings 40 24 th Street, 6 th Floor Pittsburgh, PA 15222-4656
SSPC	Steel Structures Painting Council 4516 Henry Street, Suite 301 Pittsburgh, PA 15123-3728
SSPWC-NCT	Standard Specifications for Public Works Construction-- North Central Texas North Central Texas Council of Governments P O Box 5888 Arlington, Texas 76005-5888
TCEQ	Texas Commission on Environmental Quality P O Box 13087 Austin, TX 78701
TDA	Texas Department of Agriculture 1700 N. Congress, 11th Floor Austin, Texas 78711

TPWD	Texas Parks & Wildlife Department 4200 Smith School Road Austin, Texas 78744
TxDOT	Texas Department of Transportation 125 E. 11th Street Austin, TX 78701
UBC	Uniform Building Code Published by ICB
UL	Underwriters Laboratories, Inc. 2600 NW Lake Road Camas, WA 98607
UMC	Uniform Mechanical Code Published by ICBO
UPC	Uniform Plumbing Code Published by ICBO
USBR	Bureau of Reclamation U.S. Department of Interior Engineering and Research Center Denver Federal Center, Building 67 Denver, CO 80225
WWPA	Western Wood Products Association 522 SW Fifth Ave, Ste. 500 Portland, OR 97204

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Cast-in-place concrete consisting of Portland cement, aggregate, water, and admixtures.
- B. Mix design requirements.
- C. Formwork, reinforcement, joints, and placing requirements.

1.2 REFERENCES:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- A. ASTM A615--Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
- B. ASTM C31--Making and Curing Concrete Test Specimens in the Field.
- C. ASTM C33--Concrete Aggregates.
- D. ASTM C39--Compressive Strength of Cylindrical Concrete Specimens.
- E. ASTM C94--(1986; Rev. b) Ready-Mixed Concrete.
- F. ASTM C143--Slump of Portland Cement Concrete.
- G. ASTM C172--Sampling Freshly Mixed Concrete.
- H. ASTM C173--Air Content of Freshly Mixed Concrete by the Volumetric Method.

1.3 SUBMITTALS:

- A. Certificates: Mill certificates for bulk cement.
- B. Product Data: Manufacturer's data sheets for Engineer approved additives and bonding agents.
- C. Submit test data on proposed design mixes for each type of concrete to be used in the project to verify that the specification requirements are met or exceeded.

1.4 QUALITY ASSURANCE:

- A. Project Controls: Provide necessary controls during evaluation of material, mix designs, production and delivery of concrete, placement, compaction, finishing and curing necessary to assure that work will be accomplished in

such a manner to produce the work in accordance with Contract Documents.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Materials shall be delivered, stored, and handled in a manner to prevent deterioration, contamination, or any other circumstance that would be harmful to cast-in-place concrete.

1.6 PROJECT CONDITIONS:

- A. Do not place concrete during rain, sleet, or snow unless protection is provided and approved by the Engineer.
- B. Coordinate concrete placement schedule with other related work.
- C. Notify Engineer at least 24 hours before placement.

PART 2 PRODUCTS

2.1 MATERIALS:

- A. Cement: ASTM C 94, Type I cement, unless approved by the Engineer. Only one brand of any one type of cement shall be used for exposed concrete surfaces of any individual structure.
- B. Fine Aggregate: Aggregate meeting the requirements of ASTM C33.
- C. Coarse Aggregate: Aggregate sizes No. 67 or No. 57 according to ASTM C33 or as approved by the Engineer.
- D. Water: Potable water free from detrimental chemicals and solids that will decrease the strength of the concrete.
- E. Embedded Items: Embedded items shall be of the size and type shown or as needed for the application.
- F. Curing Materials: Curing materials shall be burlap, impervious sheets, or membrane-forming compounds.
- G. Dowels: Plain carbon steel bars, minimum yield point of 40,000 psi for use in slabs on grade.
- H. Expansion Joint Filler Strips: Premolded nonextruding, resilient bituminous or non bituminous type for use in concrete paving or construction, thickness as shown.
- I. Form Materials: Wood, metal or other Engineer approved materials that will produce the specified finishes without adversely affecting the concrete surfaces.
- J. Form Coating: Nonstaining form oil or form-release agent that will not deleteriously affect concrete surfaces nor impair subsequent applications.

- K. Form Ties: Metal, factory-fabricated removable snap-off type, that will not leave holes less than 1/4 inch nor more than 1 inch deep and not more than 1 inch in diameter.
- L. Joint Sealant: As shown or approved by Engineer for sealing joints in concrete against moisture infiltration.
- M. Reinforcement: Bar reinforcement shall be deformed, Grade 60 conforming to ASTM A615. Mesh reinforcement shall be welded wire fabric with wires at right angles to each other.
- N. Bonding Agent: As approved by Engineer.
- O. Admixtures: Air-entraining, retarders, and other admixtures as approved by Engineer.

2.2 MIX DESIGN:

- A. Concrete Class: Concrete mixes shall be proportioned to obtain the following characteristics:
 - 1. Class "A": Minimum compressive strength of 3000 psi in 28 days with a minimum of 5 bags of cement per cubic yard.
 - 2. Class "B": Minimum compressive strength of 2500 psi in 28 days with a minimum of 4 bags of cement per cubic yard.
- B. All concrete shall be Class "A", unless specified otherwise.
- C. Air Content: Total air content of exterior concrete shall be maintained at 5 to 7 percent by volume of concrete.
- D. Slump: Slump shall be 3 to 5 inches. If admixtures are used, slump shall be as approved by Engineer.

2.3 STORAGE:

- A. Materials shall be stored so as not to deteriorate or become contaminated.

PART 3 EXECUTION

3.1 FORMWORK:

- A. Formwork shall be made mortar tight, properly aligned and adequately supported to produce concrete conforming accurately to the indicated shapes, lines, dimensions, and with surfaces free of offsets, waviness, or bulges.
- B. Unless otherwise shown exposed external corners shall be chamfered, beveled, or rounded by moldings placed in the forms. Chamfer shall be 1" nominal.

- C. Surfaces shall be thoroughly cleaned and coated before each use.
- D. Forms shall be removed at a time and in a manner that will not damage the concrete.

3.2 REINFORCEMENT:

- A. Reinforcement shall be fabricated to the shapes required.
- B. Reinforcement shall be interrupted 2 inches clear on each side of expansion joints.
- C. Reinforcement shall be continuous through contraction and construction joints.
- D. Supports fabricated of plastic, or other Engineer approved material, shall be used to support reinforcement during placing operations.
- E. Dowels and tie bars shall be installed at right angles to joints, accurately aligned parallel to the finished surface, and rigidly held in place and supported during concrete placement.
- F. One end of dowels shall be oiled or greased.

3.3 INSTALLATION OF ANCHORAGE ITEMS:

- A. Installation of anchorage items shall be as shown or required to ensure sufficient anchorage for purpose intended.

3.4 JOINTS:

- A. Contraction Joints: Joints shall be installed as specified or shown.
- B. Expansion Joints: Joints shall be installed as specified or shown.
- C. Construction Joints: Construction joints shall be located as shown or approved by the Engineer.

3.5 PLACING:

- A. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water.
- B. Concrete may be placed directly on impervious surfaces that are thoroughly moistened but not muddy.
- C. During cold weather, in-place concrete shall be protected from freezing weather, throughout the curing period.
- D. During hot weather, a retarder may be used if approved by the Engineer.
- E. Concrete to receive other construction shall be struck to the proper level leaving a textured surface to receive the additional construction.

3.6 CONSOLIDATION OF CONCRETE:

- A. Except for slabs 4 inches or less, each layer of concrete shall be consolidated with internal concrete vibrators supplemented by hand-spading, rodding, and tamping.
- B. Vibrating equipment shall be adequate to thoroughly consolidate the concrete.
- C. Concrete in slabs 4 inches and less shall be consolidated by compacting and screening.

3.7 FINISHING CONCRETE:

A. Formed Surfaces:

- 1. Fins and loose material shall be removed.
- 2. Unsound concrete, voids over ½ inch in diameter, and tie-rod and bolt holes shall be cut back to solid concrete, reamed, brush-coated with cement grout, and filled solid with a stiff Portland-cement-sand mortar mix.
- 3. Patchwork shall finished flush with adjoining concrete surfaces and, where exposed, shall match adjoining surfaces in texture and color.

B. Unformed Surfaces:

- 1. Surfaces shall be finished to a true plane with no deviation exceeding 5/16 inch when tested with a 10-foot straightedge.
- 2. Surfaces shall be screed and floated to the required finish level with no coarse aggregate visible before finishing as specified below.

C. Monolithic Finish:

- 1. Monolithic finish shall be given to flatwork unless otherwise specified.
- 2. After the surface moisture has disappeared, floated surfaces shall be steel-troweled to a smooth, even, dense finish, free from blemish including trowel marks.

3.8 CURING:

- A. Curing shall start as soon as free water has disappeared from concrete surfaces after placing and finishing.
- B. Curing materials shall be applied and maintained so as to protect the concrete from moisture loss for 7 days.
- C. Curing shall be accomplished by impervious sheet or membrane-forming curing compound.

- D. Concrete surfaces shall be thoroughly wetted before covering with impervious sheet materials.
- E. Membrane-forming curing compound shall be applied with mechanical spraying equipment at a coverage rate as recommended by manufacturer.
- F. Curing compound shall not be used on surfaces receiving applications depending on adhesion or bonding.

3.9 TESTING:

- A. The frequency and type of tests shall be determined by the Engineer.
- B. Sampling of Concrete: Samples of concrete for air, slump, unit weight, and strength tests may be taken at Engineer's discretion. Owner will pay for initial collection and sampling of concrete. Concrete that fails any test will not be accepted and Contractor shall reimburse Owner for initial testing and pay for all additional testing required to confirm concrete meets specified requirements.
- C. Contractor shall coordinate and cooperate with Engineer for taking samples.

END OF SECTION

SECTION 09 90 00

PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. The work of this section includes the coating of all interior and exterior surfaces specified herein. Refer Architectural Painting for interior and exterior surfaces not specified herein.

1.2 REFERENCES:

- A. ASTM D16 – Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
- B. ASTM D2200 – Standard Practice for Use of Pictorial Surface Preparation Standards and Guides for Painted Steel Surfaces.
- C. ASTM D4417 – Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
- D. ASTM D4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
- E. ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- F. ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- G. ICRI – International Concrete Repair Institute.
- H. NACE (National Association of Corrosion Engineers) – Industrial Maintenance Painting.
- I. NACE SP0287 – Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces using a Replica Tape.
- J. NACE SP0178 – Design, Fabrication, and Surface Finishes for Tanks and Vessels to be Lined for Immersion Service.
- K. NACE SP0188 – Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
- L. NAPF – National Association of Pipe Fabricators.
- M. NPCA (National Paint and Coating Association) – Guide to U.S. Government Paint Specifications.
- N. SSPC (Society for Protective Coatings) – Steel Structures Painting Manual.

- O. SSPC-Guide 15 – Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.
- P. SSPC-VIS 1 – Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning.
- Q. SPC-PA1 – Shop, Field and Maintenance Painting of Steel.
- R. SSPC-PA 2 – Measurement of Dry Film Thickness with Magnetic Gages.
- S. Paint Manufacturer's printed instructions.

1.3 DEFINITIONS:

- A. DFT - Dry film thickness.
- B. mil(s) - a unit of measure equal to a thousandth of an inch (0.0254) mm.
- C. VOC(s) - volatile organic compound(s).

1.4 INTERPRETATION:

- A. The Engineer's decision shall be final in the interpretation and/or conflict between any of the referenced Specifications and Standards contained herein.

1.5 SUBMITTALS:

- A. Information to be provided: Provide a list of materials to be used under this Section. Submit the list before the materials are delivered to the job site. Cross reference the list to the coating systems identified. Furnish with the list, the coating Manufacturer's standard product data and color chart for each material to be used.
- B. Manufacturer's color charts shall be submitted to the Engineer at least 30 days or prior to paint application. Coordinate work so as to allow sufficient time for paint to be delivered to the job site.

1.6 QUALITY ASSURANCE:

- A. General: Use quality assurance procedures and practices to monitor all phases of surface preparation, application, and inspection throughout the duration of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and accepted professional standards.
- B. Surface Preparation: Surface preparation will be based upon comparison with: SSPC-VIS 1, ASTM D2200, ASTM D4417 Method A and/or Method C, or NACE Standard SP0287. In all cases the written standard shall take precedence over the visual standard. In addition, NACE Standard SP0178, along with the Visual Comparator, shall be used to verify the surface preparation of welds.

- C. Application: No coating shall be applied: When the surrounding air temperature or the temperature of the surface to be coated or painted is below the minimum surface temperature for the products specified herein; or in rain; snow, fog, or mist; when the temperature is less than 5 degrees F above the dew point; when the air temperature is expected to drop below 35 degrees F within six hours after application of coating. Dew point shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychrometric Tables. If the above conditions are forecast, coating or painting shall be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions.
- D. Thickness: Thickness of coatings and paint shall be measured and checked according to the procedures outlined in SSPC-PA 2 with particular attention to section(s) 4.0, 7.8, 7.9, 7.11, 7.13, and 7.14, with a non-destructive, magnetic-type thickness gage that has been calibrated according to the procedures outlined in SSPC-PA 2 with particular attention to section(s) 3.0, 7.4, 7.5, and 7.15. Pass/fail criteria shall require that ninety (90) percent of the spot measurements (average of 3 gage readings within a 1.5-inch diameter area) be at or above the minimum specified dry film thickness. Of the remaining ten (10) percent of the spot measurements (average of 3 gage readings within a 1.5-inch diameter area) that are below the minimum specified dry film thickness, they shall be no less than ninety (90) percent of the minimum specified dry film thickness. Areas that fail to meet these criteria shall be corrected at no expense to the Owner. Use of an instrument such as a Tooke Gauge, precision groove grinder, etc. is permitted if a destructive test is deemed necessary by the Engineer and the total DFT is less than 50 mils.
- E. Holiday (Pinhole) Testing: The integrity of interior coated surfaces shall be tested for holidays in accordance with NACE Standard SP0188. For dry films less than 20 mils, a non-destructive holiday detector shall not exceed 67.5 volts, nor shall destructive holiday detector exceed the voltage recommended by the Manufacturer of the coating system. A solution of 1-ounce, non-sudsing type wetting agent, such as Kodak Photo-Flo, and 1-gallon of tap water shall be used to perform the holiday testing. For coating thickness at 20 mils and greater, a high voltage Tinker & Razor AP/W holiday tester shall be used. Contact coating Manufacturer for voltage recommendations and curing parameters. All pinholes and/or holidays shall be marked and repaired in accordance with the Manufacturer's printed recommendations and retested. No pinholes or other irregularities will be permitted in the final coating.
- F. Inspection: Inspection shall consist of 'hold point' inspections. The Engineer or its representative shall inspect the surface prior to abrasive blasting, after abrasive blasting but prior to application of coating materials, and between subsequent coats of material. Final inspection shall take place after all coatings are applied, but prior to placing the equipment, piping, tank, etc. in service. Contractor shall insure that sufficient rigging is in place so that the Engineer or his representative shall be able to conduct the required inspections.
- G. Inspection Devices: The Contractor shall furnish, until final acceptance of coating and painting, inspection devices in good working condition for detection of holidays and measurement of DFT of coating. The Contractor shall also furnish U.S. Department of Commerce; National Bureau of Standards certified thickness calibration plates to test accuracy of DFT gages and

certified instrumentation to test accuracy of holiday detector. Dry film thickness gages and holiday detectors shall be made available for the Engineer's use at all times until final acceptance of application. Holiday detection devices shall be operated in the presence of the Engineer.

- H. Warranty Inspection: Warranty inspection shall be conducted during the eleventh month following completion of all coating and painting work. All defective work shall be repaired in accordance with this specification and to the satisfaction of the Engineer/Owner.

1.7 QUALIFICATIONS:

- A. The Contractor shall have three years practical experience and successful history in the application of specified products to surfaces in water treatment, wastewater treatment, or industrial facilities. The Contractor shall be a knowledgeable and experienced professional, fully aware of the methods and regulatory requirements of coating removal and application. Upon request, he shall substantiate this requirement by furnishing a list of references and job completions.

1.8 SAFETY AND HEALTH REQUIREMENTS:

- A. General: The Contractor shall perform all work in accordance with applicable local, state, and federal laws and regulations, and material Manufacturer's instructions and recommendations pertaining to the methods, materials, or activities in the work. Some of these regulations are included in the following groups:

Occupational Safety and Health Act and derived regulations.

Clean Air Act and derived regulations, both federal and state.

The items listed below in the rest of this Paragraph are intended to call the Contractor's attention to some of the frequently necessary compliance activities. The Contractor is solely responsible for compliance with applicable regulations including, but not limited to, the areas identified in this Specification. The Contractor shall provide and require the use of personal protective equipment for persons working on or about the project.

- B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets which shall be worn by all persons while in the vicinity of the work. In addition, workers engaged in or near the work during sandblasting shall wear appropriate eye and face protection devices and air purifying, half mask or mouthpiece respirators with appropriate filters.
- C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Ventilation shall reduce the concentration of air contaminants to the degree a hazard does not exist. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.
- D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the Contractor shall provide and require the use of approved ear protective devices.

- E. Illumination: Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Whenever required by the Engineer, the Contractor shall provide additional illumination and necessary supports to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the Engineer.
- F. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the Engineer to facilitate inspection and be moved by the Contractor to locations requested by the Engineer.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Materials specified are those that have been evaluated for the specific service. Products are listed to establish a standard of quality. Equivalent materials of other Manufacturers may be substituted on written approval of the Engineer.

Requests for substitution shall include Manufacturer's literature for each product giving name, product number, and generic type, descriptive information, solids by volume, recommended DFT and certified laboratory test reports showing results to equal the performance criteria of the products specified herein. In addition, a list of five projects shall be submitted in which each product has been used and rendered satisfactory service. The listed projects shall be in the State of Texas, Oklahoma, Louisiana, or Arkansas.

2.2 DELIVERY AND STORAGE:

- A. All materials shall be brought to jobsite in original sealed containers. They shall not be used until the Engineer has inspected contents and obtained data from information on containers or label. Materials exceeding storage life recommended by the Manufacturer shall be rejected.
- B. All coatings and paints shall be stored in enclosed structures to protect them from weather and excessive heat or cold. Flammable coatings or paint must be stored to conform with City, County, State, and Federal safety codes for flammable coating or paint materials. At all times coatings and paints shall be protected from freezing.

2.3 MATERIALS:

The number of coats called for in this schedule shall be considered minimum. If additional coats are required for complete coverage and uniform appearance, they shall be applied. Colors will be selected by the Owner. The system numbering may not be sequential or inclusive of all numbers from the first to last system or schedule numbers. Color coding of piping to be as noted in Section 3.5, Paragraph B.

SYSTEM NO. 1

TYPE OF SURFACE: Exterior exposed ferrous metals including handrails and walkways.

TYPE OF STRUCTURE: Structural steel, handrails, walkways, stairways, tops of digester covers, bridges, etc.

EXPOSURE CONDITION: Interior and exterior.

SURFACE PREPARATION: SSPC-SP6/NACE 3 Commercial Blast Cleaning. A 1.5 to 2.0 mil angular anchor profile as per ASTM D4417, Method C or NACE Standard SPO287. All surfaces to be clean and dry. All surfaces should be clean, dry, free of oil, rust, loose and scaling paint, and foreign material.

PAINTING SYSTEM:

First Coat:

Tnemec Series 66 Hi-Build Epoxoline 5.0–7.0 mils DFT

Second Coat:

Tnemec Series 1074 Endura-Shield II (Gloss) 2.0–3.0 mils DFT

Alternate Second Coat:

Tnemec Series 1075 Endura-Shield II (Semi-Gloss) 2.0–3.0 mils DFT

Total Thickness = 7.0–10.0 mils DFT min.

SYSTEM NO. 2

TYPE OF SURFACE: Ferrous metals.

TYPE OF STRUCTURE: Severe moisture and chemical contact and fumes such as: chemical tanks, feeders, rotary drums, vacuum filters, valves, conveyors, pipes, slurry tanks, and lime and ferric sulfate or chloride tanks, interior and exterior.

EXPOSURE CONDITION: Non-submerged; inside or outside.

SURFACE PREPARATION: Surface shall be sandblasted to a SSPC-SP6/NACE 3 Commercial Blast Cleaning. Anchor profile shall be angular with a 1.5 to 2.0 mil profile as per ASTM D4417, Method C or NACE Standard SPO287. All surfaces to be clean and dry.

PAINTING SYSTEM:

First Coat:

Tnemec Series 66 Hi-Build Epoxoline 4.0–6.0 mils DFT

Second Coat:

Tnemec Series 66 Hi-Build Epoxoline 5.0–7.0 mils DFT

Third Coat (Interior):

Tnemec Series 66 Hi-Build Epoxoline 5.0–7.0 mils DFT

Third Coat (Exterior):

Tnemec Series 290 CRU 2.0–3.0 mils

Total Thickness (Interior) = 14.0–20.0 mils DFT min.
Total Thickness (Exterior) = 11.0–16.0 mils DFT min.

SYSTEM NO. 3

TYPE OF SURFACE: Steel.

TYPE OF STRUCTURE: Piping, fittings and valves, and exposed structural steel and metal trim.

EXPOSURE CONDITION: Non-submerged.

SURFACE PREPARATION: Surface shall be sandblasted to a SSPC-SP6/NACE 3 Commercial Blast Cleaning. Anchor profile shall be angular with a 1.5 to 2.0 mil profile as per ASTM D4417, Method C or NACE Standard SP0287. All surfaces to be clean and dry.

PAINTING SYSTEM:

First Coat:

Tnemec Series 66 Hi-Build Epoxoline 4.0–6.0 mils DFT

Second Coat:

Tnemec Series 1074 Endura-Shield II (Gloss) 2.0–3.0 mils DFT

Alternate Second Coat:

Tnemec Series 1075 Endura-Shield II (Semi-Gloss) 2.0–3.0 mils DFT

Total Thickness = 6.0–9.0 mils DFT min.

SYSTEM NO. 4

TYPE OF SURFACE: Ductile iron.

TYPE OF STRUCTURE: Piping, fittings and valves, and miscellaneous ductile iron.

EXPOSURE CONDITION: Non-submerged.

SURFACE PREPARATION: Clean all surfaces as per NAPF 500-03-01 Solvent Cleaning to remove all oil, grease, factory applied tars and/or bitumastic coatings and all other soluble contaminants. Prepare ductile iron pipe as per NAPF 500-03-04 Abrasive Blast Cleaning for Ductile Iron pipe, providing a minimum 1.5 mil angular anchor profile. Prepare ductile iron valves and fittings as per NAPF 500-03-05 Abrasive Blast Cleaning for Cast Ductile Iron Fittings. If existing ductile iron is factory coated with Tnemec Series N140, follow the recoat window listed on the current product data sheet.

PAINTING SYSTEM:

First Coat:

Tnemec Series 133 Pro-Tuff Mastic 4.0–6.0 mils DFT

Second Coat:
Tnemec Series 1074 Endura-Shield II (Gloss) 2.0–3.0 mils DFT

Alternate Second Coat:
Tnemec Series 1075 Endura-Shield II (Semi-Gloss) 2.0–3.0 mils DFT

Total Thickness = 6.5–9.5 mils DFT min.

SYSTEM NO. 5

TYPE OF SURFACE: Factory-primed metal.

TYPE OF STRUCTURE: Piping, fittings and valves, and miscellaneous metal structures.

EXPOSURE CONDITION: Non-submerged.

SURFACE PREPARATION: All surfaces shall be dry, clean and free of all contaminants. Clean all surfaces as per SSPC-SP2 or SSPC-SP3 Hand or Power Tool Cleaning. Apply a test patch when necessary to ensure compatibility.

PAINTING SYSTEM:

First Coat:
Tnemec Series 133 Pro-Tuff Mastic 4.0–6.0 mils DFT

Second Coat:
Tnemec Series 1074 Endura-Shield II (Gloss) 2.0–3.0 mils DFT

Alternate Second Coat:
Tnemec Series 1075 Endura-Shield II (Semi-Gloss) 2.0–3.0 mils DFT

Total Thickness = 6.0–9.0 mils DFT min.

SYSTEM NO. 6

TYPE OF LIQUID HANDLED: Non-potable water.

TYPE OF SURFACE: Steel.

TYPE OF STRUCTURE: Trickling filter arms, gates, troughs, weirs, pipes, fittings, baffles, aerators, air diffusers, pumps, flights, and skimming arms.

EXPOSURE CONDITION: Submerged or intermittently submerged.

SURFACE PREPARATION: SSPC-SP10/NACE 2 Near White Metal Blast Cleaning. Anchor profile shall be angular with a 1.5 to 2.0 mil profile as per ASTM D4417, Method C or NACE Standard SP0287. All surfaces to be clean and dry.

PAINTING SYSTEM:

First Coat:

Tnemec Series 66-1255 Hi-Build Epoxoline 4.0–6.0 mils DFT

Second Coat:

Tnemec Series 141 Epoxoline 12.0–15.0 mils DFT

Total Thickness = 16.0–21.0 mils DFT min.

SYSTEM NO. 7

TYPE OF LIQUID HANDLED: Potable water.

TYPE OF SURFACE: Steel.

TYPE OF STRUCTURE: Filter bed agitators, gates, flumes, weirs, pipes, baffles, paddles, pumps, flights, and troughs.

EXPOSURE CONDITION: Submerged or intermittently submerged.

SURFACE PREPARATION: SSPC-SP10/NACE 2 Near White Metal Blast Cleaning. A 2.0 mil minimum anchor profile is required.

PAINTING SYSTEM:

First Coat:

Tnemec Series 94-H20 Hydro-Zinc 2.5–3.5 mils DFT

Second Coat:

Tnemec Series 20-1255 Pota-Pox 4.0–6.0 mils DFT

Third Coat:

Tnemec Series 20-15BL Pota-Pox 4.0–6.0 mils DFT

Total Thickness = 10.5–15.5 mils DFT min.

SYSTEM NO. 8

TYPE OF SURFACE: Exterior concrete.

TYPE OF STRUCTURE: Exterior building structures.

EXPOSURE CONDITION: Non-submerged.

SURFACE PREPARATION: All surfaces must be clean and in sound condition. Previously painted surfaces are to be prepared by 3,500 psi power wash with a zero-degree spinner tip and a minimum flow rate of 3.5 gallons per minute. All loose paint, chalk, and contaminants are to be completely removed. New concrete is to be cured

a minimum of 14 days and be free of all form oils, release agents and other contaminants. Contractor will perform all surface preparation necessary to achieve a clean, dry surface prior to application of materials.

PAINTING SYSTEM:

<u>Prime Coat:</u> Tnemec Series 151-1051 Elasto-Grip FC	0.7–1.5 mils DFT
<u>First Coat:</u> Tnemec Series 156 Enviro-Crete	6.0–8.0 mils DFT
<u>Second Coat:</u> Tnemec Series 156 Enviro-Crete	6.0–8.0 mils DFT
Total Thickness =	12.7–17.5 mils DFT min.

SYSTEM NO. 9

TYPE OF SURFACE: Interior concrete.

TYPE OF STRUCTURE: Interior of building walls and ceilings, walls and ceilings in pipe galleries, pump galleries, pump and blower rooms, chlorine rooms, and control rooms.

EXPOSURE CONDITION: Non-submerged.

SURFACE PREPARATION: All surfaces must be clean and in sound condition. Previously painted surfaces are to be prepared by 3,500 psi power wash with a zero-degree spinner tip and a minimum flow rate of 3.5 gallons per minute, or equivalent. All loose paint, chalk, and contaminants are to be completely removed. New concrete is to be cured a minimum of 14 days and be free of all form oils, release agents and other contaminants. Contractor will perform all surface preparation necessary to achieve a clean, dry surface prior to application of materials.

PAINTING SYSTEM:

<u>Adhesion Promoter:</u> Tnemec Series 151-1051 Elasto-Grip FC	0.7–1.5 mils DFT
<u>First Coat:</u> Tnemec Series 66 Hi-Build Epoxoline	4.0–6.0 mils DFT
<u>Second Coat:</u> Tnemec Series 66 Hi-Build Epoxoline	4.0–6.0 mils DFT
Total Thickness =	8.7–13.5 mils DFT min.

SYSTEM NO. 10

TYPE OF SURFACE: Exterior CMU.

TYPE OF STRUCTURE: Exterior building structures.

EXPOSURE CONDITION: Non-submerged.

SURFACE PREPARATION: New CMU is to be cured a minimum of 14 days and be free of all mortar splatter or other contaminants. Contractor will perform all surface preparation necessary to achieve a clean, dry surface prior to application of materials.

PAINTING SYSTEM:

Prime Coat:

Tnemec Series 130 Envirofill 60–80 sq. ft. /gal.

First Coat:

Tnemec Series 156 Enviro-Crete 6.0–8.0 mils DFT

Second Coat:

Tnemec Series 156 Enviro-Crete 6.0–8.0 mils DFT

Total Thickness = 12.0–16.0 mils DFT

SYSTEM NO. 11

TYPE OF SURFACE: Interior CMU.

TYPE OF STRUCTURE: Interior of building walls and ceilings, walls and ceilings in pipe galleries, pump galleries, pump and blower rooms, chlorine rooms, and control rooms.

EXPOSURE CONDITION: Non-submerged.

SURFACE PREPARATION: All loose paint, chalk, and contaminants are to be completely removed. New CMU is to be cured a minimum of 14 days and be free of all mortar splatter or other contaminants. Contractor will perform all surface preparation necessary to achieve a clean, dry surface prior to application of materials.

PAINTING SYSTEM:

Adhesion Promoter:

Tnemec Series 130 Envirofill 60–80 sq. ft/gal.

First Coat:

Tnemec Series 66 Hi-Build Epoxoline 4.0–6.0 mils DFT

Second Coat:

Tnemec Series 66 Hi-Build Epoxoline 4.0–6.0 mils DFT

Total Thickness = 8.0–12.0 mils DFT
min.

SYSTEM NO. 12

TYPE OF LIQUID HANDLED: Non-potable water.

TYPE OF SURFACE: Concrete.

TYPE OF STRUCTURE: Influent or effluent channels. Parshall flumes and tank structures, such as aerator, primary and secondary settling, trickling filters, and primary and secondary clarifiers.

EXPOSURE CONDITION: Submerged.

SURFACE PREPARATION: SSPC-SP13/NACE 6 Brush-Off Blast Cleaning. An angular anchor profile equivalent to ICRI CSP 3 Moderate Service is required. Concrete should be completely cured and free of form release compounds, laitance, loose particles and be completely dry. Pits, bugholes, or unconsolidated areas are to be repaired with Series 218 Surfacing Epoxy.

PAINTING SYSTEM:

First Coat:

Tnemec Series 66. Hi-Build Epoxoline 4.0–6.0 mils DFT

Second Coat:

Tnemec Series 141 Epoxoline 10.0–12.0 mils DFT

Total Thickness = 14.0–18.0 mils DFT
min.

SYSTEM NO. 13

TYPE OF LIQUID HANDLED: Potable water.

TYPE OF SURFACE: Concrete.

TYPE OF STRUCTURE: Rapid mix chambers, coagulation basin, flocculation and sedimentation basins, filter beds, troughs, flumes, channels, conduits, and clear wells.

EXPOSURE CONDITION: Submerged.

SURFACE PREPARATION: SSPC-SP13/NACE 6 Brush-off Blast Cleaning. An angular surface profile equivalent to ICRI CSP 3 Moderate Service is required. Concrete should be completely cured and free of all form release compounds, laitance, loose particles and be completely dry. Previously coated surfaces must be cleaned of all paint, rust, grease, and dirt. Pits, bugholes, or unconsolidated areas are to be repaired with Series 218 Surfacing Epoxy.

PAINTING SYSTEM:

First Coat:

Tnemec Series 20-1255 Beige Pota-Pox 4.0–6.0 mils DFT

Second Coat:

Tnemec Series 22-15BL Tank White Epoxoline 20.0–25.0 mils DFT

Total Thickness = 24.0–31.0 mils DFT
min.

SYSTEM NO. 14

TYPE OF SURFACE: Concrete.

TYPE OF STRUCTURE: Exterior walls of buildings below grade.

EXPOSURE CONDITION: Below grade.

SURFACE PREPARATION: Concrete should be completely cured and brushed free of all form release compounds, laitance, loose particles, and be completely dry. Previously coated surfaces must be cleaned of all loose paint, rust, grease, and dirt by 3,500 psi power wash with zero-degree spinner tip at a minimum flow rate of 3.5 gpm.

PAINTING SYSTEM:

First Coat:

Tnemec Series 46H-413 Hi-Build Tnemec-Tar 16.0–20.0 mils DFT

SYSTEM NO. 15

TYPE OF SURFACE: Concrete.

TYPE OF STRUCTURE: Concrete floors, steps, and walkways. Inside and outside.

EXPOSURE CONDITION: Non-submerged.

SURFACE PREPARATION: SSPC-SP13/NACE 6 Brush-off Blast Cleaning. An angular surface profile equivalent to ICRI CSP 3 Moderate Service is required. Concrete should be completely cured and free of all form release compounds, laitance, loose particles and be completely dry.

PAINTING SYSTEM:

First Coat:

Tnemec Series 66-Color Hi-Build Epoxoline 4.0–6.0 mils DFT

Second Coat:
Tnemec Series 66-Color Hi-Build Epoxoline* 4.0–6.0 mils DFT
*Broadcast with aggregate for non-skid as recommended per Manufacturer’s instructions.

Total Thickness = 8.0–12.0 mils DFT min.

SYSTEM NO. 16

TYPE OF SURFACE: Wood.

TYPE OF STRUCTURE: Normal conditions indoors such as doors, framing, window sash, and woodwork.

EXPOSURE CONDITION: Non-submerged.

SURFACE PREPARATION: Surfaces must be cleaned of dirt, grease, and other contaminants. All surfaces must be dry.

PAINTING SYSTEM:

First Coat:
Tnemec Series 1026 Enduratone 2.0–3.0 mils DFT

Second Coat:
Tnemec Series 1026 Enduratone 2.0–3.0 mils DFT

Third Coat:
Tnemec Series 1029 Enduratone (Semi-Gloss) 2.0–3.0 mils DFT

Total Thickness = 6.0–9.0 mils DFT min.

SYSTEM NO. 17

TYPE OF SURFACE: Wood.

TYPE OF STRUCTURE: Exteriors of buildings, walls, trim, and wood siding.

EXPOSURE CONDITION: Non-submerged.

SURFACE PREPARATION: All surfaces must be clean and dry. New wood should be well seasoned. Painted surfaces should be cleaned of dirt, grease, and loose, and cracked or peeling paint.

PAINTING SYSTEM:

First Coat:
Tnemec Series 66 Hi-Build Epoxoline 5.0–6.0 mils DFT

Second Coat:
Tnemec Series 1075 Endura-Shield II (S-G) 2.0–3.0 mils DFT
Total Thickness = 7.0–9.0 mils DFT min.

SYSTEM NO. 18

TYPE OF LIQUID HANDLED: Potable and non-potable water.
TYPE OF SURFACE: Wood.
TYPE OF STRUCTURE: Surface baffles and paddles.
EXPOSURE CONDITION: Submerged, Potable and Non-Potable.
SURFACE PREPARATION: Surface to be clean and dry.
PAINTING SYSTEM:

First Coat:*
Tnemec Series 20 Pota-Pox 5.0–7.0 mils DFT

Second Coat:*
Tnemec Series 20 Pota-Pox 5.0–7.0 mils DFT

Total Thickness = 10.0–14.0 mils DFT min.

*If surface temperature is 50 degrees Fahrenheit or less when the surface is to be painted, two coats of Tnemec Series FC20 Pota-Pox shall be used at the same thickness as above.

SYSTEM NO. 19

TYPE OF SURFACE: Gypsum board.
TYPE OF STRUCTURE: Plant interior.
EXPOSURE CONDITION: Normal atmosphere.
SURFACE PREPARATION: All surfaces must be clean and dry.
PAINTING SYSTEM:

First Coat:
Tnemec Series 51 PVA Sealer 1.5 mils DFT

Second Coat:
Tnemec Series 113 Hi-Build Tneme-Tufcoat 4.0–6.0 mils DFT

Third Coat:
 Tnemec Series 113 Hi-Build Tneme-Tufcoat 4.0–6.0 mils DFT
 Total Thickness = 9.5–13.5 mils DFT min.

SYSTEM NO. 20

TYPE OF SURFACE: PVC pipe.
 TYPE OF STRUCTURE: PVC conduits and pipes in building.
 EXPOSURE CONDITION: Normal atmosphere.
 SURFACE PREPARATION: Hand sand to roughen pipe surface.

PAINTING SYSTEM:

First Coat:
 Tnemec Series 66 H.B. Epoxoline 4.0–6.0 mils DFT

Second Coat (Interior):
 Tnemec Series 66 H.B. Epoxoline 4.0–6.0 mils DFT

Second Coat (Exterior):
 Tnemec Series 1075 Endura-Shield II (Semi-Gloss) 2.0–3.0 mils

Total Thickness (Interior) = 8.0–12.0 mils DFT min.
 Total Thickness (Exterior) = 6.0–9.0 mils DFT min.

SYSTEM NO. 21

TYPE OF SURFACE: Repair of Factory-Installed Bituminous-Coated Ductile Iron Pipe.
 TYPE OF STRUCTURE: Piping.
 EXPOSURE CONDITION: Buried.

PAINTING SYSTEM:

First Coat:
 Tnemec Series 46H-413 Hi-Build Tneme-Tar 8.0–10.0 mils DFT

Second Coat:
 Tnemec Series 66 Color Hi-Build Epoxoline 8.0–10.0 mils DFT

Total Thickness = 16.0–20.0 mils DFT min.

SYSTEM NO. 22

TYPE OF SURFACE: Galvanized or non-ferrous metal.

TYPE OF STRUCTURE: Throughout plant.

EXPOSURE CONDITION: Atmospheric.

SURFACE PREPARATION: Visible deposits of oil, grease, or other contaminants shall be removed as required by SSPC-SP1. Sweep (Abrasive) Blasting per SSPC-SP16 to achieve a uniform anchor profile (1.0 to 2.0 mils). Galvanized surfaces must be clean, dry, and contaminant free prior to application of coatings.

PAINTING SYSTEM:

First Coat:

Tnemec Series 66 Hi-Build Epoxoline 3.0–5.0 mils DFT

Second Coat:

Tnemec Series 1074 Endura-Shield II (Gloss) 2.0–3.0 mils DFT

Total Thickness = 5.0–8.0 mils DFT min.

SYSTEM NO. 23

TYPE OF SURFACE: Galvanized or non-ferrous metal.

TYPE OF STRUCTURE: Throughout plant.

EXPOSURE CONDITION: Submerged.

SURFACE PREPARATION: Visible deposits of oil, grease, or other contaminants shall be removed as required by SSPC-SP1. Sweep (Abrasive) Blasting per SSPC-SP16 to achieve a uniform anchor profile (2.0 to 2.5 mils). Galvanized surfaces must be clean, dry, and contaminant free prior to application of coatings.

PAINTING SYSTEM:

First Coat:

Tnemec Series 20 Pota-Pox 2.0–3.0 mils DFT

Second Coat:

Tnemec Series 20 Pota-Pox 4.0–6.0 mils DFT

Third Coat:

Tnemec Series 20 Pota-Pox 4.0–6.0 mils DFT

Total Thickness = 10.0–15.0 mils DFT min.

SYSTEM NO. 24

TYPE OF SURFACE: Steel piping.

TYPE OF STRUCTURE: Buried.

EXPOSURE CONDITION: Below grade.

SURFACE PREPARATION: SSPC-SP10/NACE 2: Near White Metal Blast Cleaning. A 2.0 minimum surface profile is required. Surface to be clean and dry.

PAINTING SYSTEM:

First Coat:

Tnemec Series 66 Epoxoline 4.0–6.0 mils DFT

Second Coat:

Tnemec Series 46H-413 Hi-Build Tnemec-Tar 16.0–20.0 mils DFT

Total Thickness = 20.0–26.0 mils DFT min.

SYSTEM NO. 25

TYPE OF SURFACE: Galvanized steel.

TYPE OF STRUCTURE: Throughout plant, galvanized steel repair.

EXPOSURE CONDITION: Atmospheric.

SURFACE PREPARATION: Visible deposits of oil, grease, or other contaminants shall be removed as required by SSPC-SP1. Sweep (Abrasive) Blasting per SSPC-SP16 to achieve a uniform anchor profile (1.0 to 2.0 mils). Surfaces must be clean, dry, and contaminant free prior to application of coatings.

PAINTING SYSTEM:

First Coat:

Tnemec Series 66 Hi-Build Epoxoline 4.0–6.0 mils DFT

Second Coat:

Tnemec Series 1075 Endura-Shield II 2.0–3.0 mils DFT

Total Thickness = 6.0–9.0 mils DFT min.

SYSTEM NO. 26

TYPE OF LIQUID HANDLED: Raw sewage and sewer effluent.

TYPE OF SURFACE: Steel.

TYPE OF STRUCTURE: Underside of digester covers, odor control covers.

EXPOSURE CONDITION: Severe wastewater exposure, H2S gas exposure.

SURFACE PREPARATION: SSPC-SP5/NACE 1 White Metal Blast Cleaning. A 3.0 mil minimum anchor profile is required. All surfaces to be clean and dry.

PAINTING SYSTEM:

Stripe Coat:

Tnemec Series N69 Hi-Build Epoxoline II
Brushed & Scrubbed into Weld Seams

First Coat:

Tnemec Series N69 Hi-Build Epoxoline II
5.0–7.0 mils DFT

Second Coat:

Tnemec Series 435 Perma-Glaze
50.0–60.0 mils DFT

Total Thickness =
55.0–67.0 mils DFT min.

SYSTEM NO. 27

TYPE OF SURFACE: Steel or ductile iron.

TYPE OF STRUCTURE: Compressor, aeration piping, chilled or heated water lines and associated equipment.

EXPOSURE CONDITION: Atmospheric subject to high heat up to 300 degrees Fahrenheit, pipe condensation, or pipe requiring insulation.

SURFACE PREPARATION:

Steel: Surface shall be sandblasted to a SSPC-SP6/NACE 3 Commercial Blast Cleaning. Anchor profile shall be angular with a 1.5 to 2.0 mil profile as per ASTM D4417, Method C or NACE Standard SP0287. All surfaces to be clean and dry.

Ductile Iron: Clean all surfaces as per NAPF 500-03-01 Solvent Cleaning to remove all oil, grease, factory applied tars and/or bitumastic coatings and all other soluble contaminants. Prepare ductile iron pipe as per NAPF 500-03-04 Abrasive Blast Cleaning for Ductile Iron pipe providing a minimum 1.5 mil angular anchor profile. Prepare ductile iron valves and fittings as per NAPF 500-03-05 Abrasive Blast Cleaning for Cast Ductile Iron Fittings. If existing ductile iron is factory-coated with Tnemec Series N140, follow the recoat window listed on the current product data sheet.

PAINTING SYSTEM:

First Coat:

Tnemec Series 1224 Epoxoline WB
6.0–8.0 mils DFT

Second Coat:
Tnemec Series 971 Aerolon 50.0–60.0 mils DFT

Third Coat:
Tnemec Series 1028T 2.0–3.0 mils DFT

Total Thickness = 58.0–71.0 mils DFT
min.

SYSTEM NO. 28

TYPE OF LIQUID HANDLED: Sewage and sewer effluent.

TYPE OF SURFACE: Ductile iron.

TYPE OF STRUCTURE: Pipe.

EXPOSURE CONDITION: Submerged.

SURFACE PREPARATION: All surfaces shall be dry, clean, and free of all contaminants. All surfaces shall be inspected and pre-cleaned with suitable solvent to remove all traces of grease, oil, asphalt, and other soluble contaminants. Abrasive blast all surfaces with fine abrasive to remove all loose annealing oxides, rust, dirt, and other foreign matter. Only slight stains and tightly adhering oxides are allowed to remain on the surface. Any area where rust reappears before application shall be re-blasted. Any dust or other contaminants remaining after blasting shall be removed with dry, oil free compressed air or by vacuum cleaning. Anchor pattern shall be angular with profile of at least 3.0 mils.

PAINTING SYSTEM:

One Coat:
Tnemec Series 431 Perma-Shield PL 40.0–50.0 mils DFT

SYSTEM NO. 29

TYPE OF LIQUID HANDLED: Sewage and sewer effluent.

TYPE OF SURFACE: Steel.

TYPE OF STRUCTURE: Pipe.

EXPOSURE CONDITION: Submerged.

SURFACE PREPARATION: All surfaces shall be dry, clean, and free of all contaminants. SSPC-SP5/NACE 1 White Metal Blast Cleaning with a minimum angular anchor profile of 3.0 mils.

PAINTING SYSTEM:

One Coat:
Tnemec Series 431 Perma-Shield PL 30.0–40.0 mils DFT

SYSTEM NO. 30

TYPE OF SURFACE: Concrete.

TYPE OF STRUCTURE: Interior concrete walls and floors of structures subject to corrosive sewer gas including headworks, lift stations, and imhoff tanks.

EXPOSURE CONDITION: Submerged, intermittently submerged, and atmospheric.

SURFACE PREPARATION: Allow new cast-in-place concrete to cure a minimum of 28 days. Verify concrete dryness in accordance with ASTM F1869 (moisture vapor transmission should not exceed three pounds per 1,000 square feet in a 24 hour period), ASTM F2170 (relative humidity should not exceed 80%), or ASTM D4263 (no moisture present). Prepare concrete surfaces in accordance with SSPC-SP13/NACE 6 Joint Surface Preparation Standards and ICRI Technical Guidelines.

Abrasive Blast, shot-blast, water jet or mechanically abrade concrete surfaces to remove laitance, curing compounds, hardeners, sealers, and other contaminants and to provide a minimum ICRI CSP 5 surface profile. Large cracks, voids and other surface imperfections should be filled with a recommended filler or surfacer.

Primer Coat:

Tnemec Series 218 MortarClad 25 sq. ft/gal (1/16-inch)

Liner:

Tnemec Series 436 Perma-Shield FR 80–100 mils DFT (16 to 20 sq. ft/gal).

SYSTEM NO. 31

TYPE OF LIQUID HANDLED: Bioreactor process water.

TYPE OF SURFACE: Concrete.

TYPE OF STRUCTURE: Membrane bioreactor process tanks.

EXPOSURE CONDITION: Submerged.

SURFACE PREPARATION: Allow new concrete to cure 28 days. Abrasive blast per SSPC-SP13/NACE 6, ICRI CSP 2-4 Surface Preparation of Concrete. Fill all pits, bugholes, and voids of more than ½-inch in depth with Tnemec Series 217 MortarCast. Fill all pits, bugholes, and voids of less than ½-inch with Tnemec Series 217 MortarClad.

PAINTING SYSTEM:

Prime Coat:

Tnemec Series N140 Pota-Pox Plus 4.0–6.0 mils DFT (184-276 sq. ft/gal)

Bedding Coat:
Tnemec Series 215 Surfacing Epoxy 60–80 mils DFT (20-28 sq. ft/gal)

Reinforcement:
Tnemec Series 211-215 Fiberglass Mat

Saturate Coat:
Tnemec Series 22 Epoxoline 32–40 mils DFT (40-50 sq. ft/gal to completely saturate mat)

Finish Coat:
Tnemec Series 22 Epoxoline 20–30 mils DFT (53-80 sq. ft/gal)

SYSTEM NO. 32

TYPE OF SURFACE: Steel or ductile iron.

TYPE OF STRUCTURE: Severe moisture and chemical contact and fumes such as: chemical tanks, feeders, valves, pipes, interior and exterior.

EXPOSURE CONDITION: Non-submerged; inside or outside.

SURFACE PREPARATION:

Steel: Surface shall be sandblasted to a SSPC-SP6 commercial finish. Surface shall be dry and free of all rust and old paint.

Ductile Iron: Clean all surfaces as per NAPF 500-03-01 Solvent Cleaning to remove all oil, grease, factory applied tars and/or bitumastic coatings, and all other soluble contaminants. Prepare ductile iron pipe as per NAPF 500-03-04 Abrasive Blast Cleaning for Ductile Iron pipe, providing a minimum 1.5 mil angular anchor profile. Prepare ductile iron valves and fittings as per NAPF 500-03-05 Abrasive Blast Cleaning for Cast Ductile Iron Fittings. If existing ductile iron is factory coated with Tnemec Series N140, follow the recoat window listed on the current product data sheet.

PAINTING SYSTEM:

First Coat:
Tnemec Series 66 Hi-Build Exopoline 3.0 mils DFT

Second Coat:
Tnemec Series 66 Hi-Build Exopoline 5.0 mils DFT

Third Coat (Interior):
Tnemec Series 66 Hi-Build Exopoline 5.0 mils DFT

Third Coat (Exterior):
Tnemec Series 73 Endura-Shield 5.0 mils DFT

Total Thickness (Interior) = 13.0 mils DFT min.
Total Thickness (Exterior) = 13.0 mils DFT min.

PART 3 EXECUTION

3.1 GENERAL:

- A. All surface preparation, coating and painting shall conform to applicable standards of the Society for Protective and the Manufacturer's printed instructions. Material applied to the surface prior to the approval of the Engineer shall be removed and re-applied to the satisfaction of the Engineer at the expense of the Contractor.
- B. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice. Continuity of personnel shall be coordinated with the Engineer.
- C. The Contractor shall provide a supervisor at the work site during cleaning and application operations. The supervisor shall have the authority to sign change orders, coordinate work and make decisions pertaining to the fulfillment of the contract.
- D. Dust, dirt, oil, grease, or any foreign matter that will affect the adhesion or durability of the finish must be removed by washing with clean rags dipped in an approved cleaning solvent and wiped dry with clean rags.
- E. Coating and painting system include surface preparation, prime coating, and finish coatings. Unless otherwise approved by the Engineer, prime coating shall be field applied. Where prime coatings are shop applied, the Contractor shall instruct suppliers to provide the prime coat compatible with the finish coat specified. Any off-site work which does not conform to this specification or that is damaged during transportation, construction or installation shall be thoroughly cleaned and touched-up in the field as directed by the Engineer. The Contractor shall use repair procedures which insure the complete protection of all adjacent primer. The specified repair method and equipment may include wire brushing, hand or power tool cleaning, or dry-air blast cleaning. In order to prevent injury to surrounding painted areas, blast cleaning may require use of lower air pressure, smaller nozzle and abrasive particle sizes, or shorter blast nozzle distance from surface shielding and masking. If damage is too extensive or uneconomical to touch-up, then the item shall be re-cleaned and coated as directed by the Engineer.
- F. The Contractor's coating and painting equipment shall be designed for application of materials specified and shall be maintained in first class working condition. Compressors shall have suitable traps and filters to remove water and oils from the air.
- G. Application of the first coat shall follow immediately after surface preparation and cleaning and before rust bloom occurs. Any cleaned areas not receiving the first coat within this period shall be re-cleaned prior to application of the first coat.

- H. Prior to assembly, all surfaces made inaccessible after assembly shall be prepared as specified herein and shall receive the coating or paint system specified.

3.2 SURFACE PREPARATION:

- A. The latest revision of the following surface preparation specifications of the Society for Protective Coatings shall form a part of this Specification:
1. Solvent Cleaning (SSPC-SP1/NAPF 500-03-01): Removal of oil, grease, soil, and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning or similar materials and methods which involve a solvent or cleaning action.
 2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mil scale and other detrimental foreign matter to degree specified by hand chipping, scraping, sanding and wire brushing.
 3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mil scale and other detrimental foreign matter to degree specified by power wire brushing, power impact tools or power sanders.
 4. White Metal Blast Cleaning (SSPC-SP5/NACE 1): Blast cleaning to a gray-white uniform metallic color until each element of surface area is free of all visible residues.
 5. Commercial Blast Cleaning (SSPC-SP6/NACE 3): Blast cleaning until at least two-thirds of each element or surface area is free of all visible residues.
 6. Brush-Off Blast Cleaning (SSPC-SP7/NACE 4): Blast cleaning to remove loose rust, loose mil scale and other detrimental foreign matter to degree specified.
 7. Near White Blast Cleaning (SSPC-SP10/NACE 2): The removal of all visible oil, grease, dirt, rust, mil scale, rust, paint, oxides, corrosion products, and other foreign matter by compressed air nozzle blasting, centrifugal wheels or other specific method. Discoloration caused by certain stains shall be limited to no more than 5% of each square inch of surface area.
 8. Power Tool Cleaning to Bare Metal (SSPC-SP11): The removal of all visible oil, grease, dirt, mil scale, rust, paint, oxide, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portion of pits if the original surface is pitted. Differs from SSPC-SP3 in that it requires more thorough cleaning and a surface profile not less than 1 mil (25 microns). For areas where abrasive blasting is prohibited or not feasible.
 9. Surface Preparation of Concrete (SSPC-SP13/NACE 6): The removal of burrs, sharp edges, fins, and concrete spatter to the degree specified.

10. Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steel, and Non-Ferrous Metals (SSPC-SP16): Blast cleaning to produce a dense and uniform anchoring profile that is suitable for the coating system to be used. For galvanized steel, the presence of "wet storage stain" and passivating treatments shall be confirmed and addressed in accordance with the surface preparation specification prior to applying the specified coating system. Removal of "wet storage stain" from galvanized steel surfaces is not permitted by blast cleaning.
 11. Abrasive Blast Cleaning of Ductile Iron Pipe (NAPF 500-03-04): The removal of all visible dirt, dust, loose annealing oxide, loose rust, loose mold coating, and other foreign matter.
 12. Abrasive Blast Cleaning of Cast Ductile Iron Fittings (NAPF 500-03-05): The removal of all visible dirt, dust, loose annealing oxide, loose rust, loose mold coating and other foreign matter. Differs from NAPF 500-03-04 in that it establishes varying degrees of staining, in terms of the percentage of surface area, that are permissible dependent upon the surface prior coating. For fittings previously coated with asphaltic paint, no staining shall remain on the surface after abrasive blast cleaning. Where referenced in this Section and where asphaltic paint coatings are not present, discoloration caused by stains shall be limited to not more than 5% of each square inch of surface area.
 13. (ICRI CSP 2): Visual and tactile standard for field-measuring surface profile for light service.
 14. (ICRI CSP 3): Visual and tactile standard for field-measuring surface profile for moderate service.
 15. (ICRI CSP 5): Visual and tactile standard for field-measuring surface profile for severe service.
- B. Slag and weld metal accumulation and spatters not removed by the Fabricator, Erector, or Installer shall be removed by chipping and grinding. All sharp edges shall be panned, ground, or otherwise blunted as required by the Engineer.
 - C. Field blast cleaning for all surfaces shall be by dry method unless otherwise directed.
 - D. Particle size of abrasive used in blast cleaning shall be that which will produce a 2.0–3.0 mils (37.5 microns–50.0 microns) surface profile or in accordance with recommendations of the Manufacturer of the specified coating or paint system to be applied.
 - E. Abrasive used in blast cleaning operations shall be new, washed, graded and free of contaminants that would interfere with adhesion of coating or paint and shall not be reused unless specifically approved by the Engineer.
 - F. During blast cleaning operations, caution shall be exercised to ensure that existing coatings or paint are not exposed to abrasion from blast cleaning.

- G. The Contractor shall keep the area of his work and the surrounding environment in a clean condition. He shall not permit blasting materials to accumulate as to constitute a nuisance or hazard to the accomplishment of the work, the operation of the existing facilities, or nuisance to the surrounding environment.
- H. Blast cleaned surfaces shall be cleaned prior to application of specified coatings or paint. No coatings or paint shall be applied over damp or moist surfaces.
- I. Pit repair on steel tanks, clarifiers, etc. shall be accomplished by welding if pits are 1/8-inch deep or greater. Pits of less than 1/8-inch in depth may be repaired with Tnemec Series 215 Surfacing Epoxy.
- J. Specific Surface Preparation: Surface preparation for the specific system shall be as noted in Section 2.3.
- K. Non-Visible Contaminants: Interior steel tank surfaces shall be checked in three locations for the presence of chlorides, iron, and sulfates. New tanks shall be tested prior to abrasive blasting, tanks being rehabilitated shall be tested prior to blasting. If blisters are present in existing tank, testing shall also be performed after abrasive blasting. These tests are an Iron Test (ferrous iron [Fe²⁺]), Chloride Test and Sulfate Test. Testing shall be carried out as per SSPC- Guide 15. The maximum limits for these contaminants shall be:
1. The maximum level of chlorides is 30 milligrams per square meter or 3 micrograms per square centimeter.
 2. The maximum level of sulfates is 100 milligrams per square meter or 10 micrograms per square centimeter.
 3. The maximum level of ferrous ions (Fe²⁺) is 50 milligrams per square meter or 5 micrograms per square centimeter.
 4. Contamination levels above these limits will require washing and retesting in accordance with Item L (below) until the surface is under the allowable limits.

If testing shows amounts present in the test solution to be greater than the limits listed herein, the Contractor shall clean the surface of the entire tank interior with a 5,000 psi water blast until the levels in the test solutions are below the maximum acceptable level. Alternate cleaning methods may be allowed with prior approval of the Engineer. Surface shall be re-blasted as specified in 2.3 at no additional cost to the Owner.

Contractor shall provide a written statement from paint Manufacturer stating that the maximum acceptable levels are not less than those listed herein. Results of the testing shall be provided to the Owner before any coatings are applied.

The following test kits are approved for use on this project:

- a. Chlor*Rid Test Kit.
- b. KTA SCAT Test Kit.
- c. Test kits from other vendors shall be submitted to the Engineer for prior approval before use.

3.3 APPLICATION:

- A. Coating and paint application shall conform to the requirements of the revision of SSPC-PA1, the American Water Works Association, and the Manufacturer of the coating and paint materials.
- B. Thinning shall be permitted only as recommended by the Manufacturer and approved by the Engineer.
- C. Each application of coating or paint shall be applied evenly, free of brush marks, sags, runs, with no evidence of poor workmanship. Care shall be exercised to avoid lapping on glass or hardware. Coatings and paints shall be sharply cut to lines. Finished surfaces shall be free from defects or blemishes.
- D. Protective coverings or drop cloths shall be used to protect floors, textures, and equipment. Care shall be exercised to prevent coatings or paints from being spattered onto surfaces which are not to be coated or painted. Report surfaces from which materials cannot be satisfactory removed to the Engineer.
- E. When two coats of coating or paint are specified, where possible, the first coat shall contain sufficient approved color additive to act as an indicator of coverage or the two coats must be of contrasting color.
- F. Film thickness per coat specified in Section 2.3 are minimum required. If roller application is deemed necessary, the Contractor shall apply additional coats to achieve the specified thickness.
- G. All material shall be applied as specified.
- H. All welds and irregular surfaces shall receive a stripe coat by brushing and scrubbing into the weld seam of the specific product prior to application of the first complete coat.
- I. All bolted connections on rake arms, rotary drums, and filter connections are to be fully coated with a flexible polysulfide coating after the coating system has been installed per Paragraph 2.3.

3.4 COATING SYSTEM APPLICATION:

- A. After completion of surface preparation as specified for the specific system, materials shall be applied as noted in Section 2.3.

3.5 COLOR SCHEME:

- A. The Engineer shall select colors for the project. The Contractor shall submit a current chart of the Manufacturer's available colors to the Engineer thirty days prior to the start of coating and painting.

- B. The identification of influent, effluent, waste backwash, and chemical feed lines shall be accomplished by use of labels or various colors of paint. Where labels are used, they shall be placed along the pipe at no greater than five foot intervals. Where colors are used they shall follow the color code prescribed below. Color coding must be by solid color or banding. If bands are used, they shall be placed along the pipe at no greater than five foot intervals. The color code is as follows:

<u>LABELS</u>	<u>COLOR OF PIPE</u>
Potable Water	Light Blue
Compressed Air	Light Green
Instrument Air	Light Green with Dark Green Bands
Chlorine (gas, liquid, or vent)	Yellow
Chlorine (solution)	Yellow with Red Bands
Ammonia	Yellow with Brown Bands
Liquid caustic	White with Red Bands
Caustic (solution)	White with Orange Bands
Filter Effluent	Light Blue
Backwash Supply	Light Blue
Backwash Waste	Dark Grey
Drain	Dark Gray
Raw Water	Tan

3.6 DISINFECTION:

- A. Disinfection may be required for interior surfaces of tanks or systems containing potable water. Coordinate painting with disinfection requirements per Section 330110 – Water System Disinfection.

3.7 VAPOR REMOVAL:

- A. All solvent vapors shall be completely removed by suction-type exhaust fans and blowers before placing tank or system in operating service.

3.8 CLEAN UP:

- A. Upon completion of the work, all staging, scaffolding and containers, waste blast abrasive, or other painting debris shall be removed from the site. Coating or paint spots or oil stains upon adjacent surfaces shall be removed and the jobsite cleaned. All damage to surfaces resulting from the work of this section shall be cleaned, repaired, or refinished to the satisfaction of the Engineer at no cost to the Owner.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 SCOPE OF WORK:

- A. Provide the labor, materials, equipment and test equipment necessary to furnish, install, and place into operation the power, motor, lighting, control, alarm, and associated electrical systems of this Contract. Connect motors, meters, panels, sensors, switches, and outlets or any other electrical device installed or provided as part of the project. Mark and identify circuits, terminal boards, equipment, enclosures, etc. with identification numbers, wire numbers, nameplates, and warning signs. Test, adjust and calibrate equipment and start-up all electrical equipment and its associated mechanical attachments as necessary to place the project into operation.
- B. Provide and install all control equipment and wiring to instruments and devices installed by others.
- C. Where the work of several crafts is involved, coordinate all related work to provide each system in complete and in proper operating order.
- D. Cooperate with all others involved in the project, with due regard to their work, to promote rapid completion.
- E. Local Conditions: The Contractor shall thoroughly familiarize himself with the work as well as the local conditions under which the work is to be performed. Schedule work with regard to seasons, weather, climate conditions, and all other local conditions which may affect the progress and quality of work.
- F. See Divisions 1 and 2 of which contain information and requirements that apply to work specified herein.
- G. The Contractor shall provide electrical service to, connection and/or interconnection of various units of equipment supplied by others. The Contractor shall not be required to set in place or align motors or calibrate devices supplied as an integral part of equipment provided by others.

1.2 RELATED REQUIREMENTS:

- A. This section applies to all Division 26 work.
- B. See Divisions 1 and 26 which contain information and requirements that apply to work specified herein.

1.3 ELECTRICAL SUPPLY:

- A. Electrical power for this project is provided by Texas New Mexico Power. Local contact is Mr. Greg Underwood, 254-675-3908, Ext 6112.

1.4 CODES AND STANDARDS:

- A. Codes: Perform all work in strict accordance with all applicable national, state, and local codes; including, but not limited to the latest legally enacted editions of the following specifically noted requirements:
 - 1. The 2020 National Electrical Code (NFPA 70).
 - 2. Local Amendments to the 2020 National Electrical Code.
 - 3. The Life Safety Code (NFPA 101).
 - 4. ANSI-C2, National Electrical Safety Code – NESC.
 - 5. Americans With Disabilities Act (Public Law 101-336).
 - 6. International Building Code – IBC.
 - 7. International Fire Code - IFC.

- B. Standards: Reference to the following standards infers that installation, equipment, and materials shall be within the limits for which it was designed, tested, and approved, in conformance with the current publications and standards of the following organizations:
 - 1. American National Standards Institute – ANSI.
 - 2. American Society for Testing and Materials – ASTM.
 - 3. American Society of Heating, Refrigerating and Air Conditioning Consultants - ASHRAE (Standard 90-75).
 - 4. Factory Mutual – FM.
 - 5. Institute of Electrical and Electronics Consultants – IEEE.
 - 6. National Electrical Contractors Association – NECA.
 - 7. National Electrical Manufacturers' Association – NEMA.
 - 8. National Fire Protection Association – NFPA.
 - 9. Underwriters Laboratory – UL.

1.5 SPECIFIC TERMINOLOGY:

- A. Streamlining: In many instances, the products, reference standards, and other itemized specifications have been listed without verbiage. In these cases, it is implied that the Contractor shall provide the products and perform in accordance with the references listed.

- B. The word "Contractor" as used in Division 26 specifications shall mean "Electrical Contractor."

- C. The word "General Contractor" as used in Division 26 specifications shall mean the Contractor responsible for the project.

- D. "Furnish" means to purchase material as indicated and specified, and cart the material to an approved location at the site or elsewhere as noted or agreed to be installed by supporting crafts.

- E. "Install" means to set in place and connect, ready for use and in complete and properly operating finished condition, material that has been furnished.

- F. "Provide" means furnish all products, labor, sub-contracts, and appurtenances required and install to a complete and properly operating, finished condition.
- G. "Rough-in and Connect" means provide an appropriate system connection such as conduit with "J" boxes, wiring, switches, disconnects, etc., and all wiring connections. Equipment furnished is received, uncrated, assembled and set in place under the Division in which it is specified.
- H. "Accessible" means arranged so that an appropriately dressed man 6-foot 2 inches tall, weighing 250 pounds, may approach the area in question with the tools and products necessary for the work intended, and may then position himself to properly perform the task to be accomplished, without disassembly or damage to the surrounding installation.
- I. "Serviceable" means arranged so that the component or product in question may be properly removed and replaced without disassembly, destruction, or damage to the surrounding installation.
- J. "Product" is a generic term which includes materials, equipment, fixtures, and any physical item used on the project.

1.6 DRAWINGS, SPECIFICATIONS & SYMBOLS:

- A. Electrical Drawings are partly diagrammatic and it is not the intent to show in detail all features of the work or exact physical arrangement of equipment. The location of outlets and equipment are approximate unless dimensioned. The exact locations and routing of conduits shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance, however, provide all systems complete and in proper operating order.
- B. Drawing symbols used for basic materials, equipment and methods are commonly used by the industry and should be universally understood. Special items are identified by a supplementary list of graphical illustrations, or called for on the Drawings or in the specifications.
- C. The drawings and specifications are complementary. What is indicated on one is binding whether indicated or specified in the other or not. Failure to check both the drawings and the specifications will not be grounds for a change order if additional equipment or material is required to be provided by the Contractor after the Engineer reviews, or deficiencies are identified during testing, either in the Factory or the field.

1.7 SUBMITTALS, MANUALS AND SHOP DRAWINGS:

- A. Furnish submittals in the manner described herein, and in the Invitation for Bid and Contract documents.
- B. Provide submittals for all products and systems described in Division 26 Specifications and indicated on the Drawings to demonstrate compliance

with the requirements of the project.

1. Under this Section provide submittals for all equipment, devices, conductors, and instrumentation as indicated on the schedules on the Drawings.
 2. Under the Sections that follow provide submittals for all materials and equipment specified under that Section.
- C. Include data for review, and organize data, as noted below.
1. Specific reference and/or drawings reference for which literature is submitted for review with an index, following specification format, and item by item identification.
 2. Manufacturer's name and address, and supplier's name, address, and phone number.
 3. Catalog designation or model number with rough-in data and dimensions.
 4. Operation characteristics.
 5. Complete customized listing of characteristics required. Indicate whether item is "As Specified" or "Proposed Substitution." Indicate any deviations on submittal. Mark out all non- applicable items. The terminology "As Specified" used without this customized listing is not acceptable.
 6. Wiring diagrams for the specific system.
 7. Coordination data to check protective devices.
 8. Working construction Drawings (Shop Drawings).
- D. Submittal review is for general design and arrangement only and does not relieve the Contractor from any of the requirements of the Contract Documents. Submittals will not be checked for quantity, dimension, fit or proper technical design of manufactured equipment. Where deviations of substitute product or system performance have not been specifically noted in the submittal by the Contractor, provision of a complete and satisfactory working installation of equal quality to system specified is the sole responsibility of the Contractor.

1.8 QUALITY ASSURANCE:

- A. All work shall be furnished, installed, and connected in accordance with the National Electrical Code, these specifications, and the drawings.
- B. All materials used in this work shall be new, except where otherwise indicated or noted, and shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriter's Laboratories,

Inc. standards where test standards have been established. Materials and equipment which are not covered by UL standards shall be accepted, providing that the materials and equipment are listed, labeled, and certified or otherwise determined to meet the safety requirements of a NRTL.

- C. All equipment of the same type and capacity shall be by the same manufacturer.
- D. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as indicated on the drawings.
- E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity. Normal maintenance shall not require the removal of protective guards from adjacent equipment. Install equipment as close as practical to the locations indicated on the Drawings.
- F. Installation shall be supervised by an electrician licensed as a "Master Electrician."
- G. Field work shall be under the continuous supervision of a licensed "Journeyman or Master Electrician."
- H. The Contractor shall have a full time Master Electrician on staff.
- I. Licensing as a "Master" or "Journeyman" electrician shall mean to hold a current certification or license to that effect issued by the State of Texas. Additionally, if the local authority having jurisdiction requires a local license, the Contractor shall maintain licensed electricians that meet the requirements of the local authority. Submit copies of current licenses or certificates for persons employed on the work. Notify Engineer and remove from the work (within 10 days) any persons for whom a license or certificate is suspended, revoked, or is otherwise rendered void by the issuing agency.
- J. Contractor's Project Manager or his Assistant shall be familiar with types of electrical construction required by this project in order to determine that all subcontractor and vendor's work is in conformance with the plans and specifications.
- K. Contractor shall have an established safety-training program in effect for the duration of this project and will be required to submit proof of safety training for all employees working on this project.

1.9 EQUIPMENT ACCESSIBILITY:

- A. All equipment requiring access for monitoring, controlling other equipment, or servicing shall be accessible. Motor starters and other control equipment shall be installed at a height that will allow an operator to view or control the

equipment without stooping or without requiring a platform, stool, or raised floor to view or control the equipment. Generally, motor starters, panels, and similar equipment shall be installed with the top of the enclosure at approximately 5'-6" above floor level. Control stations, and other small enclosures that require normal access, shall be installed with the top of the enclosure at approximately 48-inches above floor level.

- B. Equipment that is not considered accessible by the Engineer or Owner shall be relocated by the Contractor, at the request of the Engineer or Owner, at no additional cost to the Owner.
- C. Provide working space in accordance with NEC 110.26 to permit ready and safe operation and maintenance of equipment for all voltages specified or installed.

1.10 STORAGE OF MATERIALS AND EQUIPMENT:

Materials and equipment shall be stored so as to protect the materials and equipment during storage. Equipment and materials to be located outdoors may be stored outdoors if protected against moisture condensation. Equipment shall be stored at least 6 inches above ground. Equipment and materials to be located indoors shall be stored indoors. Instrumentation shall be stored indoors.

1.11 CODES AND INSPECTIONS:

- A. Electrical work shall be installed in accordance with the latest edition of the National Electric Code and local and state codes in legal force in the project area.
 - 1. If the Contractor observes that the Drawings and/or Specifications are at variance with such codes and regulations, he shall promptly notify Owner/Engineer in writing.
 - 2. Should the Contractor perform any work in non-compliance with the above-mentioned codes and regulations without such notice to Owner/Engineer, the Contractor shall bear all costs arising therefrom.
- B. The codes referenced herein are provided to establish minimum requirements and wherever this specification requires higher grades of material or workmanship than required by the codes, this specification shall prevail.
- C. The Contractor shall pay all costs and fees required by inspecting and other agencies required for his work.

1.12 COORDINATION:

- A. If conduit is placed incorrectly with respect to equipment connections or if equipment connections are relocated without appropriate changes in the electrical work, and the resulting work is not coordinated, the work affected shall be removed and re-installed at the Contractor's expense, even if removal and replacement of structural and/or mechanical parts of the work are necessary.

- B. The Contractor shall schedule his work to coordinate through the General Contractor and with all other subcontractors, power and telephone utilities in order to maintain job progress and to avoid conflicts with equipment installation or work done by the various trades.
- C. The Contractor is responsible for maintaining required clearance. Should the Contractor become aware of a clearance violation or if the installation of electrical equipment as indicated produces a clearance violation, notify the Engineer in writing before proceeding with the installation.

1.13 LOCATIONS:

- A. If hazardous location boundaries exist, they will be shown on the drawings. Locations for seal-off fittings shall be field determined by the Contractor.
- B. Wet Locations: Wet locations shall include all areas underground (below grade), in direct contact with the earth, areas subject to saturation with water or other liquids from splashing, surface water, exposed to the weather and unprotected.

1.14 RECORD DRAWINGS:

- A. Invitation for Bid and Contract documents – Project Record Documents.
- B. Reference requirements stated elsewhere in these specifications.
- C. In addition to other requirements, mark up a clean set of Drawings as the work progresses, to show the dimensioned location and routing of all electrical work which will become permanently concealed. Show routing or work in permanently concealed blind spaces within the facility. Show complete routing and sizing of any significant revisions to the systems shown.
- D. Maintain Record drawings in an up-to-date fashion in conjunction with the actual progress of installation. "Record" progress mark-ups shall be available on-site for examination by the Owner/Engineer at all times.
- E. Prepare wiring diagrams on reproducible media using AutoCAD V.2012 or later for all individual special systems as installed. Identify all components and show all wire and terminal numbers and connections.
- F. Prior to substantial completion, deliver these drawings and their electronic files in both .dwg and full size .pdf format to the Owner/Engineer and obtain a written receipt.

1.15 OPERATING INSTRUCTIONS:

Prior to final acceptance, instruct Owner on the proper operation and maintenance of all electrical systems and equipment under this contract. Make available a qualified technician for each component of the installation for this instruction. Give these operating instructions after the operation and maintenance manuals have been furnished to Owner.

1.16 OPERATION AND MAINTENANCE MANUALS:

- A. Provide Operation and Maintenance Manuals in the manner described elsewhere in these specifications. In addition, organize manual and include data and narrative as noted below. Bind each manual in a hard-backed loose-leaf binder.
- B. Provide a separate chapter for each section of the electrical specifications with subchapters for each class of equipment or system. Provide a table of contents for each chapter, and each major item in each chapter, to indicate the page number of each. Label all pages to assure correct placement in manual. Identify each piece of equipment with its associated nameplate number, i.e. pump P-1A, etc.
- C. Operating Sequence Narrative:
 - 1. In each chapter, describe the procedures necessary for personnel to operate the system and equipment covered in that chapter.
 - 2. Describe procedures for start-up, operation, emergency operation and shutdown of each system. If a particular sequence is required, give step-by-step instructions in that order.
 - 3. Describe all seasonal adjustments which should be accomplished for each system.
 - 4. Provide the above descriptions in typewritten, simple outline, narrative form.
- D. Maintenance Instructions:
 - 1. Provide complete information for preventive maintenance for each product, including recommended frequency of performance for each preventive maintenance task.
 - 2. Provide all information of a maintenance nature covering warranty items, etc., which have not been discussed in the manufacturer's literature or the operating sequence narrative.
 - 3. Provide complete informational data for all the spare and replacement parts for each product and system. Properly identify each component by part number and manufacturer.
- E. Manufacturers' Brochures: Include manufacturers' descriptive literature covering all products used in each system, together with illustrations, exploded views and renewal parts lists. Highlight all applicable items and instructions, or mark-out non-applicable items. Brochure bearing submittal review stamp are not acceptable.
- F. Shop Drawings: Provide a copy of all corrected, approved shop drawings for the project either with the manufacturers' brochures or properly identified in a separate subsection.

1.17 INSTRUCTION OF OPERATING PERSONNEL:

- A. Provide services of qualified representative of supplier of each item or system listed below to instruct Owner in operation and maintenance of item or system.
- B. Make instruction when system is complete of number of hours indicated, and performed at time mutually agreeable.
 - 1. Electrical Distribution Equipment: 2 hours
 - 2. Alarm and Control Panels: 2 hours per panel
- C. Have approved operating and maintenance data, and parts lists for all equipment on hand at the time of instruction.

1.18 PROJECT COMPLETION AND DEMONSTRATION:

- A. Invitation for Bid and Contract documents - Closeout Requirements.
- B. Tests: During final inspection, conduct operating tests for approval.
- C. Demonstrate installation to operate satisfactorily in accordance with requirements of Contract Documents. Should a portion of installation fail to meet requirements of Contract Documents, repair or replace items failing to meet requirements until items can be demonstrated to comply.
- D. Have instruments available for measuring, voltage and current values and for demonstration of continuity, ground, or open circuit conditions. Furnish personnel to assist in taking measurements and making tests.
- E. In the event that systems are not complete and fully operational at the time of Final Inspection, all costs of any subsequent inspections shall be borne by the Contractor at no additional cost to the Owner.

1.19 CERTIFICATE OF COMPLETION:

- A. Submit, at time of request for Final Inspection, a completed letter in the following format:

I, _____ (Name), of _____ (Firm), certify that the Electrical Work is complete in accordance with Contract Drawings and Specifications, and authorized change orders (copies of which are attached hereto), and will be ready for Final Inspection as of _____ (Date). I further certify that the following Specification requirements have been fulfilled:

- 1. Megger readings performed, ___ copies of log attached.
- 2. Operating manuals completed and instructions of operating personnel performed _____ (Date).

Owner

- 3. Record drawings up-to-date and ready to deliver to Owner.

4. Emergency systems tested and fully operational.
5. All other tests required by Specifications have been performed.
6. All systems are fully operational. Project is ready for Final Inspection.

SIGNED: _____

DATE: _____

TITLE: _____

PART 2 MATERIALS

2.1 COATING SYSTEM:

A. GENERAL:

Where specified, electrical equipment in Division 26 shall be painted by the manufacturer as specified below.

1. FINISH:

Unless otherwise required to be stainless steel, equipment shall be treated with zinc phosphate, bonderized or otherwise given a rust-preventative treatment. Equipment shall be primed, painted with enamel and baked. Minimum dry film thickness shall be 3 mils.

2. COLOR:

Exterior color shall be ANSI 61, gray. Interior shall be painted white. Nonmetallic electrical enclosures and equipment shall be the manufacturer's standard gray or beige color.

2.2 TERMINAL BLOCKS:

Unless otherwise specified, terminal blocks shall be screw terminal, heavy duty, rated at 600V AC. Minimum capacity for control service is 5 amps. Terminals shall be provided with integral marking strips which shall be permanently identified as shown on the shop drawings or required for installation.

2.3 MISCELLANEOUS METAL:

A. Miscellaneous metal installed in conjunction with electrical or instrumentation work shall be hot-dipped galvanized or stainless steel as specified or indicated on the drawings. Painted steel is not acceptable.

B. Materials included in this specification group includes, but is not limited to bars, rods, sheet, plate, channel, or other metal shapes used to, or incorporated in support frames, brackets, mounting plates, etc. Unless otherwise specified, steel parts shall be hot-dipped galvanized after fabrication. Pre-galvanized material used for fabrication shall have all nicks, dings, or other imperfections in the coating repaired. No welding is allowed on pre-galvanized materials. If fabrications require welding after galvanizing, the part or parts shall be regalvanized after welding.

- C. Materials used in wet, damp, or corrosive locations shall be stainless steel.
- D. Bolts, nuts, screws, washers, or similar ancillary materials used shall be 316 stainless steel for exterior areas. Carbon steel with galvanized or cadmium-plated finish may be used in dry, indoor areas.
- E. All anchor bolts that are installed in floors shall be 316 stainless steel.

PART 3 EXECUTION

3.1 GENERAL:

- A. Any discrepancy between the Contract Documents and the existing conditions or any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, the Electrical Contractor shall report to the Engineer in accordance with the Standard Conditions of the Contract.
- B. Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, the Electrical Subcontractor shall request shop drawings, equipment location drawings, foundation drawings, and any other data required by him to locate the concealed conduit before the floor slab is poured. Additional penetrations/openings not indicated on the drawings shall not be made without preapproval by the Engineer.
- C. Materials, equipment, or labor not indicated, but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.
- D. The right by the Owner and Engineer is reserved to make reasonable changes in locations of equipment indicated on drawings prior to rough-in without increase in contract cost.
- E. The Contractor shall not reduce the size or number of conduit runs indicated on the drawings without the written approval of the Engineer.
- F. Locate pull boxes, panelboards, control pushbuttons, terminal cabinets, safety switches, and such other apparatus that may require periodic maintenance, operation, or inspection, so that they are easily accessible. If such items are indicated on the plans in locations which are found to be inaccessible, the Engineer shall be advised of the situation before work is advanced to the point where extra costs will be involved.
- G. All additional circuit connections to panelboards shall be preapproved by the Engineer.
- H. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.

- I. The location of equipment fixture outlets, and similar devices indicated on the Drawings are approximate only. Do not scale drawings. Obtain layout dimensions for equipment from other discipline plans unless indicated on electrical plans.
- J. Review all drawings for door swings, cabinets, counters, and built-in equipment.

3.2 EQUIPMENT SEALING:

- A. All equipment shall be sealed to prevent entrance of wasps and other insects. All mounting holes or other openings remaining after installation of the equipment, such as disconnect switches, terminal boxes, panels, etc. shall have the holes permanently closed. Small holes may be closed using a clear 100% silicone caulk. Larger holes, such as mounting holes shall be permanently sealed using plates or bolts. Materials such as tape shall not be used.

3.3 MISCELLANEOUS SUPPORT MATERIAL:

- A. Install no plastic tywraps or other nonmetallic supports outside. All exterior straps installed shall be stainless steel.

3.4 PHASE CONNECTIONS:

Phase connections for equipment shall be A, B, C, counting from front to back, top to bottom, and left to right as viewed from the operating mechanism side. Conductors shall be color coded as specified.

3.5 TESTING:

A. GENERAL:

Prior to energizing the electrical circuits, the following tests shall be performed. Unless otherwise specified, a 1000 volt megohmmeter shall be used for resistance measurements. Record and submit test results using form at the back of this Section.

B. INSULATION RESISTANCE MEASUREMENTS:

Test all energized electrical components including conductors for circuits 120V volts and higher. Conductors and devices with less than 50 megohms resistance to ground or between conductors or phases shall be removed and replaced. All conductors in a raceway shall be removed if a conductor in that raceway fails the insulation resistance test. The conductors shall not be reused.

C. MOTOR TESTS:

All motors shall have their insulation resistance measured before they are connected. Insulation resistance values less than 10 megohms are not acceptable. Verify that motors are connected to rotate in the correct

direction. Verification may be accomplished by momentarily energizing the motor, provided the Contractor confirms that neither the motor nor the driven equipment will be damaged by reverse operation. Measure the full load current on each phase with the motor running at maximum operating load.

D. FUNCTIONAL CHECKOUT:

Protective devices shall be adjusted and operative during the testing period. Prior to start-up of each piece of equipment or system, perform a functional checkout on control circuits. The checkout shall consist of energizing each control circuit and operating each control, alarm, or malfunction device, and each interlock in turn to verify that the specified action occurs. This may be performed with the motor connected or disconnected, providing that no harm will be done to the equipment.

3.6 DEMONSTRATION:

- A. Test the electrical system to specification requirements and to demonstrate correct installation and operation of equipment.
- B. Before 7-days test, demonstrate the system to the Engineer. Show the system to be fully operational. All alarms, safety's, and communication points to central and locally must operate in both full-automatic and back-up modes.
- C. Operate the system continuously for a period of 7 days in full automatic, without failure, to qualify as acceptable. "Failure" is considered any problem that requires correction by maintenance personnel, such as: high or low water level, any motor alarm, power failure, phase failure, communication failure, PLC failure, or UPS failure. This would exclude conditions not under the control of Contractor, such as: evident lightning strikes, 25-year rains, purchased power failure longer than the specified duration of service from UPS. Failures due to uncontrollable situations would allow the 7-day test to continue, as soon as test conditions are restored and the Engineer is notified.

3.7 AS-BUILT DRAWINGS:

At the end of the project, provide one set of "red-lined" as-built drawings to the Engineer. As-built drawings shall show all addenda, change orders, or other modifications made by the contractor or directed by the Engineer/Owner. Drawings shall be complete and shall be accurate. Manholes and other in-ground structures shall be dimensioned from a known structure. Modifications to control schematics shall be marked on the drawings. Final payment will not be made until as-built drawings are accepted by the Engineer.

END OF SECTION

MOTOR, CIRCUIT, AND DEVICE
ELECTRICAL TEST RESULTS

PROJECT _____

OWNER _____

DATE _____

CIRCUIT OR
EQUIPMENT ID _____

1 PHASE 3 PHASE 120 VOLT 208 VOLT 480 VOLT _____ VOLT

MEASURED VOLTAGES: MEASURED CURRENT:

PH. A--GND _____ A-B _____ PH. A _____ AMPS

PH. B--GND _____ B-C _____ PH. B _____ AMPS

PH. C--GND _____ A-B _____ PH. C _____ AMPS

MEASURED INSULATION RESISTANCE, MEG OHMS, PHASE TO GROUND @ 1,000 VOLTS:

PH. A _____ PH.B _____ PH.C _____

MOTOR NAMEPLATE DATA:

VOLTS _____ pH _____ SF _____ FLA _____

THERMAL OVERLOAD DEVICE:

MFG: _____ CAT/PART NO. _____ AMPS _____ SETTING _____

OPERATING CONDITIONS:

COMMENTS:

CONTRACTOR'S SIGNATURE

INSPECTOR'S SIGNATURE

END OF SECTION

SECTION 26 05 02

BASIC ELECTRICAL MATERIALS and METHODS

PART 1 GENERAL

1.1 SCOPE OF WORK:

- A. This Section describes specific requirements, products, and methods of execution which are typical throughout the Electrical Work of this Project. Additional requirements for the specific systems will be found in the Division specifying those systems.

1.2 RELATED REQUIREMENTS:

- A. Section 26 05 00 Common Work Results for Electrical.
- B. All other Invitation for Bid and Contract documents and 26 Specifications.

1.3 COORDINATION:

- A. Layout all the work in advance and avoid conflict with other Work in progress. Physical dimensions shall be coordinated with Architectural, Civil, Mechanical, and Structural Drawings. Verify locations for junction boxes, disconnect switches, stub-ups, etc., for connection to equipment furnished by others, or in other Divisions of this Work.

1.4 SERVICEABILITY OF PRODUCTS:

- A. Furnish all products to provide the proper orientation of serviceable components to access space provided.
- B. Coordinate installation of all products to allow proper service areas for any items requiring periodic maintenance inspection or replacement.
- C. Replace or relocate all products incorrectly ordered or installed.

1.5 ACCESSIBILITY OF PRODUCTS:

- A. Arrange all work to provide access to all serviceable and/or operable products. Layout work to optimize net usable access space within confines of space available. Advise OWNER, in a timely manner, of areas where proper access or required clearspace cannot be maintained. Furnish Layout Drawings to verify this claim, if requested.

PART 2 PRODUCTS

2.1 PRODUCTS FURNISHED IN DIVISION 26:

- A. All products furnished and installed in permanent construction shall be new, full-weight, standard in every way, and in first class condition.

- B. Products shall be identical with apparatus or equipment which has been in successful operation for at least two years. All products of similar class or service shall be of one manufacturer.
- C. Capacities, sizes, and dimensions given are minimum unless otherwise indicated. All systems and products proposed for use on this project shall be subject to review for adequacy and compliance with Contract Documents.

2.2 PRODUCTS FURNISHED IN OTHER DIVISIONS:

- A. Controls, including conduit, wiring, and control devices required for the operation of systems furnished in other Divisions shall be installed in accordance with Division 26 Specifications.
- B. Provide complete power connections to equipment including but not limited to feeders, connections, disconnects and motor running overcurrent protection. Where starters are provided as part of a packaged product, overcurrent heaters shall be provided.

PART 3 EXECUTION

3.1 STORAGE AND HANDLING:

- A. All items shall be delivered and stored in original containers, which shall indicate manufacturer's name, the brand, and the identifying number.
- B. Items subject to moisture and/or thermal damage shall be stored in a dry, heated place.
- C. All items shall be covered and protected against dirt, water, chemical and/or mechanical damage.

3.2 PROTECTION OF PRODUCTS:

- A. The Contractor shall be held responsible for products to be installed under this Contract.
- B. The Contractor will be required to make good, at his own cost, any injury or damage which said products may sustain before Final Acceptance.

3.3 INSTALLATION:

- A. All products shall be installed by skilled craftsmen. The norms for execution of the work shall be in conformity with NEC Chapter 3 and the NECA "Standards of Installation," which herewith is made part of these Specifications.
- B. Repair all surfaces and furnish all required products and labor to maintain fire-proof, air-tight and water-proof characteristics of the construction.
- C. Installation of all equipment shall be in accordance with manufacturer's instructions.

3.4 SUPPORT SYSTEMS:

- A. All interior materials used shall be galvanized or zinc plated, unless otherwise specified or indicated.
- B. All exterior materials used shall be stainless steel.
- C. Support from structure only.

3.5 MOUNTING HEIGHTS:

- A. Mounting heights shall be above finished floor (AFF) or above finished grade as noted below, unless otherwise shown or indicated.
 - 1. Lighting Switches, 48 inches to center
 - 2. Receptacles shall be mounted as indicated on the Drawings.
- B. Other mounting heights are indicated on the Drawings by detail.

3.6 CUTTING AND PATCHING:

- A. Obtain written permission from OWNER before cutting or piercing structural members.
- B. Sleeves through floors and walls to be galvanized iron pipe, flush with walls, ceilings or finished floors, sized to accommodate the raceway. Interstitial space around conduit passing through sleeves shall be filled with non-hardening duct sealant.

3.7 PROTECTIVE FINISHES:

- A. Take care not to scratch or deface factory finish on electrical apparatus and devices. Repaint all marred or scratched surfaces.
- B. Provide hot dip galvanized components for ferrous materials exposed to the weather.

3.8 CLEAN-UP AND COMMISSIONING:

- A. Throughout the Work, the Contractor shall keep the work area reasonably neat and orderly by periodic clean-ups.
- B. As independent parts of the installation are completed, they may be commissioned and utilized during construction.

3.9 WARRANTY:

- A. Invitation for Bid and Contract documents - Closeout Requirements: Warranties.
- B. Unless otherwise specified, the Warranty starts on the date Written Notice is given that the project is complete and all required corrections have been made. Warranty shall certify that all defects in products or workmanship

shall be promptly repaired or replaced by the Contractor, to the satisfaction of OWNER, for a period of one year, except when, in the opinion of OWNER such failure is due to neglect or carelessness by OWNER.

3.10 OPERATIONAL INSTRUCTIONS:

The Contractor shall instruct Owner in the operation of the products shown and/or specified.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SCOPE OF WORK:

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 volts and less.
 - 2. Connectors, splices, and terminations rated 600 volts and less.

1.2 RELATED REQUIREMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 26 05 00 Common Work Results for Electrical.
- C. Section 26 05 02 Basic Materials and Methods.
- D. Section 26 05 53 Identification of Electrical Systems.

1.3 QUALITY ASSURANCE:

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by UL and marked for intended use.
- B. Comply with ASTM.
- C. Comply with UL 44, 83, and 486.
- D. Comply with NFPA 70.

1.4 SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. Include data sheets for the following additional items:
 - 1. Splices and terminations.
 - 2. Pulling compounds.
 - 3. Cable accessories.
- C. Field quality-control test reports.

1.5 PROJECT CONDITIONS:

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities unless permitted by the Owner.

PART 2 PRODUCTS

2.1 CONDUCTORS AND CABLES:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Cable Corporation.
 - 2. Okonite Company.
 - 3. Southwire Company.
 - 4. Belden, Inc.
 - 5. Engineer approved equal.

- B. Copper Conductors: Comply with NEMA WC 70.: Soft drawn, tin-plated annealed copper, UL listed, rated at 600 volts, continuous without weld, splice or joint, uniform cross-section, free from flaws, scale and other imperfections. No. 8 and larger shall be stranded; No. 10 and smaller shall be solid.
 - 1. Aluminum conductors shall not be used under any circumstances.

- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN, THWN, THWN-2, XHHW-2 and SO.
 - 1. Voltage rating: 600 Volts for 480/277 Volts and 208/120 Volts.

2.2 COLOR CODING:

- A. Use standardized color-coding of conductors throughout. All color coding shall be continuous for the entire length of the conductors, and shall be permanent and readily distinguished after installation. In cases where they specified colors of insulated wire and cable are unavailable, such conductors shall be color-coded, as specified above, by means of Brady, or plastic tape at all pull boxes, support boxes, outlet boxes, panelboards, and other terminal and splicing points. Heat shrink sleeves for tight fit.

- B. For No. 6 AWG and smaller conductors, color coding shall be provided by using conductors with continuous color imbedded in the insulation. For all conductors larger than No. 6, Scotch 35 marking tape, or equivalent may be used to color code the cable. Where marking tape is used, the cable shall be identified at every accessible location. Provide a minimum of 2 inches of tape at each location.

- C. Neutral conductors shall be white. Grounding conductors shall be green or green with one or more yellow stripes.

- D. Phase conductors shall be black, orange, and blue for phases A, B, and C respectively in the 120/240 volt, 3-phase, 4-wire system. Identify the "high leg" with orange.

- E. Color coding for multi conductor control circuits shall conform to ICEA Method 1, Table E-2.

2.3 CONNECTORS AND SPLICES:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Burndy, Thomas & Betts.
 2. O-Z/Gedney; EGS Electrical Group LLC.
 3. 3M; Electrical Products Division.
 4. IIsco.
 5. Engineer approved equal.
- B. Stranded Copper Conductors: UL approved tin-plated, copper compression connectors, Thomas & Betts, Panduit, or Burndy. All connectors shall be of proper sizes to match conductor sizes. All compression connectors shall be applied with properly sized dies and tools. Split-bolt connectors or other mechanical connectors are not acceptable.
- C. Solid Copper Conductors: UL approved electrical spring connectors of "Scotchlock", Ideal, T&B, or approved equivalent. All connectors shall be of proper sizes to match conductor sizes. Split bolt connectors are not acceptable.
- D. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
1. Aboveground Circuits (No. 10 AWG and smaller):
 - a. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 90° C, with integral insulation, approved for copper conductors.
 - b. The integral insulator shall have a skirt to completely cover the stripped wires.
 - c. The number, size, and combination of conductors, as listed on the manufacturer's packaging, shall be strictly followed.
 - d. Use of "push-in" type splice connectors is not permitted.
 2. Aboveground Circuits (No. 8 AWG and larger):
 - a. Cable termination lugs shall be made of high conductivity and corrosion-resistant material, electro-tin plated, listed for use with copper conductors only, rated for 600 volt Lugs shall be color coded by size.
 - b. Cable termination lugs shall be indent type, long barrel with chamfered entry, 2 – hole, compression type for 250 MCM and above, 1 – hole for less than 250 MCM.

PART 3 EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS:

- A. Feeders: Soft annealed Copper stranded, class B compressed.
- B. Branch Circuits: Copper. Stranded for No. 12 AWG and larger.
- C. Minimum Wire Size: #12 AWG for power and lighting circuits, #14 AWG for control circuits. In the case of "homeruns" over 125 feet in length, no conductor smaller than a No. 10 AWG wire shall be used. The tap conductor from the J-box in the ceiling to the receptacle may be No. 12. Each 120-volt phase conductor shall have a neutral conductor of the same size. The sizing of all wire except remote control wire shall be accomplished in the case of both feeder and branch circuits by conforming to the following provisions. Only lighting circuits may share grounding conductors. All lighting circuits with shared grounding conductors shall be #10 AWG minimum.

3.2 CONDUCTOR\INSULATION AND WIRING METHODS:

- A. Service Entrance: Type XHHW, or type THHN/THWN up to and including 600 MCM, single conductors in conduit.
- B. Exposed Feeders: Type THHN/THWN for all sizes up to and including 600 MCM, single conductors in conduit.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type XHHW for #2 AWG and larger, or type THHN/THWN for all sizes up to and including 600 MCM, single conductors in conduit.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and underground: Type XHHW for #2 AWG and larger, single conductors in conduit.
- E. Exposed Branch Circuits: Type XHHW, single conductors in conduit.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and underground: Type XHHW single conductors in conduit.

3.3 INSTALLATION OF CONDUCTORS AND CABLES:

- A. Sizes: No wire shall be smaller than No. 12 except for control circuits.
- B. All conductors shall be continuous between points of termination.
- C. Splices in feeder circuits shall not be allowed unless specifically authorized by the Engineer.
- D. Splices in boxes permissible in 120-volt lighting and receptacle circuits only.
- E. Conductors may be run parallel from sizes 250 MCM up to and including 600 MCM provided all paralleled conductors are of the same size, manufacturer, length and type of insulation.

- F. Homeruns may not contain more than three circuits.
- G. Home runs on 120 volt, 20 ampere Lighting Branch lighting outlet exceeding 75 feet, use No. 10 conductors; otherwise use No. 12 conductors. Power and Lighting circuits of different system voltages (eg. 208Y/120 and 480Y/277 volts) shall not occupy the same conduit.
- H. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems" for secondary service, feeders and branch circuits.
- I. Except as required for sealing conduits in classified areas, after wire and cable have been installed and connected, conduit ends shall be sealed with a non-hardening sealing compound (Duxseal or equal), forced into conduits to a minimum depth equal to the conduit diameter. This shall apply for all conduits, including spares, entering any structures or electrical enclosures from underground, or from wet/corrosive areas. Seal conduit at both ends of the conduit.
- J. Wire and cable shall not be pulled tight against bushings nor pressed heavily against enclosures.
- K. Bundling Conductors: Bundle all conductors in panelboards, cabinets and the like using nylon straps made for the purpose. Bundle conductors larger than No. 10 in individual circuits. Bundle smaller conductors in larger groups. Straps shall be Panduit, Thomas and Betts, or equivalent.

3.4 CONNECTIONS:

- A. Tighten electrical connectors and terminals according to manufacturer's published torque- tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Do not splice control or instrument cables. Instrument or control cables shall only be terminated at devices or on terminal blocks. Conductors may be terminated without compression connector on terminal blocks with appropriate mechanical type terminals. Conductors terminated at terminal blocks with screw terminals shall be terminated with insulated, tin-plated copper locking fork terminals.
- D. For terminations at motors lower than 600 volts, Scotchfil shall be applied to round out the connection and the entire connection shall be wrapped with Scotch 88.
- E. Only receptacle and lighting circuits will be allowed to be spliced. Make joints and splices in solid copper conductors only where necessary and only at outlet boxes and pull boxes. All joints shall be mechanically and electrically secure.

- F. Ground the drain wire of shielded instrumentation cables at one (1) end only. Grounding location shall be at the load (e.g., control panel), not at the source (e.g., field mounted instrument).
- G. Cut conductor off square, trim insulation back the correct distance and prepare the conductor strands for termination as specified. Apply the proper lug or splice connector, making certain that the conductor strands are inserted full length of the barrel.
- H. Wiring at Outlets: Install conductor at each outlet or junction box with at least 6 inches of slack.

3.5 CABLE IDENTIFICATION:

- A. Identity Tags: Non-ferrous; stamped to clearly identify each circuit. Securely fasten tags to all cables, feeders and power circuits in pull boxes, lighting, power and distribution panelboards, motor control centers, control panels, etc.

3.6 WIRE PULLING:

- A. Provide suitable installation equipment for pulling conductors into raceways or conduits. Use ropes of polyethylene, nylon or other suitable material to pull in conductors. Attach pulling lines to conductors by means of woven basket grips or by pulling eyes attached directly to conductors. Grips and pulling eyes shall be Kellems or equivalent. All conductors to be installed in a single conduit shall be pulled in together. Pull no conductors into conduits until all work of a nature which may cause injury to conductors is completed. Use cable pulling compound where necessary.
- B. Cable Lubricants: All cable lubricants shall be UL listed, and shall be certified by their manufacturer to be non-injurious to the insulation on which they are used.
- C. "Yellow 77" or similar product is not an acceptable lubricant and shall not be used.

3.7 FIELD QUALITY CONTROL:

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.

2. Test results that comply with requirements.
 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace non-compliant cables or wires and retest as specified above.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SCOPE OF WORK:

- A. This section describes general requirements, products, and methods of execution relating to the furnishing and installation of a grounding system complete as required for this project.

1.2 RELATED REQUIREMENTS:

- A. Section 26 05 00 Common Work Results for Electrical.
- B. Section 26 05 02 Basic Materials and Methods.

1.3 QUALITY ASSURANCE:

- A. Provide products specified in the Section that are listed and labeled by a nationally recognized testing laboratory.
- B. Install products that comply with UL 467, "Grounding and Bonding Equipment."

1.4 MINIMUM REQUIREMENTS:

- A. The minimum requirement for the system shall conform to Article 250 of the NEC.
- B. Requirements that exceed the requirements of Article 250 of the NEC may be required.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING PRODUCTS:

- A. Install types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications shall govern.

2.2 GROUND CONNECTIONS:

- A. Exterior grounding conductor connections shall be made with exothermic welds.
- B. Grounding conductor connections to building structure shall be made with mechanical lugs or compression lugs as indicated. Drill and tap steel structure and equipment as required for positive bond.

2.3 GROUND CONDUCTORS:

- A. Equipment Grounding Conductor: Green insulated. Minimum size No. 12 AWG, unless otherwise indicated on the drawings.
- B. Ground Grid or Grounding Electrode Conductor: Class B, concentric stranded.
 - 1. Bare Copper conductors: Conform to the following:
 - a. Solid Conductors: ASTM B-3.
 - b. Stranded Conductors: ASTM B-8.
 - c. Tinned Conductors: ASTM B-33.
- C. Material: Copper. Aluminum material is not acceptable for use in any location, unless specifically specified.

2.4 CONNECTOR PRODUCTS:

- A. Listed and labeled as grounding connectors for the materials used.
- B. Connector Material: Copper or bronze.
- C. All exposed copper material shall be tin-plated.
- D. Pressure Connectors: High conductivity plated units.
- E. Bolted Clamps: Heavy duty units listed for the application.
- F. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sized, and combinations of conductors and other items to be connected.

2.5 GROUNDING ELECTRODES:

- A. Copper clad steel $\frac{3}{4}$ "X10' with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core.
- B. Wherever the ground rod crosses the ground grid it shall be connected.

2.6 MISCELLANEOUS CONDUCTORS:

- A. Ground Bus: Bare annealed copper bars of rectangular cross section.
- B. Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules.
- C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

PART 3 EXECUTION

3.1 SERVICE AND EQUIPMENT GROUNDING:

- A. Provide adequate and permanent service neutral and equipment grounding in accordance with the National Electrical Code, and subject to the following additional requirements.
- B. Connect the service ground and equipment ground to a common point within the metallic enclosure containing the main service disconnecting means. From the common point of connection of the service ground and equipment ground, run in conduit a combined service and equipment grounding conductor without joints or splices to the grounding grid as shown. Grounding grid shall be constructed of copperclad steel ground rods with buried grounding conductors as indicated on the drawings.
- C. Size grounding conductors in accordance with National Electrical Code Tables 250.66 and 250.122 or as indicated.
- D. The building structural steel frame shall be grounded to the building service grounding electrode, using the conductor size specified in National Electrical Code Section 250.66.
- E. Provide additional connections as may be required by the local authority. Contractor shall contact the local authority prior to bidding. Any additional connections that may be required by the local authority shall be provided by the Contractor at no increase in the bid price.

3.2 GROUNDING RACEWAYS:

- A. Assure the electrical continuity of all metallic raceways systems, pulling up all conduits and/or locknuts wrench tight. Where expansion joints or telescoping joints occur, provide bonding jumpers. Where flexible metallic conduit is employed, provide a green-insulated grounding jumper installed in the flexible conduit. Install a separate green-insulated conductor in each conduit.
- B. Provide grounding bushings on all service and feeder raceways terminating within switchboards, motor control centers, panel boards, cabinets, and all other enclosures. Provide grounding conductors from such bushings to the frame of the enclosure and to the ground bus or equipment grounding strap. Size grounding conductors in accordance with NEC Table 250.122.

3.3 EQUIPMENT GROUNDING CONDUCTORS:

- A. Provide a separate, green-insulated equipment copper grounding conductor, with insulation of the same rating as phase conductors, for each feeder and for each branch circuit indicated. Install the grounding conductor in the same raceway with the related phase and neutral conductors, and connect the grounding conductor to pull boxes or outlet boxes at intervals of 100 feet or less. Where paralleled conductors in separate raceways occur, provide a grounding conductor in each raceway. Connect all grounding conductors to bare grounding bars in panel boards, and to ground buses in

service equipment to the end that there will be an uninterrupted grounding circuit from the point of a ground fault back to the point of connection of the equipment ground and system neutral. Size all of these grounding conductors per NEC Table 250.122.

3.4 UNDERGROUND CONNECTIONS:

- A. All underground connections shall be made using exothermic weld connections.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SCOPE OF WORK:

- A. Support and align raceways, cabinets, boxes, fixtures, etc., in an approved manner and as specified.

1.2 RELATED REQUIREMENTS:

- A. Section 26 05 00 Common Work Results for Electrical.
- B. Section 26 05 02 Basic Materials and Methods.
- C. Section 26 05 33 Raceway and Boxes for Electrical Systems.

1.3 QUALITY ASSURANCE:

- A. Strut, brackets, fittings, straps, and accessories shall be standard types and sizes as manufactured by a nationally recognized manufacturer of this type of materials and be in conformity with applicable standards.

1.4 SUBMITTALS:

- A. Shop Drawings and Product Data: Submit shop drawings and product data for the products of this section in compliance with Section 26 05 00 Common Work Results for Electrical.

PART 2 PRODUCTS

2.1 MATERIALS:

- A. Support raceways on approved types of wall brackets, ceiling trapeze hangers, or straps.
 - 1. B-Line, or equal.
 - 2. Plumbers perforated strap not permitted as means of support.
 - 3. All anchor bolts shall be stainless steel.
- B. Individual Conduits: Support conduits running vertically or horizontally with approved supports. Carry individually supported horizontal conduits 1-1/4" and larger on B-Line hangers. Use no perforated strap iron as hanger material.
- C. Unless otherwise indicated on the drawings, support material installed outdoors or in wet or damp locations shall be stainless steel. Support material installed indoors in dry locations, may be hot dip galvanized.
- D. All supports that come in contact with the floor, or where water may stand or accumulate, whether indoors or outdoors, shall be stainless steel.

- E. Support Spacing: Use minimum spacing as directed by National Electrical Code, but space hangers more closely where required by conditions.
- F. All galvanized material cut during installation shall have the cut ends painted with a zinc rich paint.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. Conduits and equipment shall be mounted using strut or similar supports unless otherwise noted.
- B. Do not strap conduits to piping. When run in parallel with piping maintain adequate separation to allow maintenance to take place on either piping or conduit system so that the other does not have to be removed when maintenance is required.

END OF SECTION

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SCOPE OF WORK:

- A. This section describes specific requirements, products, and methods of execution relating to conduit and conduit fittings approved for use on this project. Type, size and installation methods shall be as shown on the Drawings, required by Code and specified in these specifications.

1.2 RELATED REQUIREMENTS:

- A. Section 26 05 00 Common Work Results for Electrical.
- B. Section 26 05 02 Basic Materials and Methods.
- C. Section 26 05 26 Grounding and Bonding for Electrical Systems.
- D. Section 26 05 29 Hangers And Supports For Electrical Systems.

1.3 QUALITY ASSURANCE:

- A. Conduit and conduit fittings shall be standard types and sizes as manufactured by a nationally recognized manufacturer of this type of materials and be in conformity with applicable standards and UL listings.

1.4 SUBMITTALS:

- A. Shop Drawings and Product Data: Submit shop drawings and product data for the products of this section in compliance with Section 26 05 00 Common Work Results for Electrical.

PART 2 PRODUCTS

2.1 GALVANIZED RIGID CONDUIT (GRC):

- A. Galvanized rigid conduit shall be mild steel with continuous welded seam, hot-dip galvanized complying with ANSI C80.1 and shall be UL listed.
- B. Elbows, bends, and fittings shall be made of full weight materials complying with the above and shall be coated and threaded the same as conduit.
- C. Factory made steel threaded condulets and couplings; gasketed, bushing at all boxes and cabinets, with locknuts inside and outside box or cabinet. Fittings shall be cast steel with threaded connections.
- D. Threads for conduit shall be tapered and clean cut. All threads shall be hot dip galvanized after cutting.

- E. Conduit shall be 1/2-inch trade size or larger and shall be manufactured by Allied Tube and Conduit Corp., Triangle PWC, Inc., or approved equal.

2.2 LIQUIDTIGHT FLEXIBLE METAL CONDUIT:

- A. Spirally wound with continuously interlocked hot dip galvanized steel core for flexible metal conduit; with polyvinyl chloride cover extruded over the exterior to make conduit liquidtight.
- B. Fittings shall be designed for use with liquidtight flexible conduit and shall maintain electrical continuity throughout fittings and conduit.
- C. Nylon insulated throat steel connectors at box or cabinet terminations.
- D. UL listed for grounding.

2.3 WIREWAY:

- A. Exterior Use: UL Listed, stainless steel, hinged cover, NEMA 4X. Wireway shall be positioned such that the cover opens downward.

2.4 JUNCTION BOXES AND ENCLOSURES:

- A. UL listed of sizes and types specified.
- B. For interior electrical junction boxes larger than 4" square provide NEMA 1 steel wall mount screw cover enclosures. Minimum 12-gauge steel with color ANSI 61 gray powder coated finish. Hoffman, B-Line or approved equal. Provide with plated or stainless-steel cover screws.
- C. Weatherproof gang boxes for exterior use and where specifically indicated shall be die cast zinc metal with powder coated finish and threaded hubs. Provide with matching weatherproof gasketed covers and mounting hardware.
- D. For exterior electrical junction boxes larger than 4" square, provide stainless steel, NEMA 4X, with hinged, lockable cover, and fast operating clamps.
- E. Cast Metal Boxes: Cast iron or cast alloy with threaded hubs; Crouse-Hinds, Appleton, or O.Z./Gedney.

PART 3 EXECUTION

3.1 CONDUIT USAGE:

- A. INTERIOR - All interior locations shall be galvanized rigid (GRC) except where specifically indicated as wireway or liquidtight flex.
- B. EXTERIOR - All exterior above grade locations shall be rigid aluminum conduit (RAC).
- C. BELOW GRADE - All below grade conduit shall be rigid PVC conduit or rigid aluminum conduit (RAC).

- D. Liquidtight flexible metal conduit shall be used in lengths 18 to 24 inches for connections to motors or equipment subject to vibration and where indicated on the Drawings.

3.2 CONDUIT INSTALLATION, GENERAL:

- A. Conduit field joints shall be cut square and reamed smooth. Threads shall be cleanly cut and joints drawn up tight. Running threads shall not be permitted.
- B. After cutting and threading GRC, threads shall be cleaned and degreased and shall receive two coats of cold galvanizing compound.
- C. Offsets and bends shall be made carefully, without reducing cross sectional area, and shall not be less than the radius of standard elbows.
- D. Raceways traversing from warm to cold areas shall be sealed (at the penetration point) with a non-hardening duct sealing compound to prevent the accumulation of moisture.
- E. All metal conduits shall have insulating bushings and shall have locknuts inside and outside of enclosure box, etc. Conduits smaller than 1-1/4-inch trade size shall be equipped with bushings and shall have locknuts inside and outside of enclosure.
- F. All conduit runs shall be grounded in an effective and approved manner at point of origin and shall maintain a continuous ground throughout all runs, cabinets, pull boxes, and fittings from point of service to all outlets.
- G. All conduit runs shall be completed and cleaned free from foreign matter inside before conductors are drawn in. After installation conduit ends shall be plugged or capped to prevent the entrance of foreign materials.
- H. All conduits not used by this Contract shall have a pull wire installed and securely tied off at each end for future conductor installation.

3.3 INSTALLATION OF RACEWAYS:

- A. All wiring of every description shall be run in conduit. All exposed runs shall be installed parallel and plumb to the surface of the building or structure in a neat and orderly manner.
- B. Conduits that are field cut and threaded shall have the end reamed and thoroughly de-burred prior to installation. All conduits shall be terminated in a hub or shall be provided with a threaded conduit bushing. Where indicated or required, the conduit bushing shall be grounding type.
- C. Sizes: Size and install raceways so that conductors may be drawn in without injury or excessive strain. Make field bends with approved bending devices. Do not install bends or offsets in which conduit is crushed, deformed or otherwise injured. Sizes of conduits shown on the drawings are minimum sizes to be installed. Size conduits per applicable electrical code.

- D. Connections: Use lengths of liquid tight flexible metal conduit, not less than 12" long at final connections to all motors, controls, and other devices subject to movement because of vibration or mechanical adjustment. Do not install liquidtight flexible metal conduit to other devices or between panelboards or enclosures unless specifically shown on the drawings or approved by the Engineer.
- E. Damp or Wet Locations: In damp or wet locations make every effort to avoid installing raceways in a manner which will create moisture traps. Where they must be so installed, seal both ends of raceways with an approved sealing compound to prevent "breathing" and moisture condensation within the raceways.
- F. Joining Rigid Conduits: Join with threaded couplings. Ream out all conduit ends after threading. Secure rigid conduits at panel boxes, junction boxes, pull boxes, switchboards, support boxes, or sheet metal outlet boxes by galvanized locknuts, inside and outside, with insulating bushing inside. Unthreaded set screw type couplings or connectors are not acceptable in rigid conduit systems. No running threads shall be used in conduit systems.
- G. Install blank knock out plugs in all unused openings in boxes, enclosures, or panels. All knock out plugs and other coverings shall match the material of the boxes, enclosures, or panels.
- H. Penetrations: Wherever raceways pass through floors, walls, partitions, etc., carefully fill all space between the outside of the raceway and the building material to prevent passage of air, water, smoke and fumes. Filling materials shall be fire resistive and in general, similar to the basic building materials through which the raceway passes.

3.4 SEALING CONDUITS:

- A. Damp or Wet Locations: In damp or wet locations make every effort to avoid installing raceways in a manner which will create moisture traps. Where they must be so installed, seal both ends of raceways with an approved sealing compound to prevent "breathing" and moisture condensation within the raceways.
- B. Protection of Raceways: Seal ends of all raceways with blank discs ("pennies"), push pennies or other approved closers during construction. Do not pull any conductors into raceways until all plastering and concrete finishing in the vicinity is completed. Swab out all raceways before pulling in conductors.

3.5 INSTALLATION OF PVC CONDUIT:

- A. Transition from below grade PVC to above grade rigid steel or PVC coated rigid steel shall be before conduit rises out of ground. On conduits larger than 2 inches, use rigid steel elbow. Tape wrap the portion of rigid aluminum conduit in the ground as specified in Section 26 05 43.
- B. PVC conduit shall not be installed above grade in outdoor areas unless specifically indicated on the drawings.

3.6 CONDUIT TAGGING:

- A. Unless the conduit purpose is obvious, all conduits shall be provided with a conduit tag at each end. The tag shall be stamped stainless steel or aluminum and shall be attached with stainless steel tie wire. Conduits that terminate at a box shall be identified inside the box.
- B. The conduit tag shall identify the opposite end of the conduit.

3.7 SPARE OR EMPTY CONDUITS:

- A. Provide in every spare or empty raceway, not containing conductors to be installed by this Contractor, a suitable pull line to facilitate future installation of wiring. Lines shall be free from splices and shall have ample exposed length at each end, or coiled in a box.
- B. All lines shall be nylon or polyethylene cord with a tensile strength not less than 200 pounds.
- C. All spare conduits, not terminated in an enclosure, shall be terminated using a conduit cap or plug.

3.8 INSTALLATION OF OUTLET BOXES:

- A. Usage: Provide at each outlet or device of whatever character a metal outlet box in which conduits shall terminate.
- B. Boxes for Exposed Work: Cast metal boxes.
- C. Boxes for Outdoors: Cast metal boxes with gasketed covers.

3.9 INSTALLATION OF PULL AND JUNCTION BOXES:

- A. Sizing: Size all pull and junction boxes in accordance with NEC, using larger sizes than required by code where job conditions so indicate.
- B. Mounting: Fasten all boxes securely to the building construction, independent of conduit systems. On concealed conduit systems where boxes are not otherwise accessible, set box covers flush with finished surfaces for access.
- C. Identification of Pull and Junction Boxes: Each pull and junction box shall be labeled with indelible ink to indicate the wiring contained inside the box. The label shall indicate the panel and circuit number of the wiring contained. The cover plates of boxes serving emergency circuits shall be painted red. Boxes servicing other systems shall be indicated by name.

END OF SECTION

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Underground electrical duct and direct burial conduit, together with all other accessories required.

1.2 Related requirements:

- A. Section 26 05 00 Common Work Results for Electrical.
- B. Section 26 05 02 Basic Materials and Methods.
- C. Section 26 05 26 Grounding and Bonding for Electrical Systems.
- D. Section 26 05 29 Hangers And Supports For Electrical Systems.

1.3 SUBMITTALS:

- A. Submit manufacturer's data on all materials, under provisions of the Invitation for Bid and Contract documents.

PART 2 GENERAL

2.1 UNDERGROUND DUCTS:

- A. Schedule 40, heavy wall, high impact rigid virgin polyvinyl chloride (PVC) conduit and fittings, conforming to NEMA Publications TC2 and TC3 and UL listed; Carlon or equivalent.

2.2 CONDUITS:

- A. Underground PVC Conduit: Schedule 40, heavy wall, high impact rigid virgin PRECAST polyvinyl chloride (PVC) conduit and fittings, conforming to NEMA Publications TC2 and TC3 and UL listed for direct burial use; Carlon or equivalent.
- B. Galvanized Rigid Conduit.

2.3 BURIED CABLE MARKING TAPE:

- A. Buried cable marking tape shall meet the following requirements:
 - 1. 5 mil thick.
 - 2. Six inches wide.
 - 3. Detectable Aluminum core.
 - 4. Permanently printed A.P.W.A uniform color coded.
 - 5. Red – "CAUTION BURIED ELECTRIC LINE BELOW."

PART 3 GENERAL

3.1 GENERAL:

- A. After the affected electrical work has been installed, tested, and approved, backfill all excavations with suitable material. Include the cutting of all sidewalks, streets, and other pavement and repairing the openings in them to return the surface to its original condition.

3.2 EXCAVATIONS:

- A. Perform all excavations of every description of whatever substances encountered and to the depths required for installation of the work under this Division.
- B. During excavation, stockpile material suitable for backfilling in an orderly manner a sufficient distance from the banks of the trenches to prevent slides or cave-ins. Remove all excavated material not required or suitable for backfill, or waste as directed. Control grading to prevent surface water from flowing into excavations and remove any accumulated water by pumping.
- C. Use open cut grading and make trenches of the necessary width for proper installation of the lines with banks as nearly vertical as possible.
- D. Grade the bottom of trenches accurately to provide uniform bearing and support for conduit or duct on undisturbed soil at every point along its entire length.
- E. Except at locations where excavation of rock from the bottoms of trenches is required, take care not to excavate below the depths required. Where rock excavation is required, remove the rock to a minimum overdepth of 4 inches below the trench depths specified. Backfill the overdepth rock excavation and excess trench excavation to the proper level with sand prior to the installation of conduit or ducts. Whenever wet or otherwise unstable soil that is incapable of properly supporting conduits or ducts is encountered in the trench bottom, remove such soil to a depth required and backfill the trench to trench bottom grade with sand or other suitable material.

3.3 BACKFILLING:

- A. Carefully backfill trenches with earth, sandy clay, sand and gravel, or other approved material free from large clods of earth or stone, deposited in thoroughly and carefully compacted 6-inch layers. Do not use blasted rock, broken concrete or pavement, or large boulders as backfill material. Settling the backfill with water will be permissible and will be required when so directed. Re-open any trenches improperly filled or where settlement occurs to the depth required for proper compaction the refill, mound over and smooth off.
- B. Backfill open trenches across roadways or other areas to be paved as specified above except that the entire depth of trench shall be backfilled in 6-inch layers, each layer moistened and compacted to a density of not less than 95 percent Standard Proctor in such manner as to permit the rolling and compaction of the filled trench together with the adjoining earth to provide the required bearing value and permit paving of the area immediately after backfilling is completed.

Along all other portions of the trenches, grade the ground to a reasonable uniformity and leave the mounding over the trenches in a uniform and neat condition.

- C. All trenches that settle shall be refilled by the contractor.

3.4 UNDERGROUND PVC CONDUIT INSTALLATION:

- A. Install at least 18 inches below finished grade unless indicated otherwise. Assemble and install raceways in accordance with manufacturer's instructions. Make joints with couplings and solvent cement. Fabricate bends of 30 degrees or more with factory-made elbows, or make field bends with proper heating equipment. Bends showing signs of overheating or flattening are unacceptable. Ream ends of all conduits before joining.
- B. "Snake" PVC conduit in trench, from side to side, with a complete cycle every 40 feet to allow for expansion and contraction. Maintain this configuration during backfilling.
- C. Where conduit turns up out of earth, or floor slabs, change from PVC to rigid galvanized steel conduit below grade and outside of such structures. Make similar change from PVC to rigid galvanized steel conduit at connections to underground pull or junction boxes. Wrap all steel conduits and fittings buried in earth as specified elsewhere herein.
- D. Do not extend any PVC conduit above grade.
- E. Install 6 inch wide detectable electrical warning tape above conduits.

3.5 UNDERGROUND RIGID ALUMINUM CONDUIT INSTALLATION:

- A. All rigid aluminum conduit exposed to earth shall be wrapped with 3M Company 0.020 inch thick No. 51 "Scotchrap" vinyl plastic tape, half lapped to give double thickness wrap. Remove all oil, grease and dirt from conduit with a suitable solvent, and clean and dry conduit before wrapping. If conduit is pre-wrapped in the shop and then cut and joined on the job, wrap all joints on the job, overlapping pipe wrapping 3" on both sides of joints.

3.6 EXISTING UNDERGROUND CONDUITS:

Existing underground conduits shall be removed in their entirety or abandoned in place, as indicated on the drawings or directed by the Engineer.

3.7 SPARE OR EMPTY CONDUITS:

- A. Provide in every spare or empty raceway, not containing conductors to be installed by this Contractor, a suitable pull line to facilitate future installation of wiring. Lines shall be free from splices and shall have ample exposed length at each end.
- B. All lines shall be nylon or polyethylene cord with a tensile strength not less than 200 pounds.

- C. Identify each end of each line with a stainless steel tag bearing complete information as to the purpose of the raceway and the location of its other end.
- D. All spare conduits, not terminated in an enclosure, shall be terminated using a conduit cap or plug.

END OF SECTION

SECTION 26 05 46

UTILITY POLES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SCOPE:

This specification describes the minimum acceptable quality of wood poles. Where there is conflict between this specification and any other specification referred to herein, this specification shall govern. The poles shall be constructed in accordance with these specifications.

1.2 STANDARDS:

All characteristics, definitions, and terminology, except as specifically covered in this specification, shall be in accordance with the latest revision of the following standards.

RUS Bulletin 1728F-700: Specification for Wood Poles, Stubs, and Anchor Logs.

ANSI 05.1: Wood Poles - Specifications and Dimensions.

AWPA-C4: Poles - Preservative Treatment by Pressure Processes, American Wood Preservers Association.

1.3 SUBMITTALS:

A. Shop Drawings and Product Data: Submit shop drawings and product data for the products of this section in compliance with Section 26 05 00 Common Work Results for Electrical.

PART 2 PRODUCTS

2.1 WOOD POLES:

A. Wood poles shall meet the requirements of ANSI 05.1 and shall be Douglas Fir drilled and gained in accordance with RUS W1.1G Pole Framing Guide. Wood poles shall have pole markings located 10 feet from pole butts. Other locations will not be acceptable. Poles shall be machine trimmed by turning smooth full length, and shall be roofed, gained, and bored prior to pressure treatment. No climbing rungs shall be provided.

B. Poles shall be full length pressure treated using a pressure injection method approved by the Western Wood Preserves Institute that prevents leaching. Pressure treatment shall be by the Pentachlorophenol process in accordance with AWPA C4. Other treatment processes will not be accepted.

C. Poles exhibiting any of the following defects will not be accepted; cross-breaks (horizontal cracks), catface (scars), compound through checks, decay, double sweep (poles having sweep in two planes), hollow butts or tops, improper framing, plugged holes (other than increment core holes), spike

knots or any knot with bark inclusion, and split top.

D. Checks:

1. Checks (vertical cracks) are permitted in the top of pole except for any check more than 1/8 inch wide and extending down from the top of the pole more than 12 inches and within 30 angular degrees from the axis of the face of pole directly above ground; and any through checks or splits.
2. Through checks or splits in the butt surface of the pole are not permitted.
3. A check is considered to be continuous if it is not separated by at least 1/2 inch of wood. The maximum allowable width and length of any single check are found in Table II "Maximum Allowable Check Dimensions".

TABLE II. MAXIMUM ALLOWABLE CHECK DIMENSIONS

LENGTH OF POLE	MAXIMUM WIDTH	MAXIMUM LENGTH
30 feet	¼ inch	5 inches
35 and 45 feet	5/16 inch	5 inches
50 feet and longer	3/8 inch	8 inches

E. Knots:

1. The diameter of any single knot or sum of the diameters of all knots in any one foot section shall not exceed the limits of Table III "Maximum Allowable Knot Dimensions". Knots 1/2 inch or less in diameter shall be ignored in applying the limitations for the sum of diameters.
2. The maximum single knot in any "sworl" shall be 2 inches in diameter. Maximum sum of knots in any "sworl" shall not exceed 20% of the pole circumference at the point of the sworl or more than allowed in Table III.

TABLE III. MAXIMUM ALLOWABLE KNOT DIMENSIONS

SUMMARY OF DIAMETERS		
DIAMETER OF KNOTS IN ANY		
POLE LENGTH	ANY SINGLE KNOT	1 FOOT SECTION
45 feet and shorter	2.5 inches	8 inches
50 feet and longer	3.0 inches	10.0 inches

PART 3 EXECUTION

3.1 SETTING POLES:

- A. Where identified on the Staking Sheets, poles shall be connected to the H-pile foundation as indicated on the drawings.

- B. All direct buried poles shall be set to RUS specifications plus one foot. The minimum depth for setting poles shall be as follows:

MINIMUM POLE SETTING DEPTH	
LENGTH OF POLE (FT)	SETTING IN SOIL (FT)
30	6.0
35	6.0
40	7.0
45	7.5

- C. On sloping ground, the depth of the hole shall be measured from the low side of the hole.
- D. Pole backfill shall be thoroughly tamped the full depth. Excess dirt shall be banked around the pole.

3.2 CERTIFICATION:

- A. Provide a certificate of compliance, signed by an authorized employee of the producer, that the material shipped meets the requirements of this specification and any supplementary requirements cited in a contract or order under which it was purchased.
- B. Provide independent inspection certification.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. This Section specifies furnishing and installing identification signs on all electrical devices.

PART 2 PRODUCTS

2.1 NAMEPLATES:

- A. Identify electrical equipment by attaching engraved nameplates constructed from laminated phenolic plastic, at least 1/16" thick, 2-ply, with black surfaces and white core. Engraving shall be condensed gothic, appropriately spaced. Nomenclature on the label shall include the name of the item or equipment served utilizing the equipment names shown on the drawings.

- B. Nameplate lettering size shall be as follows:

- 1. ½" Minimum Height Letters:

- Service Disconnects.

- a. Secondary feeder breakers in distribution equipment with designation as required by the load served.
 - b. Special equipment housed in cabinets, as indicated on the drawings, or outside of door.
 - c. Panelboards, switchboards, as designated on the drawings, on outside of door.

- 2. 1/4" Minimum Height Letters:

- a. Disconnects and starters for motors or fixed appliances.
 - b. Items listed in the "Equipment Schedule" on drawings.

PART 3 EXECUTION

3.1 EQUIPMENT:

- A. Install nameplates on electrical equipment. Equipment to be labeled shall include but not be limited to the following:

- 1. Panelboards.

3.2 CONTROL DEVICES:

- A. Install nameplates on all electrical control devices to indicate the device served. Label electrical control devices regardless of proximity to the equipment served. Electrical control devices to be labeled shall include but not be limited to the following.

- 1. Disconnect switches.

3.3 ATTACHMENT:

- A. Nameplates attached to the exterior of the enclosure shall be attached with self-tapping screws. Devices attached to the back side of panel fronts and on the interior of panels shall be attached with adhesive. Adhesive shall be waterproof and heat resisting up to 250 degrees Fahrenheit.

END OF SECTION

SECTION 26 21 00

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SCOPE OF WORK:

- A. This Section includes the following:
 - 1. Secondary overhead conductors.
 - 2. Connectors.

1.2 RELATED REQUIREMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 26 05 00 Common Work Results for Electrical.

1.3 QUALITY ASSURANCE:

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by UL and marked for intended use.
- B. Comply with ASTM.
- C. Comply with UL 44, 83, and 486.
- D. Comply with NFPA 70.

1.4 SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. Include data sheets for the following additional items:
 - 1. Splices and terminations.
 - 2. Cable accessories.
- C. Field quality-control test reports.

1.5 PROJECT CONDITIONS:

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities unless permitted by the Owner.

PART 2 PRODUCTS

2.1 CONDUCTORS AND CABLES:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. General Cable Corporation.
 2. Okonite Company.
 3. Southwire Company.
 4. Engineer approved equal.

2.2 SECONDARY OVERHEAD CONDUCTORS:

- A. All secondary conductors shall be overhead service drop, multiplex, aluminum, 600 volt, 75° C rating, polyethylene insulated conductors. For each assembly, provide insulated conductors as indicated and an ACSR concentrically stranded neutral messenger. Conductors shall conform to the following standards.

B-230: Aluminum Wire, 1350-H19 for Electrical Purposes.

B-231: Aluminum Conductors, Concentric-Lay-Stranded.

B-232 Aluminum conductors, Concentric-Lay-Stranded, Coated Steel Reinforced (ACSR).

B-399: Concentric-Lay-Stranded 6201-T81 Aluminum Alloy Conductors.

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- B. Each multiplex cable shall be provided in the sizes indicated in the Staking Sheets or on the drawings. Cables shall be provided based on the standard Code Word for the specific cable. Cables shall be provided as follows:

1. Duplex Conductors:

Cables utilized for lighting or other 120 volt service. Cable shall consist of one insulated conductor and one neutral.

2. Triplex Conductors:

Cables utilized for single phase service or other uses as indicated on the drawings. Cable shall consist of two insulated conductors and one neutral ACSR.

3. Quadruplex Conductors:

Primarily used for three-phase service. Shall be provided with three insulated conductors and one neutral ACSR. Conductors shall be marked for easy phase identification.

2.3 CONNECTIONS:

- A. Connectors for secondary to secondary connections shall be made using preinsulated compression connectors suitable for copper or aluminum, sized for the conductors provided.

PART 3 EXECUTION

3.1 DEADENDS:

- A. Secondary overhead conductors shall be deadended using Preformed Line Products service grip deadends, suitable for the conductor provided.

3.2 FIELD QUALITY CONTROL:

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace non-compliant cables or wires and retest as specified above.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Electrical panel boards for general use.

1.2 RELATED DOCUMENTS:

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

1.3 DEFINITIONS:

- A. SVR: Suppressed voltage rating.
- B. SPD: Surge Protective Device.

1.4 ACTION SUBMITTALS:

- A. Provide complete catalog data and drawings on all items of equipment, under provisions of the Invitation for Bid and Contract documents. Include all submittal data in the Operation and Maintenance Manuals.
- B. Submit shop drawings of each panel board for review before commencing fabrication; drawings shall indicate number, size, interrupting rating and type of circuit protective devices; dimensions, gauges and type of construction of cabinets; size and material of main bus and lugs; and any other pertinent information necessary to determine compliance with the drawings and specifications.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.

7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 INFORMATIONAL SUBMITTALS:

- A. Field Quality-Control Reports:
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS:

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in the Invitation for Bid and Contract documents, sections addressing Operations and Maintenance Manuals/Data, include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.
 3. Circuit directories with load descriptions prepared in electronic format. Submit to Electric Shop.

1.7 MAINTENANCE MATERIAL SUBMITTALS:

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Keys: Two spares for each type of panelboard cabinet lock. Keys shall be received and signed for by Owner.

1.8 COORDINATION:

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces.
- B. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 QUALITY ASSURANCE:

- A. All panel boards shall be listed by Underwriters' Laboratories, Inc., and the building main panel shall be listed as suitable for "Service Entrance Equipment."
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.
- G. Series rated equipment shall not be used.

1.10 WARRANTY:

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Beneficial Occupancy.

1.11 DELIVERY, STORAGE, AND HANDLING:

- A. Remove loose packing and flammable materials from inside panelboards.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Panel boards manufactured by Square D, Siemens, or Eaton.

2.2 PANEL BOARDS:

- A. Panel board Cabinets: Furnish and install cabinets to serve the various panel boards, of sizes as required to house the panel boards. Provide NEMA rated enclosure as indicated on the drawings.
- B. Service Equipment Approval: Listed for use as service equipment for panelboards having main service disconnects.

- C. Cabinet Construction: Rigidly constructed of sheet steel of gauges conforming to Underwriters' Laboratories, Inc., requirements; corners overlapped or welded; edges turned over to receive trim.
- D. Cabinet Fronts: Cut from single sheet of not less than No. 12 gauge cold rolled sheet steel; fastened in place by adjustable trim clamps which will allow plumbing; same size as the cabinet box if surface mounted; size to overlap the box a minimum of 3/4" on all sides if flush mounted.
- E. Each panel board shall be provided with a cover and a hinged door. Each door shall be provided with a substantial flush, cylinder tumbler lock and catch. Provide each lock with two keys, with all locks keyed alike.
- F. Bus Requirements:
 - 1. Bus Material: Copper or Aluminum.
 - 2. Panelboards with buses rated 600 ampere and above shall be provided with silver-plated hard-drawn copper.
 - 3. Main and Neutral Lugs: Mechanical.
 - 4. Neutral: Ampacity and material equal to bus. Panelboards shall be provided with insulated neutral bars with grounding screw for field grounding to enclosure.
 - 5. Equipment Ground Bus: Provide each panel board with a separate equipment grounding bus bar bonded to the panel board cabinet. Where indicated on the drawings, provide panel boards with an isolated grounding bus bar insulated from the panel board cabinet.
- G. Additional requirements for subfeed breakers, lugs, or other accessories as indicated on the drawings.
- H. Where a circuit protective device is scheduled as a "spare", provide the device complete for operation. Where such a device is scheduled as a "space" or "space only", provide proper space and all necessary connectors for future installation of the size of device scheduled. Where a breaker or switch is scheduled to serve a "future" load, provide the device complete for operation.
- I. Panel boards shall have the number and sizes of bolted-in circuit breakers scheduled on the drawings with main circuit breakers or lugs only on the mains as scheduled.
- J. All circuit breakers shall be fully rated for the current interrupting rating as indicated on the drawings, or at a minimum, as follow:

VOLTAGE RATING	INTERRUPTING RATING
120/240 Volts	10,000 Amps

- K. All circuit breakers shall be quick make, quick break, trip free, thermal magnetic, indicating type unless noted otherwise. Provide all multiple pole breakers with common trip and single operating handle; handle ties between breakers are unacceptable. Branch circuit breakers shall be fully interchangeable without disturbing adjacent units.
- L. Connect all circuit interrupting devices with sequence phasing.
- M. Mount all panel boards in cabinets as specified hereinbefore, arranged for flush or surface mounting as indicated on drawings.

2.3 IDENTIFICATION:

- A. Provide each panel board with a neatly typewritten directory of circuits. Install the directory in a cardholder on the inside of the panel board cabinet. Cover directory with transparent sheet plastic.
- B. Provide each panel board with a factory engraved nameplate which shall identify the panel board name and voltage.

PART 3 EXECUTION

- 3.1 Install panel boards in accordance with manufacturer's instructions and as specified or shown.
- 3.2 Test all elements of panel board with 1000-volt insulation resistance tester before energizing. Insulation resistance less than 50 megohms is unacceptable.

END OF SECTION

SECTION 26 27 28

DISCONNECTS

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. This Section specifies disconnect switches for general use.

1.2 SUBMITTALS:

- A. Provide complete catalog data and drawings on all items of equipment, under provisions of the Invitation for Bid and Contract documents. Include all submittal data in the operation and maintenance manuals.

PART 2 PRODUCTS

2.1 DISCONNECT SWITCHES:

- A. Unless otherwise noted or required, all disconnect switches shall be UL listed and shall meet the latest edition of NEMA Standard KS1 for Type HD heavy duty switches. Switches shall be fused or unfused; quick make, quick break; in NEMA 3R enclosures. All motor circuit switches shall be horsepower rated.
- B. Switches shall be of General Electric, Eaton, or Square D manufacture, equivalent to General Electric Type TH quick make, quick break switches.
- C. Switches shall be provided with an equipment or service grounding kit. Provide a neutral assembly as required for the installation.
- D. Additional disconnect switches may be identified on the drawings. If so identified, provide the type called for on the drawings.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. Section includes field-mounted SPD for installation on new and existing low-voltage (120 to 480 volts) power distribution equipment.
- B. Related Sections:
 - 1. Division 26 Section "Low Voltage Electrical Power Conductors and Cables".
 - 2. Division 26 Section "Grounding and Bonding for Electrical Systems".

1.3 DEFINITIONS:

- A. ATS: Acceptance Testing Specifications.
- B. SPD: Surge Protective Device(s), both singular and plural.
- C. SVR: Suppressed voltage rating.
- D. TVSS: Transient voltage surge suppressor(s), both singular and plural; also, transient voltage surge suppression.

1.4 ACTION SUBMITTALS:

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.
- B. Verification that all SPD are UL tested and labeled with 20kA (In) nominal discharge rating for compliance to UL96A Lightning Protection Master Label and NFPA 780.

1.5 INFORMATIONAL SUBMITTALS:

- A. Product Certificates: For SPD devices, from manufacturer.
- B. Field quality-control reports.
- C. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS:

- A. Operation and Maintenance Data: For SPD devices to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS:

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Replaceable Protection Modules: One for each SPD provided.

1.8 QUALITY ASSURANCE:

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by UL and marked for intended location and application.
- B. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.
- C. Comply with NFPA 780.
- D. Comply with NEMA LS 1.
- E. Comply with UL 1449 and UL 1283 (Type 2 only).
- F. Comply with NFPA 70.

1.9 PROJECT CONDITIONS:

- A. Service Conditions: Rate SPD devices for continuous operation under the following conditions unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 - 2. Operating Temperature: 30°F to 120°F.
 - 3. Humidity: 0 to 100 percent, non-condensing.

1.10 COORDINATION:

- A. Coordinate location of field-mounted SPD devices to allow adequate clearances for maintenance, minimum 36" in front and 12" from centerline.

1.11 WARRANTY:

- A. Comply with the Invitation for Bid and Contract documents requirements.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Square D.
 2. Eaton Electrical Inc.
 3. Siemens Industry Inc.
 4. Approved equal.
- B. Surge Protection Devices Installed in new Service Entrance:
 1. Type 1, Complying with UL 1449, 3rd edition, with UL card.
 2. SPD relying upon external or supplementary installed safety overcurrent protection do not meet the intent of this specification.
 3. Arranged for copper bus bar connections to phase buses, neutral bus, and ground bus.
 4. A three pole circuit breaker for dedicated disconnecting means shall be provided in the switchgear.
 5. LED indicator lights for power and protection status.
 6. Audible alarm, with silencing switch, to indicate when protection has failed.
 7. Form-C contacts rated at 5 Amp and 250-VAC, one normally open and one normally closed. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device.
 8. Six-digit transient-event counter set to totalize transient surges.
- C. Comply with UL 1283.
- D. Minimum Surge Current Capacity Rating: 300 kA per phase.
- E. Nominal discharge current (In): 20 kA.
- F. Short circuit current rating (SCCR): 200 kA.
- G. Maximum Continuous Operating Voltage (MCOV):]
 1. 480/277 volts: 320 volts.
 2. 240/120 volts: 150 volts.

2.2 ENCLOSURES:

- A. Indoor Enclosures: NEMA 250, Type 1.
- B. Outdoor Enclosures: NEMA 250, Type 3R.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. Type 1 SPD devices at service shall be installed on the line side with ground lead bonded to service entrance ground.

3.2 FIELD QUALITY CONTROL:

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
 - 2. After installing SPD devices but before electrical circuitry has been energized, test for compliance with requirements.
 - 3. Complete startup checks according to manufacturer's written instructions.
- C. SPD device will be considered defective if it does not pass tests and inspections.

3.3 STARTUP SERVICE:

- A. Do not energize or connect service entrance equipment, distribution equipment, or panelboards to their sources until SPD devices are installed and connected.
- B. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

END OF SECTION

SECTION 31 11 00

SITE CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Preparation for Work
- B. Protection of Existing Features.
- C. Clearing and Grubbing.
- D. Debris Removal.
- E. Erosion Control.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 GENERAL:

- A. Site clearing and grubbing shall consist of the removal and disposal of trees, stumps, brush, roots, vegetation, logs, rubbish and other objectionable matter within the footprint of the proposed irrigation storage pond and the irrigation sites as shown on the Drawings.

3.2 PREPARATION FOR WORK:

- A. Verify that existing plant life designated to remain, if any, is tagged or identified and protected.
- B. Verify and protect survey control.

3.3 PROTECTION OF EXISTING FEATURES:

- A. Locate, identify and protect the utilities to remain from damage.
- B. Protect trees, plant growth and features designated to remain.
- C. Protect benchmarks and survey control from damage or displacement.

3.4 CLEARING AND GRUBBING:

- A. Remove existing trees, stumps, brush, roots, vegetation, logs, rubbish and other objectionable matter and other items shown, or described to be removed.

3.5 DEBRIS DISPOSAL:

- A. Contractor may temporarily stockpile debris and extracted plant life on site in locations approved by the Owner and Engineer.
- B. Contractor shall chip/mulch/grind stockpiled debris and extracted plant life and spread evenly on-site for final disposal.

3.6 EROSION CONTROL:

- A. Provide erosion control measures necessary to maintain site. Protect against both wind and rainfall erosion.
- B. Provide erosion control.

END OF SECTION

SECTION 31 23 00

EXCAVATION, BACKFILLING and COMPACTING FOR STRUCTURES

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Excavating, Backfilling and Compacting for Structures.

1.2 REFERENCES:

- A. ASTM C136 – Sieve Analysis of fine and course aggregates.
- B. ASTM D698 – Standard Methods of Test for Moisture-Density Relations of Soil (Standard).
- C. ASTM D1557 – Test for Moisture-Density Relations of Soil (Modified).
- D. ASTM D2992 – Density of Soil and Soil Aggregate In-Place by Nuclear Methods.
- E. ASTM D3017 – Moisture Content of Soil and Soil Aggregate In-Place by Nuclear Methods.

1.3 SUBMITTALS:

- A. Samples: Aggregate samples of material as required by the testing laboratory.
- B. Quality Control Submittals: For information only.

1.4 PROJECT CONDITIONS:

- A. Protection:
 - 1. Erect sheeting, shoring and bracing as necessary for protection of person, improvements and excavations.
 - 2. Provide dewatering and drainage necessary to keep excavations free of water.
- B. Coordination: Coordinate backfill operations with installation of utilities.

1.5 TESTING:

- A. Compaction tests for structures is a standard test performed through Owner-provided third-party testing firm.

PART 2 PRODUCTS

2.1 EXCAVATED MATERIAL:

- A. Source: Select fill shall be imported borrow material from borrow areas and/or on-site materials approved by the Engineer. Material from source shall be tested for compliance with project requirements and approved by the Engineer.
- B. Suitability: Use the best material available, suitability of select fill is subject to the Engineer's approval.
- C. Quality: Select fill material must be free of clay lumps larger than 1 inch, rocks larger than 2-inches and/or excessive silts. Do not use soil containing brush, roots, sod, or similar organic materials.
- D. Characteristics: Materials shall conform to ASTM D2487 Class II or Class III and shall have a liquid limit less than 35 with a plasticity index less than 15 but greater than 4.

2.2 GENERAL SITE FILL:

- A. Source: Obtain general site fill from required excavation or, if excavated material is not sufficient, from borrow areas approved by the Engineer.
- B. Suitability: Use the best material available from excavation or borrow. Suitability of general site fill material is subject to the Engineer's approval.
- C. Quality: Fill material shall be free of lumps larger than 3 inches, rock larger than 2 inches and excessive silts. Do not use soil containing brush, roots, sod, or similar organic materials.
- D. Characteristics: General site fill material shall conform to ASTM D2487 Class II or Class III Soils.

2.3 AGGREGATE:

- A. Free-draining, well-graded crushed rock, gravel, or sand per ASTM 136, Coarse Aggregate Section.

2.4 TOP SOIL:

- A. Source: Obtain top soil from the required excavation, or if sufficient material is not available, from borrow areas approved by the Engineer.
- B. Suitability: Use the best material available. Suitability of material is subject to the Engineer's approval.
- C. Quality: Material shall be free of large roots or branches, stumps, brush, rubbish, or other objectionable matter.
- D. Characteristics: Soils possessing the characteristics that produce growth of grasses or other vegetation.

2.5 SOURCE QUALITY CONTROL:

- A. Provide materials of each type from same source throughout the project.
- B. A change in source requires sampling, testing and approval by Engineer.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION:

- A. Examine project site and investigate existing subsurface conditions to determine nature, kind and character of materials and conditions to be encountered.
- B. Prior to commencing excavation operations, disconnect and cap or protect existing utility services, if any, in accordance with the requirements of the owning companies and applicable ordinances and regulations.
- C. Provide for surface drainage.
- D. Keep excavations free of water during entire progress of the work.
- E. Prior to backfilling against grade beams and below grade walls, verify that beams, walls and footings have properly cured.
- F. Verify that forms, trash, debris and applicable temporary shoring have been removed.
- G. Verify that walls are supported at top and bottom.

3.2 EXCAVATION:

- A. Excavate beneath structures to lines, grades and elevations as shown. Over-excavation shall be restored by the Contractor at his own expense.
- B. Scarify exposed surfaces to a depth of 8 inches and re-compact to a density of 95% of the maximum dry density when tested by the Standard Proctor Compaction Test (ASTM D698), at or above optimum moisture content.
- C. Remove weak or highly organic soils noted by probing and replace with general site fill. Place fill in 8-inch lifts and compact to 95% of maximum dry density (ASTM D698) at or above optimum moisture content.
- D. Do not extend structure fill beyond structure lines or as shown.
- E. Excavation is unclassified. Break rock with hydraulic ram or rock saw to obtain near neat line excavation. Blasting is not allowed.

3.3 BACKFILL:

- A. Schedule backfilling to expedite construction progress.

- B. Backfill in manner to prevent excessive pressure against previously completed work and to prevent damage or displacement to utility systems.
- C. Place backfill materials for grade beams as follows:
 - 1. Exterior Face of Grade Beams: Where required, backfill with select fill. Place backfill in layers of approximately 8 inches loose lifts and compact to minimum 95% of maximum dry density percent at or above optimum moisture content. Standard Proctor Density (ASTM D698).
 - 2. Place backfill at grade beams as soon as forms are removed. Keep grade beam excavations dry at all times. If rain occurs before backfill is placed, remove water for excavations immediately.
- D. Backfill structure walls with free-draining coarse aggregate backfill. Consolidate by tamping to uniform density to prevent settling. Do not over compact.
- E. Exercise care to prevent over compaction of backfills.
- F. Where top of below grade structure backfill is not covered with paving or other impervious barrier, the final two feet of backfill shall be general site fill. Place fill in 8-inch thick lifts and compact to minimum 95% of maximum dry density at or above optimum moisture content. Allow for 4 inches of top soil placement.
- G. Undercut any soft or compressible areas detected during the re-compaction process to sound subgrade soils and re-compact. General or select fill shall be used to bring the soft or compressive areas to grade. Work shall precede placement of topsoil, walks, drives, or structure foundations. Allow for placement of minimum 4-inch layer of topsoil in areas not covered by structures or pavement.

3.4 MATERIAL DISPOSAL:

- A. Remove waste and excess excavated material from the construction site before final inspection. Legally dispose of material at a licensed site or with written and notarized permission from the property Owner for a private disposal site. All costs associated with waste material removal and disposal shall be paid for by the Contractor.

3.5 TESTING:

- A. Soil Moisture and Density: Perform a minimum of 1 test per 100 square feet.

END OF SECTION

SECTION 31 50 00

TRENCH AND EXCAVATION SAFETY SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Requirements for a Trench and Excavation Safety System to be designed and furnished by the Contractor for the safety and health of personnel.
- B. The requirements of this section apply to all trenches that exceed five feet in depth.
- C. Submission of a written Plan describing the System in detail.

1.2 REFERENCES:

- A. 29CFR1926—Occupational Safety and Health Standards - Excavations, United States Department of Labor, latest edition.
- B. Others—Other applicable Federal, State, and local rules for Trench Construction or Excavations.

1.3 REQUIREMENTS:

- A. The Contractor shall develop, design, and implement a System. The Contractor shall bear the sole responsibility for the adequacy of the System.
- B. The requirements of 29CFR1926 shall be the minimum requirements for this specification and is adopted as a part of this specification. Other regulations relating to trench and excavation safety shall also be considered a part of this specification as if referenced directly.
- C. Should the System require wider trenches than shown, the Contractor shall be responsible for the costs associated with determining adequacy of pipe bedding and class, as well as purchase and installation of alternate materials.

1.4 SUBMITTALS:

- A. Submit three (3) copies of the System Plan for information only. The Engineer will not review the System Plan for sufficiency, adequacy, or other engineering aspects. Submission is only to record the presence or absence of the System Plan.

1.5 QUALITY ASSURANCE:

- A. The Trench Safety System shall be designed by an Engineer licensed as a Professional Engineer in the State of Texas. The System Plan shall be annotated with the Engineer's seal, signed, and dated.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 GENERAL:

- A. Contractor shall submit three sets of plans for a site specific Trench Safety System for all portions of the work having trenches deeper than five (5) feet. The Trench Safety System must be designed and sealed by a Professional Engineer, licensed in the State of Texas, with appropriate experience in soil mechanics and structural engineering.
- B. Implement the system in accordance with the written System Plan and conduct affected work in accordance with the same.
- C. The Contractor accepts sole responsibility for compliance with all applicable safety requirements. The Contractor shall be solely responsible and liable for any property damage or bodily injury, including death that arises from his use of the Trench Safety Plan; for any negligence in the performance of contract work; and for any and all construction means, methods, techniques, and procedures.

3.2 METHODS:

- A. Contractors may have two methods to meet OSHA standards for trench safety and for complying with the provisions of this specification. The two methods are:
 - 1. Use of a trench box.
 - 2. Shoring, sheeting, and bracing methods.

END OF SECTION

SECTION 32 90 00

RE-SEEDING OF DISTURBED AREAS

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Preparation of Subsoil.
- B. Placing Topsoil.
- C. Seeding and Mulching.
- D. Maintenance.

1.2 DEFINITIONS:

- A. Weeds: Include Dandelion, Jimsonweed, Quack Grass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.3 SUBMITTALS:

- A. Seed mixtures, types and content by percentage of mixture.
- B. Maintenance Date: Include maintenance instructions, cutting method, maximum grass height; types, application, frequency and recommended coverage of fertilizer.

1.4 QUALITY ASSURANCE:

- A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging and location of packaging.

1.5 DELIVERY, STORAGE, AND PROTECTION:

- A. Transport, handle, store and protect products in accordance with vendor's recommendations and standard industry practice.
- B. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

1.6 MAINTENANCE SERVICE:

- A. Maintain seeded areas immediately after placement until grass is well established and until final acceptance of the project by the Owner.

PART 2 PRODUCTS

2.1 SEED MIXTURE:

A. Seed Mixture:

1. Areas Disturbed by Construction:

- a. Green Sprangletop - *Leptochloa dubia* - 2.0 PLS #/acre
15%
- b. Sand Lovegrass - *Eragrostis trichodes* - 0.6 PLS #/acre
20%
- c. Sand Dropseed - *Sporobolus cryptandrus* - 0.4 PLS #/acre
20%
- d. Buffalograss (Texoka) - *Buchloe dactyloides* - 4.0 PLS #/acre
35%

B. Substitutions can be with Engineer's approval.

C. Protective coating for seed.

2.2 ACCESSORIES:

A. Water: Clean, fresh and free of substances or matter which could inhibit growth of grass.

PART 3 EXECUTION

3.1 EXAMINATION:

A. Verify that prepared soil base is ready to receive the work of this section.

3.2 PREPARATION OF SUBSOIL:

- A. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated subsoil.
- C. Scarify subsoil to a depth of 3 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.

3.3 SEEDING:

A. Disturbed Areas (For Erosion Control):

- 1. Apply seed at a rates per Section 2.1 above, evenly in two (2) intersecting directions. Rake in lightly.
- 2. Do not seed areas in excess of what can be mulched on same day.

3. Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inch.
4. Roll seeded area with roller not exceeding 112 pounds.
5. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.4 HYDROMULCH:

- A. Hydromulching is permitted if used with a tackifier for all sloped embankments.

3.5 MAINTENANCE:

- A. Water to prevent grass and soil from drying out. Last water day will be day of final acceptance of the project by the Owner.

3.6 SCHEDULE:

- A. Grass seed mixture specified, all exposed areas from construction operations and area damaged or disturbed during construction.

END OF SECTION

SECTION 33 01 10

WATER SYSTEM DISINFECTION

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Disinfection of potable water distribution system.
- B. Testing and reporting results.

1.2 REFERENCES:

- A. AWWA B300--Standard for Hypochlorites.
- B. AWWA B301--Standard for Liquid Chlorine.
- C. AWWA C651--Standards for Disinfecting Water Mains.
- D. 30 TAC 290.38 through 290.49--Rules and Regulations for Public Water Systems, *Texas Administrative Code*.

1.3 SUBMITTALS FOR INFORMATION:

- A. Test Reports: Indicate results comparative to specified requirements.
- B. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.

1.4 PROJECT RECORD DOCUMENTS:

- A. Disinfection Report:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Initial and 24-hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
 - 5. Data and time of flushing start and completion.
 - 6. Disinfectant residual after flushing in ppm for each outlet tested.
- B. Bacteriological Report:
 - 1. Date issued, project name, and testing laboratory name, address, and telephone number.
 - 2. Time and date of water sample collection.

3. Name of person collecting samples.
4. Test locations.
5. Initial and 24-hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Certification that water conforms, or fails to conform, to bacterial standards of AWWA C651, and 30 TAC 290.38 through 290.46.

1.5 QUALITY ASSURANCE:

- A. Perform work in accordance with AWWA C651.
- B. Testing Firm: Approved Laboratory by Texas Department of Health, Bureau of Laboratories.
- C. Submit bacteriologist's signature and authority associated with testing.
- D. Bacteriological tests shall indicate negative. If other than negative disinfection shall be repeated at Contractor's expense.

1.6 REGULATORY REQUIREMENTS:

- A. Conform to AWWA C651, and 30 TAC 290.38 through 290.46 for performing the work of this Section.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS:

- A. Chemicals: AWWA B300, Hypochlorite and AWWA B301, Liquid Chlorine.

PART 3 EXECUTION

3.1 EXAMINATION:

- A. Verify that piping system and structures have been cleaned, inspected, and pressure tested.
- B. Perform scheduling and disinfecting activity with start-up, testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.2 EXECUTION:

- A. Provide and attach equipment required to perform the work of this Section.
- B. Inject disinfectant into piping system while filling. Disinfection agent may be introduced with permanent chlorination equipment when possible, or other means of application. Application of chlorine gas under pressure directly to

the water is not permitted.

- C. Maintain disinfectant in system for 24 hours.
- D. Flush, circulate, and clean until required cleanliness is achieved; use water from existing water wells.
- E. Replace permanent system devices removed for disinfection.

3.3 FIELD QUALITY CONTROL:

- A. Testing and all related costs are the responsibility of the Contractor.
- B. Analyze samples in accordance with AWWA C651, and 30 TAC 291.46.
- C. Take samples from water in pipe at 1000' intervals and analyze for bacteria.

END OF SECTION

SECTION 33 10 00

EXCAVATION, BACKFILLING AND COMPACTING FOR UTILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Unclassified excavation, trenching, bedding, backfilling and compacting for potable water distribution mains, gravity-flow sanitary sewers, manholes, valves, and other utility systems and appurtenances, and the disposal of excess excavated material.

1.2 REFERENCES:

- A. ASTM C33 – Coarse Aggregates.
- B. ASTM D698 – Moisture-Density Relations of Soil (Standard).
- C. ASTM D1557 – Test for Moisture-Density Relations of Soil (Modified).
- D. ASTM D2321 – Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity – Flow Applications.
- E. ASTM D2487 – Classification of Soils for Engineering Purposes.
- F. ASTM D4254 – Minimum Index Density and Unit Weight of Soils and Calculations of Relative Density.
- G. ASTM D4318 – Test for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- H. OSHA – Occupational Safety and Health Administration and Related Regulations.

1.3 SUBMITTALS:

- A. Submit sample(s) of material(s) proposed to be used for bedding in the pipe zone and backfill of fiberglass structures.
 - 1. One (1) set to materials testing lab for classification.
 - 2. One (1) set to Engineer for approval.
- B. Submit an official copy of the proposed bedding material classification results from the testing lab to the Engineer.

1.4 PROTECTION OR REMOVAL OF EXISTING UTILITIES:

- A. The Contractor shall anticipate all underground obstructions, such as but not limited to, water mains, gas lines, storm and sanitary sewers, telephone or electric light or power ducts, concrete and debris. Any such lines or obstructions indicated on the Drawings show only the approximate locations and shall be verified in the field by the Contractor. The Owner and Engineer

will endeavor to familiarize the Contractor with all known utilities and obstructions, but this shall not relieve the Contractor from full responsibility in anticipating all underground obstructions whether or not shown on the Drawings.

- B. The Contractor shall, at his own expense, maintain in proper working order and without interruption of service all existing utilities and services which may be encountered in the work. With the consent of the Engineer and utility owner such service connections may be temporarily interrupted to permit the Contractor to remove designated lines or to make temporary changes in the locations of services. The cost of making any temporary changes shall be at the Contractor's expense.
- C. Notify all utility companies involved to have their utilities located and marked in the field. All underground utilities in a particular segment of the project shall then be uncovered to verify location and elevation before construction begins in that segment of the project.
- D. The Contractor shall obtain necessary permits, except TxDOT right-of-way permits required for completion of the project.

1.5 DEFINITIONS:

- A. All excavation associated with the project is unclassified.
- B. Bedding: Includes the area from the trench bottom to the bottom of the pipe where material is placed to bring the trench bottom up to grade. A compacted depth of approximately 4 to 6 inches is generally sufficient bedding thickness.
- C. Haunching: Includes the area from the bottom of the pipe to the spring line of the pipe. Material in this area must be placed and consolidated to provide adequate side support while avoiding both vertical and lateral displacement of the pipe. **The type and density of the material in this area are the most important factors affecting the performance and deflection of the pipe.**
- D. Initial Backfill: Includes the area from the spring line of the pipe to a point at least 6 inches over the top of the pipe.
- E. Final Backfill: Includes the area above the initial backfill, up to final grade or the bottom of the flexible base material in the pavement section.
- F. Pipe Zone: Includes areas of bedding, haunching and initial backfill as defined above.

PART 2 PRODUCTS

2.1 PIPE ZONE:

- A. Materials for use within the pipe zone and within 24 inches of fiberglass structures shall be Class I, II, or III in accordance with following Table 2.1:

TABLE 2.1
DESCRIPTION OF MATERIAL CLASSIFICATION
(as defined in ASTM D2321)

Class	Type	Soil Group Symbol	Description ASTM D2487	% Passing Sieve Sizes			Atterberg Limits		Coefficients	
				1½ in (40 mm)	#4 (4.75 mm)	#200 (0.075 mm)	LL ^b	PI ^c	Uniformity C _u	Curvature C _c
I	Manufactured, Processed Aggregate; dense-graded, clean	None	Angular, granular, crushed stone or rock, crushed gravel, and stone/sand mixtures with gradations selected to minimize migration of adjacent soils; contain little or no fines	100%	≤50%0	< 5%	Non Plastic			
II	Coarse-Grained Soils, clean	GW	Well-graded gravels and gravel-sand mixtures; little or no fines	100%	< 50% of Coarse Fraction	< 5%	Non-Plastic		> 4	1 to 3
		GP	Poorly-graded gravels and gravel-sand mixtures; little or no fines						< 4	< 1 or > 3
		SW	Well-graded sands and gravelly sands; little or no fines		> 6				1 to 3	
		SP	Poorly-graded sands and gravelly sands; little or no fines		< 6				< 1 or > 3	
	Coarse-Grained Soils, borderline clean to w/fines	e.g. GW-GC, SP-SM.	Sands and gravels which are borderline between clean and with fines	100%	Varies	5% to 12%			Same as for GW, GP, SW and SP	
III	Coarse-Grained Soils with Fines	GM	Silty gravels, gravel-sand-silt mixtures	100%	< 50% of Coarse Fraction	> 12% to < 50%	< 4 or < "A" Line			
		GC	Clayey gravels, gravel-sand-clay mixtures				< 7 and > "A" Line			
		SM	Silty sands, sand-silt mixtures	> 50% of Coarse Fraction			> 4 or < "A" Line			
		SC	Clayey sands, sand-clay mixtures				> 7 and > "A" Line			
IV ^a	Fine-Grained Soils (inorganic)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, silts with slight plasticity	100%	100%	> 50%	< 50	< 4 or < "A" Line		
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays				> 7 and > "A" Line			

^a Includes Test Method ASTM D2487 borderline classifications and dual symbols depending on plasticity and liquid limits.

^b LL = Liquid Limit. ^c PI = Plasticity Index.

B. In addition to the approved materials included in Table 2.1, the following materials are approved for the pipe zone or where shown:

1. Lean Concrete: Free-flowing grout, mixed one (1) sack of cement per cubic yard of sand.

2. Structural Concrete: Concrete for encasement shall be 3000 psi compressive strength as specified in Section 033000.

2.2 FINAL BACKFILL MATERIALS:

- A. Earth Backfill: Earth backfill may be excavated and reused from trench or obtained from an approved borrow area. Material shall be processed to ensure that only select material is used for backfilling operations. Material shall be free of lumps, clods, large rocks, debris, trash, organic, spongy or otherwise objectionable material. The presence of such material in the backfill may preclude uniform compaction and result in excessive localized point loads on or deflections in the piping system or fiberglass structure.
- B. All materials included in Table 2.1 above are approved for final backfill, when installed per Table 3.3.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION:

- A. Examine utility routes and coordinate excavation work to eliminate installation conflicts.
- B. Allow room for stockpiling excavated material and utility construction material during utility construction.
- C. Contractor shall provide erosion controls as necessary to prevent stockpiled material from washing into adjacent water courses or streets in the event of rain. Maintain controls in place until applicable area has been restored to original or final grade. Refer to the Site SWP3.

3.2 TRENCH EXCAVATION:

- A. Procedure: Excavated to indicated or specified depths.
 1. Excavate by open cut method.
 2. The trench shall be excavated to the lines and grades as established by the Engineer. The minimum depth of cover for all pipe lines shall be thirty six (36) inches, unless otherwise specifically shown on the drawings.
 3. During excavation, stockpile material suitable for backfilling in an orderly manner far enough from the bank of the trench to avoid overloading, slides, or cave-ins.
 4. Grade Site as necessary to prevent surface water from flowing into trenches or other excavations.
 5. Cut walls of trench as close to vertical as the stability of the material and trench safety will allow. Remove stones as necessary to avoid point-bearing. Over-excavate wet or unstable soil from the trench bottom to permit construction of a more stable bed for pipe. Over

excavation shall be filled with clean dry sand, pea gravel, or other approved material to the required grade, and thoroughly compacted.

6. Excavate the trench the proper width as shown, or as required by the Contractor's Trench Safety Program. If the trench width below the top of pipe is wider than specified in this section or shown, install additional backfill. No additional payment will be made for additional material or work required for installation.
7. Accurately grade the trench bottom to provide proper bedding as required for pipe installation.
8. If any excavation is carried beyond the lines and grades required or authorized, the Contractor shall, at his own expense, fill such space with suitable material and properly compact the material as directed by the Engineer. No additional payment will be made.
9. If ledge rock, rock fragments or other unyielding material is encountered in the bottom of the trench, it shall be removed to a depth of three inches below grade, refilled with selected material and thoroughly compacted.
10. Trench digging machinery may be used to make trench excavations except in places where operation of same would cause damage to existing structures either above or below ground; in such instances, hand methods shall be employed. The Contractor shall locate all existing underground lines, of which he has been advised, whether or not they are shown on the drawings, sufficiently in advance of trenching operations to prevent any damage thereto. Extreme care shall be used to prevent such damage and the Contractor shall be fully responsible for damage to any such lines.
11. It should be noted that geotechnical investigations have indicated the presence of significant rock in the project area. There will be no classification of or extra payment for excavated materials and all materials encountered shall be excavated as required. Adjacent structures shall be protected from damage by construction equipment. All excavated material shall be piled in a manner which will not endanger the work or existing structures and which will cause the least obstruction to roadways.
12. Blasting for excavation of solid rock will be permitted only after securing the approval of the Engineer and only when proper precautions are taken for protection of persons or property. The hours of blasting will be fixed by the Engineer. Any damage caused by blasting shall be paid by the Contractor. The method of procedure relative to blasting shall conform to all state laws and local ordinances.

- B. Sheeting and Bracing: If trench safety methods do not include sloping of trench walls, install sheeting and bracing; or use appropriate trench box necessary to support the sides of trenches and other excavations with vertical sides, as required by current OSHA regulations.

- C. Water in Excavation: Keep work free from ground or surface water at all times. Provide pumps of adequate capacity or other approved method to remove water from the excavation in such a manner that it will not interfere with the progress of the work or the proper placing of other work.
- D. Trenching Progress: Trenching operations for any individual utility work crew shall not be in excess of 100 feet ahead of pipe laying operations in city streets or 2,000 feet in open country. Not more than two (2) consecutive cross-streets may be closed to traffic by any individual utility work crew at any given time. Ensure no trenches are left open when work is not in progress. Temporarily backfill any open trenches with un-compacted material and install proper barricades at the end of each work day.
- E. Existing Lawns and Shrubbery: The Contractor shall take particular care to preserve existing lawns and shrubbery. Make minor pipe alignment as may be necessary.
- F. Existing Pavement: Existing pavement over trenches shall be removed to a width of 6 inches outside of the trench on each side. Remove to a neat line by sawing method. Take appropriate measures to prevent damage to existing pavement adjacent to the trench by wheels, tracks and/or stabilizers of excavating equipment. Remove brick pavement by hand, deliver and stack as directed by the Owner.
- G. Dust Control: When excavation for pipeline generates significant dust (i.e. rock sawing operations) in vicinity of occupied businesses or residents, Contractor shall exercise measures to mitigate dust generated from the process.

3.3 PIPE BEDDING:

- A. Concrete Encasement:
 - 1. Where shown, the Contractor shall install the pipe in concrete encasement.
 - 2. Concrete for encasement shall be 3000 psi compressive strength as specified in Section 033000.
 - 3. Precautions shall be used to prevent pipe floating, movement or deflection during construction.
 - 4. Concrete for encasement, shall be included in the unit price bid per linear foot in place.
- B. Within the Pipe Zone:
 - 1. Accurately grade the bottom of the trench 4 inches below the bottom of the pipe and to the limits of the clear space on either side of the pipe.

2. Install materials which comply with Class I or II, per Table 2.1 place in accordance with Table 3.3 in this Section and per "Pipe Bedding Detail" shown on the Drawings.
3. The initial layer of embedment material placed to receive the pipe shall be brought up to a grade slightly higher than that required for the bottom of the pipe and the pipe shall be placed thereon and brought to grade by tamping, or by removal of the slight excess amount of embedment under the pipe.
4. Adjustment to grade line shall be made by scraping away or filling with embedment materials. Wedging or blocking up of pipe will not be permitted.
5. Each pipe section shall have a uniform bearing on the embedment for the full length of the pipe, except immediately at the joint.
6. After each pipe has been graded, aligned, placed in final position on the bedding material and joint made, sufficient embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.
7. Sheeting and shoring will not be allowed in the pipe zone during or after installation of the pipe or embedment material, unless special provisions are made to ensure the specified compaction of bedding and pipe alignment is maintained after removal of sheeting and shoring.
8. Minimum compaction effort within the pipe zone and adjacent to fiberglass structures shall be in accordance with the following Table 3.3 based on the class of bedding material used:

TABLE 3.3
MINIMUM REQUIRED COMPACTION
FOR MATERIAL USED WITHIN PIPE ZONE

Classification of Bedding Material	Standard Proctor Density ^a (Relative Density ^b shown in parentheses)
Class I	Dumped
Class II	≥85% standard (≥40% relative)
Class III	Not approved for bedding material.
Class IV	Not approved for bedding material.
Class V	Not approved for bedding material.

^a Standard Proctor Density per ASTM D698, moisture content shall be ± 2% of optimum.

^b Relative Density per ASTM D4254.

3.4 UTILITY INSTALLATION:

- A. Water Mains: Provide a minimum of 36 inches of cover over the top of the pipe. Avoid interference of water lines with other utilities. Provide class of bedding as shown. Install piping and appurtenances as specified.

- B. Sanitary Sewers: Install piping to the lines and grades as shown on the Drawings. Limit clear space on either side of the pipe to 12 inches. Above the pipe, cut as wide as necessary to sheet and brace and properly perform the work. Provide class of bedding as shown.
- C. Excavation for Appurtenances: Excavate sufficiently for manholes, valve vaults, and similar structures to leave at least 18 inches clear between the outer surfaces and the embankment or shoring that may be used to hold and protect the embankment wall. Install manholes or valve vault structure, piping and appurtenances as specified. Any other-depth excavation will be refilled with lean concrete or other suitable compacted material approved by the Engineer, at no additional cost to the Owner.

3.5 FINAL BACKFILL:

- A. Criteria: Backfill trenches to ground surface with material as specified. Reopen trenches improperly backfilled to depth required for proper compaction. Refill and compact as specified, or otherwise correct the condition in an approved manner.
- B. Take care to avoid contacting pipe or structure to be backfilled with compaction equipment. Do not use compaction equipment directly over the pipe until sufficient initial backfill has been placed to assure such equipment will not be damage or disturb the pipe.
- C. All forms, lumber, trash and debris shall be removed from trenches, manholes and other utility structures prior to backfilling.
- D. Dispose of unacceptable backfill material and provide suitable material for backfill at no additional cost to the Owner.
- E. Open Areas:
 - 1. Install materials which comply with Table 2.1 and are placed in accordance with Table 3.3 in this Section and per "Pipe Bedding Detail" shown on the Drawings.
 - 2. Above the pipe zone, deposit earth backfill from excavated material, compact to minimum of 85 percent of maximum density per ASTM D698, while maintaining moisture within ± 2 percent of optimum. Excavated material placed shall be free of rock greater than two (2) inches in any direction.
 - 3. Backfill for valves, fittings, manholes, utility pull boxes and other utility structures shall be placed in accordance with applicable Specification Sections.
- F. Pavement Section:
 - 1. Above the pipe zone to below the flexible base material, deposit earth backfill from excavated material, compact to minimum of 95 percent of maximum density per ASTM D698, while maintaining moisture within ± 2 percent of optimum; or deposit ASTM D2487

Class II material in 6-inch lifts, compact to 40 percent relative density according to ASTM D4254.

2. For valves, fittings, manholes, valve vaults or boxes in pavement sections, backfill with Class II material to bottom of proposed pavement. Backfill material shall be deposited in 6-inch lifts. Class II material must be compacted to 40 percent relative density according to ASTM D4254.

3.6 DISPOSAL OF EXCESS MATERIAL:

- A. Remove waste and excess excavated material from the construction site before final inspection. Legally dispose of material:
 1. At a licensed and approved site.
 2. On adjacent private property with written and notarized permission from the property owner.
 3. On Owner property with written and notarized permission from the Owner.
- B. All cost associated with waste material removal and disposal shall be paid for by the Contractor.

END OF SECTION

SECTION 33 11 00

WATER WELL

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. The development of a new residential supply wells including the drilling and development of a well, installation of the headworks, pump and column pipe, well head concrete and piping, pressure tank, electrical and controls, well enclosure, accessories and appurtenances.
- B. Wells shall be completed in accordance with TCEQ criteria for Public Water System wells.

1.2 REFERENCES:

- A. API RP 13B - Recommended Practice Standard Procedure for Field Testing Drilling Fluids.
- B. API Spec. 5L - Specification for Line Pipe.
- C. API Spec 10 - Specification for Materials and Testing for Well Cements.
- D. ASTM A714 - Standard Specification for High-Strength Low-Alloy Welded and Seamless Steel Pipe.
- E. ASTM C33 - Standard Specification for Concrete Aggregates.
- F. ASTM C136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- G. ASTM C150 - Standard Specification for Portland Cement.
- H. ASTM D75 - Standard Practice for Sampling Aggregates.
- I. ASTM F480 - Standard Specification for Thermoplastic Water Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80.
- J. AWWA A100 - Standard for Water Wells (current version).
- K. AWWA C200 - Standard for Steel Water Pipe, 6 inch and Larger.
- L. AWWA C206 - Standard for Field Welding of Steel Water Pipe.
- M. AWWA C654 - Standard for Disinfection of Wells.
- N. AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12-inch, for Water.

- O. EPA-570/9-75-001 - Manual of Water Well Construction Practices.
- P. NEMA MGI - Motors and Generators.
- Q. TCEQ 30 TAC 290 - Subchapter D: Rules and Regulations for Public Water Systems.
- R. TDLR 16 TAC, Chapter 76 Water Well Drillers and Water Well Pump Installer's Rules.

1.3 DESIGN REQUIREMENTS:

- A. The purpose of this project is to develop the residential groundwater supply for a remote residence utilizing industry recognized construction techniques, equipment, and materials. Well capacity and total dynamic head (TDH) requirements shall be determined based on actual field data from the test well and the down-hole conditions observed when the wells are drilled and completed.
- B. Expected design parameters for the two (2) proposed wells at the Matador Wildlife Management Area are as follows:
 - 1. Design conditions: 15 US gpm
 - 2. Design head: 350 ft (TDH)
 - 3. Minimum pump efficiency: 60 percent
 - 4. Maximum allowable speed: 3,450 RPM
 - 5. Pump setting range: 200 ft below ground level (approx.)
 - 6. Well casing size: 5 inches (nominal)
 - 7. Motor HP: 3
- C. Expected design parameters for the proposed well at the Gene Howe Wildlife Management Area is as follows:
 - 1. Design conditions: 15 US gpm
 - 2. Design head: 210 ft (TDH)
 - 3. Minimum pump efficiency: 60 percent
 - 4. Maximum allowable speed: 3,450 RPM
 - 5. Pump setting range: 60 ft below ground level (approx.)
 - 6. Well casing size: 5 inches (nominal)
 - 7. Motor HP: 1.5

1.4 SUBMITTALS:

- A. Product Data: Manufacturer's product data sheets on all materials and equipment incorporated into work.
- B. Quality Control Submittals: For information only.
 - 1. Water Well Data: The Contractor will submit to the Engineer, in accordance with AWWA A100, copies of all data collected from the water well including pump test data and completion data if applicable.

2. Certificates: Manufacturer's certificates attesting compliance with applicable specifications for grades, types, classes, performance, and other properties.
 3. Test Reports: Results of field quality control tests including pump tests, bacteriological tests, well head tests, and hydrostatic tests.
 4. Pump performance curve showing performance of pump provided. All extraneous information and curves shall be deleted. Specified operating points shall be indicated on curve. The performance curve shall indicate the following:
 - a. Pump performance over the entire range from shutoff head to maximum flow.
 - b. Horsepower versus capacity over entire range.
 - c. Curves shall be presented on 8 ½ inch by 11-inch format.
- C. Contract Closeout Submittals:
1. Protect Record Documents: Submit documents in accordance with bidding and contract documents. Accurately record all information including elevations of pump and water bearing strata.
 2. Submit executed certification of well pump after performance testing.

1.5 QUALITY ASSURANCE:

- A. Water well installation shall be in accordance with the current edition of AWWA A100 "Water Wells"; EPA-570/9-75-001 "Manual of Water Well Construction Practices"; TCEQ 30 TAC 290 "Subchapter D: Rules and Regulations for Public Water Systems"; TDLR 16 TAC, Chapter 76 "Water Well Driller's and Water Well Pump Installer's Rules"; and as supplemented by these specifications.
- B. Field inspection will be conducted by the Owner and the Engineer and/or Engineer's representative.
- C. Qualifications: Installation of water well shall be accomplished by or under direct supervision of a water well driller licensed in the State of Texas with a minimum of five years of experience in the installation of municipal water wells for potable use. Pump installation shall be accomplished by or under direct supervision of a pump installer licensed in the State of Texas with a minimum of five years of experience in the installation of municipal water well pumps.
- D. Submit proof of state license and qualifications in accordance with bidding and contract documents.

- E. The premises, materials, tools, and associated equipment shall be maintained to minimize contamination of the groundwater during drilling operations. The Contractor shall take all necessary precautions to prevent the contamination of the subsurface environment during the construction of the well. The Contractor shall install the necessary items to permanently prevent contaminants from entering the subsurface environment.
- F. Should the well become contaminated with water having undesirable chemical or physical characteristics or with any other chemical or toxic substance through negligence by the Contractor or his employees, the Contractor, at his own expense, shall provide casings, seals, sterilizing agents or any other required material or equipment to eliminate the contamination.

1.6 Delivery, Storage and Handling:

- A. Deliver, store and handle products.

1.7 Required Permits and Regulatory Requirements:

- A. The Contractor shall complete all necessary coordination with applicable state and local entities.

- 1. Local groundwater conservation district at Matador WMA is:

Gateway Groundwater Conservation District
223 South Main Street
PO Box 338
Quanah, Texas 79252

Office (940) 663-5722
Fax (940) 663-2577
Cell (940) 839-9000

District Manager: Carrie Dodson
Email: gatewaygcd@att.net

- 2. Local groundwater conservation district at Gene Howe WMA is:

Hemphill County Underground Water Conservation District
908 S 2nd Street
Canadian, Texas 79014

Office (806) 323-8350

General Manager: Janet Guthrie

- B. Copies of the permits shall be submitted to the Engineer before any work is begun.
- C. Contractor shall notify the Engineer at least 72 hours before the pressure cementing of the well casing begins.

- D. Contractor shall notify TPWD Inspector at least 5 working days prior to well cementing.
- E. The Contractor shall also provide to the Engineer all information necessary to gain approval of the well by the Texas Commission on Environmental Quality for municipal use, including but not necessarily limited to the following:
1. Construction data on the completed well, including:
 - a. Record of a 12-hour pump test on the well showing stable production at the well's rated capacity (30 TAC 290.41(c)(3)(A) & (G)). Include the final well pump capacity in gpm and feet, total dynamic head (TDH).
 - b. One bacteriological analysis report showing raw well water to be free of coliform bacterial contamination; reports must be for sample of raw (untreated) water from the disinfected well, collected and submitted to a laboratory certified or accredited by TCEQ. (30 TAC 290.41(c)(3)(A) & (F));
 - c. Chemical analysis reports for well water samples showing the water to be of acceptable quality for at least, the most problematic contaminants listed below (30 TAC 290.41(c)(3)(A) & (G), and 30 TAC 290.104 and 290.105 of Drinking Water Standards). Reports must come from a certified or accredited laboratory for interim use of the well. Maximum contaminant level (MCL) and secondary contaminant level (SCL) units are shown in the following table:

Constituent	Contaminant Level	Units
Nitrate	10 (as N)	mg/L
Nitrite	1 (as N)	mg/L
Arsenic	10	µg/L
Fluoride	4.0/2.0	mg/L
Aluminum	0.2	mg/L
Copper	1.0	mg/L
Iron	0.3	mg/L
Manganese	0.05	mg/L
Zinc	5.0	mg/L
Total Dissolved Solids	1,000	mg/L
Sulfate	300	mg/L
Chloride	300	mg/L
pH	≥ 7.0	std. units
Gross alpha	15	pCi/L
Radium-226	5	pCi/L
Radium-228	5	pCi/L
Beta particle	50	pCi/L
Uranium	30	µg/L

Note: If Gross alpha is over 15 pCi/L and Uranium is not reported, then resampling, reanalyzing, and resubmission of complete radionuclide results is required. Additionally, if gross alpha plus radium-228 are over 5 pCi/L, and radium-226 is not reported, then resampling, reanalyzing, and resubmission of complete radionuclide results is required.

- F. The location of the well site must conform to TCEQ regulation 30 TAC 290.41 (c), or as directed by the Engineer.
- G. No temporary toilet facilities shall be maintained within 150 feet of the well being constructed, unless the facility is of the sealed, leak proof type.

PART 2 PRODUCTS

2.1 MATERIALS:

- A. All materials shall be new and conform to AWWA standards.
- B. All materials that will come in contact with the water shall be NSF-61 approved.
- C. Well construction materials containing more than 0.25% lead are prohibited.
- D. Well Casing – Polyvinyl Chloride (PVC):
 - 1. Meeting AWWA A100.
 - 2. Materials: Pipe and couplings shall be made from un-plasticized PVC compounds having a minimum cell classification of 12454, as defined in ASTM D1784. The compound shall qualify for a Hydrostatic Design Basis (HDB) of 4000 psi for water at 73.4° F, in accordance with the requirements of ASTM D2837. White pipe shall be supplied, unless otherwise agreed upon at time of purchase.
 - 3. Physical Requirements: Product dimensions, weights, and performance data are summarized as follows:
 - a. Standard pipe laying length is 20’.
 - b. O.D size: 5.563”.
 - c. Class: SDR17.
 - d. Minimum Wall Thickness: 0.327”.
 - e. I.D. min/max: 4.810” / 4.909”.
 - f. Bell O.D.: 6.25”.
 - g. Approx. weight lb/ft: 3.49.
 - 4. Performance: All pipe supplied to this specification shall meet the stiffness (crush resistance), flattening, impact, and puncture test requirements of ASTM F480.
 - 5. Joints: Pipe shall be joined using non-metallic couplings which, together, have been designed as an integral system for maximum reliability and interchangeability. On small to medium diameter casing, the coupling may be replaced by an integral bell spline lock joint. High strength flexible thermoplastic splines shall be inserted into mating precision machined grooves to provide full 360° restraint with evenly distributed loading. No external pipe-to-pipe restraining devices which clamp onto or otherwise damage the pipe surface as a result of point-loading shall be permitted. The joining system shall incorporate elastomeric sealing gasket(s) which are designed to

provide a watertight seal. Note that this specification does not cover integral bell pipe with solvent-cement joints.

6. Marking: Well Casing pipe shall be legibly and permanently marked in ink with the following information:
 - a. Manufacturer and trade name.
 - b. Nominal Size, SDR or SCH rating.
 - c. Manufacturing Date Code.
 - d. NSF-61.
7. Workmanship: Pipe and couplings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, blisters and dents, interior roughness, and other injurious defects that may affect wall integrity. The pipe and couplings shall be as uniform as commercially practicable in color, opacity, density, and other physical characteristics.
8. Materials:
 - a. Certa-Lok™ PVC Well Casing as supplied by:
 - i. CertainTeed Corporation
P.O. Box 860
Valley Forge, PA 19482
866-CT4-PIPE
 - ii. Or Engineer-approved equal.

E. Well Screen:

1. Slotted Certa-Lok™ PVC meeting the requirements of Section 2.1 (C) above.
2. Slot width: planned as 0.035"
 - a. When the test hole is drilled, the Contractor shall provide the Engineer representative samples of the particle size within the production zone as retrieved from the bore hole. The Engineer will verify the appropriate size of screen to be installed in the well with the screen manufacturer, if other than planned.
3. Size: Match well casing.
4. The material shall meet the requirements of AWWA A100.

F. Grout - AWWA A100:

1. Neat Cement:

- a. Neat cement shall consist of a mixture of API Spec. 10, Class A (similar to ASTM C150, Type I) or Class B (similar to ASTM C150, Type II) and water in the ratio of not more than 6.0 gal of water per 94-lb sack of cement weighing approximately 118 lb/ft³.
- b. A maximum of 6 percent, by dry weight, un-beneficiated (not enhanced or "high yield") bentonite may be added to the neat cement grout. With bentonite additive, the mixture of cement and water should begin at the base ratio of 5.2 gal (19.7 L) of water per 94-lb sack of cement plus an additional 0.65 gal of water per sack of cement for each 1 percent bentonite additive. Note also that the bentonite contribution to the mixture is affected by the mixing protocol, that is, whether the bentonite is mixed dry with the dry cement prior to adding mixing water or instead is added first to the mixing water (pre-hydrated) prior to the addition of cement. Pre-hydrated bentonite generates more effect, such that 1 percent of bentonite added first to the mixing water (pre-hydrated) has the same effect as 3.6 percent of bentonite by dry weight mixed first with the dry cement. The additional gallons of mixing water required (0.65 gal of water for each 1 percent bentonite dry mixed) must be selected with consideration to the different mixing protocols and the relative effect of the bentonite in each protocol.

G. Gravel Pack:

1. The gravel pack planned for each well is clean, ¼" to ¾" well gravel.
2. When the test hole is drilled, the Contractor shall provide the Engineer representative samples of the particle size within the production zone as retrieved from the bore hole. The Engineer will verify the appropriate size of gravel pack to be installed in the well, if other than planned.
3. The material shall meet the requirements of AWWA A100.

H. Drilling Fluid Additive:

1. The drilling fluid additive, if used in the drilling of the well, shall conform to all applicable state standards and shall be approved for use in potable water wells. The drilling fluid additive must also conform to the requirements of AWWA A100.
2. The choice of drilling fluid additive shall be at the discretion of the Contractor; however, no additive will be allowed unless prior approval is obtained from the Engineer.
3. All fluid used in the drilling of the well shall be of sanitary quality and shall contain a chlorine residual of at least 0.5 mg/l at all times.

4. Slush pits shall be constructed and maintained so as to minimize contamination of the drilling mud.

I. Drop Pipe:

1. Materials:

- a. Certa-Lok™ PVC Drop Pipe as supplied by:

- i. CertainTeed Corporation
P.O. Box 860
Valley Forge, PA 19482
866-CT4-PIPE

- ii. Or Engineer-approved equal.

- b. Pipe and couplings shall be made from un-plasticized PVC compounds having a minimum cell classification of 12454, as defined in ASTM D1784. The compound shall qualify for a Hydrostatic Design Basis (HDB) of 4000 psi for water at 73.4° F, in accordance with the requirements of ASTM D2837. White pipe shall be supplied, unless otherwise agreed upon at the time of purchase.

- c. Polyvinyl Chloride (PVC) Drop Pipe shall utilize a spline-lock mechanical joining system.

- d. Standard pipe laying length shall be twenty (20) feet.

- e. All pipe supplied to this specification shall meet the performance requirements of ASTM D1785 for SCH 80 pipe.

- f. Joints: Pipe shall be joined using a spline lock joint. High-strength, acid-resistant, flexible thermoplastic splines shall be inserted into mating precision-machined grooves to provide full 360° restraint with evenly distributed loading. No external pipe-to-pipe restraining devices which clamp onto or otherwise damage the pipe surface as a result of point-loading shall be permitted. The joining system shall incorporate elastomeric sealing gaskets which are designed to provide a watertight seal.

- g. Adapters: Drop pipe shall be joined to pumps, check valves, pitless adapters, or other components using a PVC or Stainless-Steel Drop Pipe Adapter provided by the same manufacturer as provides the drop pipe, and which utilizes the same spline lock joint as used on the drop pipe.

- h. Marking: Drop pipe shall be legibly and permanently marked in ink with the following information:

- i. Manufacturer and Trade Name
- ii. Nominal Size & SCH Rating

- iii. Manufacturing Date Code
- iv. (NSF-61)

i. Workmanship: Pipe and couplings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, blisters and dents, interior roughness, and other injurious defects that may affect wall integrity. The pipe and couplings shall be as uniform as commercially practicable in color, opacity, density, and other physical characteristics.

2. Size: Two (2) inch diameter.

J. Down-hole Check valve(s):

1. Contractor shall install check valve(s) in the drop pipe to prevent backflow of water into the well. The valve(s) shall be of the same size as the drop pipe with the first valve being installed as close as possible to the pump discharge.
2. The initial check valve shall be placed immediately above the submersible pump. Above the initial check valve, additional check valve(s) shall be placed at intervals not to exceed 200 feet (as required by the total depth of the well).
3. Down-hole check valve(s) shall be Flomatic® ductile iron check valve Model 80DICL VFD with stainless steel guiding, suitable for submersible applications with Certa-Lok™ drop pipe, or Engineer approved equal.

2.2 PUMP EQUIPMENT:

A. General:

1. A submersible turbine well pump with above-ground discharge, suitable driver, with all accessories furnished and installed by the Contractor. All pump wetted parts and materials shall be suitable and acceptable for use in potable water service and NSF-approved. This includes metals, gasket materials, packing materials, lubricants or other material that may come into contact with the pumped fluid. All pump components shall be furnished by the pump manufacturer who shall be responsible for the Warranty of the complete pump assembly.
2. Pumping units shall be designed and furnished in accordance with the latest Hydraulic Institute and AWWA Standard for submersible turbine pumps.
3. Performance and construction similar to Grundfos SP Series submersible pump, Model 60S.

B. Manufacturers:

1. Grundfos.
2. Goulds.
3. Franklin.
4. Berkeley.
5. Simmons.
6. A. Y. McDonald.
7. Substitutions.

C. Type:

1. Multi-stage, submersible turbine type, readily available from stock without special order.
2. For use in a 5" diameter casing pipe.

D. Construction:

1. Stainless steel construction.
2. Shaft: The pump shaft shall be constructed of stainless steel, with a precision ground and polished surface.
3. Coupling: The shaft coupling shall be of stainless steel and be capable of transmitting the total torque and total thrust of the bowl assembly in either direction of rotation.
4. Submersible Cable: Pump cable shall be sized to limit the voltage drop to no more than 5%. The cable shall have three separate conductors and a ground and shall be included in a single, continuous jacketed assembly. The insulation shall be water and oil resistant, and suitable for continuous immersion. The cable should be the length of the discharge pipe plus 25 feet to extend from the surface plate to the electrical controller. The cable should be adequately secured to the discharge pipe by plastic ties, or other non-metallic means, at minimum 10-foot intervals.
5. Surface Plate: The surface plate shall be of fabricated steel. The plate shall incorporate a TEE attached securely to an ANSI Class 150 4" flange as shown on the Drawings and shall rigidly support the total weight of the motor, bowl assembly, discharge pipe, cable, and column of water. The plate shall have a cable seal of adequate size to accommodate the cable size, well vent, and water level indicator.

E. Submersible Electric Motor:

1. Performance and construction similar to Grundfos 4-inch, 3 wire, 60 Hz, MS4000 motor with MP-204 motor protector and Pt100 temperature monitoring.

2. The motor shall be a NEMA design, heavy-duty. Motors shall be sized to not overload at any point along the pump's curve without including the service factor.
3. The motor shall be equipped with a stainless-steel shell, hermetically sealed winding resin encapsulation, copper bar rotors, high-temp winding wire (rated 180°C), and capable of continuous operation underwater at the specified conditions. A suitable Kingsbury-type thrust bearing shall be incorporated in the lower end of the motor adequate to receive the entire hydraulic thrust load of the pump unit plus the weight of the rotating parts regardless of the direction of rotation in a water lubricated setting.
4. The motor shall be 3,450 RPM with a 1.15 service factor, and suitable for use on 230-volt, single phase, 60 Hz electric service.
5. The motor leads shall be of sufficient length so that they may be spliced above the bowl assembly and the leads shall be protected by a type 304 stainless steel cable guard held in place with stainless steel banding. As the motor lead exits the top of the cable guard it shall be properly protected to prevent damaging or cutting the lead by the cable guard material.
6. The motor shall be equipped with a cooling shroud sized to provide a recommended velocity range around the motor of 3 to 5 feet per second (fps), with a maximum velocity of 10 fps.

2.3 WELL HEAD COMBINATION AIR VALVE:

- A. CAVs shall be suitable at operation between 3 and 250 pounds per square inch pressure.
- B. Constant working temperature: 140°F.
- C. Max working temperature for short period of time: 194°F.
- D. The CAV shall allow large volumes of air to escape out the large orifice (valve) when filling a pipeline and closes when liquid enters the valve.
- E. When the large orifice is closed, the small air release orifice shall open to allow small amounts of air to escape automatically.
- F. The large orifice shall also allow large volumes of air to enter when the pipeline drained.
- G. Manufacturer:
 1. A.R.I. Flow Control Accessories (Model D040P02).
 2. Engineer-approved equivalent.

H. CAV Materials:

1. Valve Body: NSF 61 Certified Reinforced Nylon.
2. Discharge Outlet: NSF 61 Certified Polypropylene.
3. Seal Plug Assembly: NSF 61 Certified E.P.D.M.
4. Screws: Stainless Steel.
5. Retaining Screw: Stainless Steel ASTM A276.
6. Plug Cover: NSF 61 Certified Reinforced Nylon.
7. Rolling Seal: NSF 61 Certified E.P.D.M.
8. Plug: NSF 61 Certified Reinforced Nylon.
9. Clamping Stem: NSF 61 Certified Reinforced Nylon.
10. Float: NSF 61 Certified Foamed Polypropylene.
11. O-Ring: NSF 61 Certified NBR 70.
12. Base: NSF 61 Certified Reinforced Nylon.
13. Outlet Screen: Stainless Steel.

I. Size:

1. Two (2) inch.

J. Accessories:

1. Screened outlet to prevent penetration of debris and insects.

2.4 WELL HEAD PRESSURE RELIEF VALVE:

A. Manufacturers:

1. Watts Series 530C Calibrated Pressure Relief Valve.
2. or Engineer-approved equal.

B. Materials:

1. Bronze body construction with NPT threaded male inlet and NPT threaded female (drain) outlet connections, stainless steel spring, brass bonnet, Buna-N disc, and Buna-N O-ring.

C. Size:

1. Three quarter inch ($\frac{3}{4}$ ”).

D. Pressure:

1. Maximum Pressure: 300psi. Adjustable Pressure Ranges: 50 to 175psi.

PART 3 EXECUTION

3.1 EXAMINATION:

- A. Verify that field conditions are ready to receive work.
- B. Beginning of installation means Contractor accepts existing conditions.

3.2 PREPARATION:

- A. Contractor shall pull the pump, equipment, and casing from the existing well.
- B. Protect all structures and work near the well from damage.
- C. Confirm locations of underground utilities before starting of work.
- D. Set 10 feet of 10¾" steel surface casing.

3.3 INSTALLATION:

A. Plugging Holes:

- 1. If it becomes necessary to abandon any test hole located on the site, the abandonment procedure of the test hole(s) shall be completed so as to eliminate the possible contamination of the water in the aquifer. Sealing of the test holes shall be done in strict accordance with AWWA A100. The test holes shall also be abandoned in strict accordance with the appropriate State and Local guidelines and regulations. The Contractor shall be responsible for complying with all rules and regulations of the regulatory agencies which govern the abandonment of the test holes. He shall submit all necessary documents to the State and Local regulatory agencies. Copies of the documents shall also be submitted to the Engineer and the Owner.

B. Drilling Procedure:

- 1. All drilling shall be done by air rotary drilling equipment or other method approved by Engineer sufficient in size to drill the well to the specified depth and diameter and as shown on the Drawings. The drill hole shall be constructed round, plumb, and true to line as specified in AWWA A100. The vertical alignment of the well shall in no way impede the operation and maintenance of the permanent pumping equipment utilized. The alignment and plumbness testing of the well shall be in strict accordance with AWWA A100 or by a method approved by the Engineer.

C. Well Casing and Screen:

- 1. After the completion of the drilling operation and prior to the development of the well, the well casing shall be lowered into the bore hole with each joint of the pipe being connected with the spline-lock mechanical joining system, in strict accordance with the manufacturer's instructions and recommendations.
- 2. The casing shall be centered in the bore hole and shall be properly braced with centralizers to prevent movement. The centralizers shall be stave-type centralizers with a maximum of 4 staves per centralizer. The centralizers shall be constructed of high strength, low carbon steel or other approved material and shall be welded to the casing or attached to the casing with a method that will prevent sliding. The centralizers shall be aligned along the casing to allow for

installation of any appurtenances shown on the Drawings. Each set of centralizers shall be spaced at 50 feet along the blank casing, with one set immediately below and above a section of screen. Centralizers shall not be attached to the screen.

3. The casing shall be round and constructed plumb and true to lines as specified in AWWA A100. The maximum allowable horizontal deviation, (i.e., drift) of the casing from vertical shall not exceed two-thirds of the smallest inside diameter of that part of the casing being tested per 100 feet as per AWWA A100. The vertical alignment of the casing shall in no way impede the operation and maintenance of the permanent pumping equipment utilized.
4. Engineer may provide a hydrogeologist, or other personnel acceptable to the Engineer, to log the bore hole, observe site conditions, conditions of surfaces and installation, quality of workmanship start-up of equipment, as applicable, and to provide instruction when necessary regarding the formation(s) to be screened and the total depth of the well to be completed.
5. The well screen shall also be properly sealed to prevent gravel and/or formation material from entering the screened section of the well casing.
6. The plumbness and alignment testing of the well shall be in strict accordance with AWWA A100 or by a method approved by the Engineer. Should the casing deviate from the vertical alignment herein specified, the Contractor shall notify the Engineer immediately. The Contractor shall correct the deficiency to the satisfaction of the Engineer. Any such correction shall be at the Contractor's expense.
7. Cut off the top of the casing in such a manner to allow it to extend a minimum of one (1) inch above the well sealing block. Do not permit cuttings to enter casing. Maintain well opening and casing free of contaminating materials.

D. Gravel Pack:

1. When the gravel packed well is constructed, all gravel shall be of selected and graded quality and shall be thoroughly disinfected with a 50 mg/L chlorine solution as it is added to the well cavity.
2. After the casing and screen have been placed as specified, the Contractor shall install gravel in the annular space between the well casing and/or screen. The gravel shall extend from the bottom of the well to the depth specified on the Drawings. The gravel shall be free of dirt, trash, clay, or any other foreign substances. Under no circumstance shall the gravel contain iron, manganese, or any other constituent at levels that could affect the quality of the water. The Contractor shall, at his expense, obtain confirmation of the use of the gravel pack gradation with the recommended screen size from the manufacturer. In confirming the screen size, The Contractor shall conform to the requirements of AWWA A100. The gravel pack shall

be placed by the tremie method or by pouring from the surface with direct circulation as described herein. Alternate methods of placing the gravel must be approved by the Engineer prior to the construction of the well. Under no circumstances will the direct dumping of the rock into the annular space be allowed, unless it meets the criteria as described herein. An acceptable alternate method must prevent bridging of the gravel pack. The Contractor shall submit to the Engineer a detailed description of any alternate method considered prior to construction start-up.

3. Tremie Method of Installation:

- a. The gravel pack shall be placed by inserting a tremie pipe in the annular space between the casing and the wall of the bore hole from the surface to a point 20 feet above the bottom of the hole. The gravel shall be washed through this pipe until the annular space is filled to the bottom of the tremie pipe. The tremie pipe is then raised approximately 20 feet and the process repeated. The gravel shall be placed in this manner until the specified depth of the gravel pack is reached. All gravel used in the construction of the well shall be thoroughly disinfected with 50 mg/l of chlorine solution as the gravel is added to the well.

4. Poured from the Surface with Direct Circulation:

- a. After the casing has been properly placed, tubing or drill pipe with two close-fitting swabs shall be inserted. One swab located near the bottom of the screen and the other near the surface in the blank casing. Clear water shall be introduced into the fluid system until the drilling fluid achieves characteristics required by AWWA A100; and a maximum sand content of 1 percent. The gravel shall be placed from the surface through a funnel or orifice in the annular space between bore hole and casing. Swabbing and circulating shall be continued during placement until the gravel pack is completely in place. Before operation is begun, the Contractor shall insure that the circulation will be continuous.

E. Well Development:

1. After the well is drilled, the casing set, and the gravel pack placed as specified, the Contractor shall "develop" the well utilizing one of the following methods. Alternate methods of well development, as outlined in EPA-570/9-75-001, may be used if approved by the Engineer. Cementing of the annulus space between the casing and the wall of the drilled hole may be performed before development upon approval by the Engineer.
 - a. Test Pump with Surging:

- i. The Contractor shall utilize a test pump having a capacity greater than the anticipated lift and final production capacity of the well.
 - ii. The pump shall be set to a depth at or below that of the anticipated pumping level.
 - iii. During the over-pumping of the well with the test pump, a surging action shall be created by periodically shutting off the pump and allowing the water in the pump column to flow back into the well.
 - b. High Speed Bailing:
 - i. Development by bailer shall be done with a rig equipped with a power unit capable of bailing at a rate of 300 ft/min with an appropriately sized bailer, unless otherwise directed by the Engineer.
 - ii. Contractor shall exercise care to prevent damage to the screen during bailing operations.
 - 2. The development equipment and method used shall permit variable production/development rates.
 - 3. The discharge piping provided shall be of sufficient diameter and length to conduct water to a point designated by the Owner/Engineer, and shall include orifices, meters, or other devices that will accurately measure the flow rate.
 - 4. Operating parameters, duration of development and development records shall be in accordance with AWWA A100 and as directed by the Engineer.
 - 5. The depth of the gravel pack shall be maintained during the development of the well. If necessary, the Contractor shall install additional gravel as shown on the Drawings.
- F. Grouting and Sealing:
- 1. After the development of the well, or upon placement of gravel pack and acceptance by the Engineer, the Contractor shall seal the space between the casing and drill hole shall be sealed by using enough cement under pressure to completely fill and seal the annular space between the casing and the drill hole. The well casing shall be cemented in this manner from the top of the shallowest formation to be developed to the earth's surface. The well driller shall utilize a pressure cementation method in accordance with the AWWA Standard for Water Wells (A100 06), Appendix C: Section C.2 (Positive Displacement Exterior Method); Section C.3 (Interior Method Without Plug); Section C.4 (Positive Placement, Interior Method, Drillable Plug); and Section C.5 (Placement Through Float Shoe Attached to Bottom of Casing).

2. The grout line shall remain in place until enough grout has been wasted on the surface to ensure all air pockets and foreign materials have been removed.
3. The cement, after placement, shall be allowed to set for a period of not less than twenty-four (24) hours, after which any settling of cement at the top of the hole shall be checked and filled to the surface with the same slurry mix as was pumped around the casing. Drilling operations may resume after additional cement has been allowed to set up for 24 hours.
4. It is important to note that when Portland cement-based grouts cure, the hydration reaction produces heat that can be transferred to the PVC well casing. The resultant temperature increase will reduce the collapse strength (RHCP) of PVC casing. The Contractor shall use measures as necessary to avoid damage to the installed casing during and after pressure grouting until the heat from hydration has dissipated. Once the heat has dissipated, the cemented portion of the well casing shall be inspected via video camera in the presence of the Owner or Engineer to verify that no damage is present. If damage exists, Contractor shall repair or replace the casing to the satisfaction of the Engineer at no additional cost to the Owner.

G. Pump:

1. Install pump and accessories in accordance with manufacturer's procedures and recommendations.

H. Drop Pipe:

1. Installation of drop pipe shall be in strict accordance with manufacturer's procedures and recommendations.
2. Prior to installation, drop pipe shall be visually inspected to ensure there is no dirt or foreign matter in the pipe, and any such material which is found shall be removed before installation.

I. Well Head:

1. After the completion of the well and installation of the pumping units, the Contractor shall install a concrete pad around the well as shown on the Drawings. The pad shall have a minimum thickness of 8 inches. A cast-in-place, concrete sealing block centered on the well shall be installed as shown on the Drawings. The concrete block shall extend a minimum of 18 inches above the concrete pad and sloped to drain away at not less than $\frac{1}{4}$ inch per foot shall be provided around the wellhead.
2. The concrete slab and block shall be in accordance with the specifications and extend at least three feet from the well casing in all directions. The finished grade of the slab shall slope away from the well in all directions at not less than a $\frac{1}{4}$ inch per foot.

3. The well head discharge shall conform to the dimensions and configuration as shown on the Drawing.
4. Wellhead and pump base shall be sealed by a gasket or sealing compound and properly vented to prevent the possibility of contaminating the well water.
5. A well casing vent shall be provided with an opening that is covered with 16-mesh or finer corrosion-resistant (stainless steel) screen, facing downward, elevated and located so as to minimize the drawing of contaminants into the well. Wellheads and well vents shall be at least two feet above the highest known watermark or 100-year flood elevation.
6. A suitable sampling cock shall be provided on the discharge pipe of each well pump prior to any treatment.
7. The discharge of the well blow-off shall terminate in a downward direction and at a point which will not be submerged by flood waters.
8. An air release device shall be installed in such a manner as to preclude the possibility of submergence or possible entrance of contaminants. In this respect, all openings to the atmosphere shall be covered with 16 mesh or finer, corrosion-resistant screening material or an acceptable equivalent.
9. Install valves and well head equipment as shown and in accordance with manufacturer's instruction. Hydrostatically test valves in conjunction with adjacent piping. Replace or repair valve as required to correct leaks. No visible leaks will be accepted.

J. Flowmeter:

1. Flow measuring devices shall be provided for each well to measure production yields and provide for the accumulation of water production data. These devices shall be located to facilitate daily reading.
2. Flow meter shall be installed per manufacturer's recommendations with applicable straight piping runs both upstream and downstream of the meter to ensure meter accuracy.

K. Electrical:

1. Permanent electrical equipment shall be installed including pump cable for submersible pump motor. Contractor shall provide adequate pump cable for connection to electrical device stand adjacent to the well head.

2. A single 20-amp duplex receptacle shall be located on the sealing block, so it is accessible within the well head enclosure. This receptacle is intended to be used for a thermostatically controlled space heater provided by Owner.
3. Pump control panel and electrical enclosures shall be mounted on an electrical stand as shown on the Drawings adjacent to the well head. Electrical panel shall be installed so the front of the panel faces north.

3.4 WELL ABANDONMENT:

A. Abandonment of Partially Completed and Completed Wells:

1. If it is necessary to abandon a partially completed or completed well it will be done in strict accordance with AWWA A100, EPA-570/9-75-001, the TCEQ and any local governing agency regulations. The Contractor shall be responsible for submitting all the necessary documents to the State and Local regulatory agencies. Copies of the documents shall also be submitted to the Engineer and the Owner.

3.5 FIELD QUALITY CONTROL AND TESTING:

A. Driller's Log:

1. A driller's log shall be maintained. The driller's log shall conform to the requirements of the TCEQ, and AWWA A100. The Contractor shall, at a minimum, record the following information:
 - a. The depth of the various formation changes.
 - b. The reference used for the depths.
 - c. The static water level.
 - d. Depth of the bore hole and diameter.
 - e. Description of the lithology.
 - f. Any information pertinent to the requirements of the Engineer.
2. The information from the driller's log shall be submitted to the appropriate State agencies and the local underground water district. In all cases, the Contractor shall conform to all ordinances and requirements of State law and/or local governmental entities.

B. Water Sampling and Testing:

1. Interim acceptance of the well as a source of potable water will be contingent upon a chemical analysis of water produced at the conclusion of the 12-hour well performance test. The Contractor is responsible for notifying Engineer/Owner as to the conclusion of the pump test. Contractor will collect samples and transport to private laboratory for analysis. These tests will determine if water with acceptable quality is produced from the wells. Contractor shall provide Owner and Engineer copies of results of all analyses performed.

2. Chemical analysis reports are required from the Texas Department of Health (TDH) laboratory in Austin or another laboratory certified by TDH for final well approval. The analysis shall include chemical testing in conformance with TDH requirements.
3. The method used to collect samples shall not contaminate the aquifer.
4. The collection and analyses required of the water samples shall be in accordance with TCEQ 30 TAC 290, AWWA A100, EPA-570/9-75-001 and as directed by the Engineer.
5. The cost of the collection and transport of the water samples to the independent laboratory will be the responsibility of the Contractor.

C. Well Performance Testing:

1. After completion of the development of the well, the Contractor shall set a test pump. The test pump shall be equipped with the appropriate power unit and shall be capable of conducting the required testing. The setting of the test pump and its removal after the completion of the tests including all discharge piping and necessary appurtenances shall be provided at the expense of the Contractor. The test pump may be the permanent pump upon approval by the Engineer.
2. After the test pump has been set, the well shall be washed, surged, and developed until the water has reached a turbidity level of less than 5 NTU. The Engineer reserves the right to extend or reduce the required pumping time. After the initial pumping, the well shall be pumped in accordance with AWWA A100 as directed by the Engineer. During this period, records of draw down and discharge shall be kept. Equipment for accurately measuring the pumping rate shall be installed. The pump test shall continue for a minimum of 36 hours, unless a shorter period of time is approved by the Engineer.
 - a. Shorter period will be acceptable under the following conditions:
 - i. The pumping rate remains constant for at least two hours, and the pumping period has been a minimum of 12 hours, or
 - ii. The pumping rate remains constant for at least two hours, and a straight-line trend is observed on a plot of water level versus a logarithm of time during pumping and recovery.
3. Measurements of static water level and pump flow shall be taken at the following designated intervals, unless otherwise directed by Engineer:

- a. Every minute for first ten minutes (0-10).
 - b. Every two minutes for second ten minutes (10-20).
 - c. Every five minutes for first hour (20-60).
 - d. Every ten minutes for second hour (60-120).
 - e. Every twenty minutes for third hour (120-180).
 - f. Every thirty minutes for remainder of test.
4. After the pumping portion of the test has been completed and the pump stopped, measurements of the recovery of the water level shall be made at these same time intervals for an eight (8)-hour period, or until the water level recovers to near or at the original static water level, whichever occurs first. The pump shall not be removed during this recovery period.
 5. Records kept during the testing shall be in accordance with AWWA A100, TCEQ 30 TAC 290, EPA-570/9-75-001, and as directed by the Engineer. The results of the test shall be kept by the Contractor and presented to the Engineer prior to the setting of the permanent pump. The permanent pump specifications will be determined by the Engineer based on the pump test data.
 6. Any pump equipment used in the hydraulic testing of the well shall not be installed as permanent equipment. Contractor shall furnish all power or make arrangements for all power to operate test pump equipment.
 7. Contractor shall notify Engineer at least twenty-four (24) hours prior to the start of pumping for the hydraulic testing.
 8. Contractor shall notify TPWD Inspector at least 5 working days prior to the start of pumping for the hydraulic testing.
 9. After the hydraulic conditions are determined, Engineer shall determine appropriate permanent well pump. Engineer shall direct Contractor as to pumping rate and total dynamic head pumping conditions. Contractor shall submit proposed pumping equipment and design conditions to be approved in writing by the Engineer before ordering the pumping equipment.

3.6 DISINFECTION:

- A. The disinfection of the drilling fluid, gravel pack, sand, and other materials and equipment used in conjunction with the drilling, installation and pumping of the well shall be done in the presence of the Engineer and in accordance with AWWA A100 and AWWA C654.
- B. The well shall be disinfected per AWWA. After the permanent pumping equipment is in place, the well shall be chlorinated by treating the water in the well casing to provide a chlorine residual of approximately 50 mg/l for the entire volume of water; circulating the chlorinated water within the well casing; and pumping the well to remove the chlorinated water. After the chlorine has been added, the Contractor shall surge the well at least three times to improve the mixing of the water and to provide contact of the

chlorine with the adjacent aquifer. The chlorinated water shall be allowed to remain in the well at least 6 hours, but no more than 24 hours. Following the completion of this process, the Contractor shall pump the chlorinated water to waste for 15 minutes after a 0 mg/l chlorine residual is measured.

- C. Before placing the well in service, the water containing the disinfectant shall be flushed from the well and then samples of water shall be collected and submitted for microbiological analysis until three (3) successive daily raw water samples are free of coliform organisms. The analysis of these samples shall be conducted by a laboratory approved by the Texas Department of Health. Owner/Engineer is responsible for obtaining these samples until three (3) successive daily samples are free of coliform organisms. Contractor may elect to obtain samples for analysis at no additional cost to the Owner.

3.7 Contractor will pay for laboratory testing costs.

- A. Chlorine compound required to dose 100 feet of water-filled well at 50 mg/l:

Well-hole or Well-Casing Diameter	Volume Per 100 ft of Water Depth	Calcium Hypochlorite (65% Available Cl ₂)	Sodium Hypochlorite (liquid) (12% Available Cl ₂)	Liquid Chlorine (100% Available Cl ₂)
4 in	65.3 gal	0.7 oz	.03 gal	0.03 lb
6 in	146.9 gal	1.5 oz	.06 gal	0.06 lb
8 in	261.1 gal	2.7 oz	.11 gal	0.11 lb
10 in	408.0 gal	4.2 oz	.17 gal	0.17 lb
12 in	587.5 gal	6.0 oz	.24 gal	0.25 lb
16 in	1,044.5 gal	10.7 oz	.44 gal	0.44 lb
20 in	1,632.0 gal	1 lb 1 oz	.07 gal	0.68 lb
24 in	2,350.0 gal	1 lb 8 oz	1.0 gal	0.98 lb
30 in	3,672.0 gal	2 lb 6 oz	1.5 gal	1.53 lb

3.8 FINAL SITE CONDITIONS:

- A. Final pump setting shall be field-tested before project completion. Tests shall include:
 1. Motor testing per Division 26.
 2. Bump to check rotation.
 3. Initial operation test.
 4. 12-hour pump test.
 5. Ops check and calibration of flowmeter.
 6. Provide Owner written documentation of flowmeter calibration certification.

- B. Upon completion of the work all excess material and equipment will be removed from the site by the Contractor in a manner approved by the Engineer.
- C. The well site shall be fine graded so that the site is free from depressions, reverse grades, or areas too rough for proper ground maintenance to ensure that surface water will drain away from the well. The final condition shall result in all drainage conveyed away from the wellhead.
- D. All damage resulting from work in this Section shall be cleaned, repaired, or replaced to the satisfaction of the Engineer at no cost to the Owner.

END OF SECTION

SECTION 33 14 00

WATER SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Water mains including valves, valve boxes, blocking, fittings, and other appurtenances for potable water distribution systems.

1.2 REFERENCES:

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

1. ASTM A53--Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless.
2. ASTM A126--Gray Iron Castings for Valves, Flanges and Pipe Fittings.
3. ASTM A307--Specification for Carbon Steel Bolts and Studs 60,000 psi Tensile.
4. ASTM A536--Ductile Iron Castings.
5. ASTM D1784--Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.
6. ASTM D1785--Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
7. ASTM D2241--Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR).
8. ASTM D2466--Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
9. ASTM D2737--Polyethylene (PE) Plastic Tubing.
10. ASTM D2855--Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings.
11. ASTM D3139--Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
12. ASTM F477--Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

B. American Water Works Association (AWWA):

1. AWWA C104--Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.

2. AWWA C105--Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
 3. AWWA C110--Ductile-Iron and Gray-Iron Fittings, 3 inches through 48 inches, for Water and Other Liquids.
 4. AWWA C150--Thickness Design of Ductile Iron Pipe.
 5. AWWA C151--Ductile Iron Pipe.
 6. AWWA C153--Ductile Iron Compact Fittings, 3 inches through 12 Inches, for Water and Other Liquids.
 7. AWWA C500--Metal-Seated Gate Valves, For Water Systems.
 8. AWWA C502--Dry Barrel Fire Hydrants.
 9. AWWA C509--Resilient-Seated Gate Valves for Water Systems.
 10. AWWA C550--Protective Interior Coatings for Valves and Hydrants.
 11. AWWA C600--Installation of Ductile-Iron Water Mains and Appurtenances.
 12. AWWA C700--Cold Water Meters Displacement-Type, Bronze Main Case.
 13. AWWA C900--Polyvinyl Chloride (PVC) Pressure Pipe, 4 inches through 12 inches, for Water.
 14. AWWA C901--Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, 1/2 inch through 3 inches for Water.
 15. AWWA C905--Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 inches through 36 inches.
- C. ANSI 16.1--Cast Iron Pipe Flanges and Flanged Fittings.
- D. 30 TAC 290, Texas Administrative Code, Volume 30, Chapter 290, Water Hygiene.
- E. UL 246--Hydrants for Fire-Protection Service.

1.3 SUBMITTALS:

- A. Product Data: Manufacturer's product data sheets on all materials incorporated into work.
- B. Quality Control Submittals: For information only.
 1. Certificates: Manufacturer's certificates attesting compliance with applicable specifications for grades, types, classes, and other properties.

2. Test Reports: Results of field quality control tests including hydrostatic tests and bacteriological tests.

C. Contract Closeout Submittals:

1. Protect Record Documents: Accurately record installed location of valves, hydrants, piping and service connections, and accessories.

1.4 QUALITY ASSURANCE:

A. Pipeline installation shall be in accordance with manufacturer's recommendations and as supplemented by these specifications.

B. Pipe shall be kept clean of all foreign matter.

1. At temporary termination of pipe laying, provide suitable cover to close open end until burying operations are resumed.

C. Jointing shall be by trained employees.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver, store, and handle products.

B. Each load of pipe delivered to the job site shall be inspected by the Engineer.

1. Pipe transported without adequate protection shall be rejected and removed immediately from the job site.

2. Inadequate wall thickness or tolerances greater than specified: Owner may elect to randomly select samples of the pipe to be forwarded immediately to an approved testing laboratory with instructions to check the pipe for compliance with applicable product standards, ASTM Specifications, and other applicable specifications.

3. When the testing laboratory reports concur that the pipe does not meet specifications, the defective pipe shall be removed immediately from the job site by the Contractor.

4. If defective, all costs for shipping of samples, laboratory testing, removal of defective pipe, and replacement pipe shall be the sole responsibility of the Contractor.

PART 2 PRODUCTS

2.1 PIPE:

A. All pipe shall bear NSF 61 seal of approval.

B. PVC Water Pipe--(4 inch and larger) Pressure Related: AWWA C900:

1. DR 18--Pressure Rating 235 psi.

2. Joints shall be integral bell with flexible elastomeric seal, meeting ASTM F477.
- C. PVC Water Pipe--(3-inch): IPS, ASTM D2241.
1. SDR 21--Pressure Rating 200 psi.
 2. Joints shall be integral bell with flexible elastomeric seal, meeting ASTM F477.
- D. PVC Water Pipe--(2-inch and less): ASTM D1784.
1. Sched 40: Pressure Rating 280 psi (min).
 2. Joints shall be solvent-weld, bell end pipe products meeting the requirements of ASTM D2672.
- E. Ductile Iron Water Pipe: AWWA C151, Pressure Class 250
1. Cement lined interior, AWWA C104.
 2. Exterior shall be bituminous coated, AWWA C151.
 3. Wrap buried pipe with 8 mil polyethylene encasement, AWWA C105.
- F. Galvanized and Steel Pipe: ASTM A53.
1. Galvanized, standard wall; threaded.

2.2 FITTINGS:

- A. Buried Fittings (size 3-inch through 48-inch).
1. Ductile iron, AWWA C110 (non-compact) or AWWA C153 (compact).
 2. Cement lined interior, AWWA C104.
 3. Exterior shall be bituminous coated.
 4. Fittings shall be push-on, mechanical joint or flanged pipe as shown.
 5. Wrap buried fittings with 8 mil polyethylene encasement, AWWA C105.
 6. Working pressure rated to 350 psi.
- B. Buried Fittings (3-inch) for use with ASTM 2241 pipe.
1. PVC, ASTM D1784, Harco Class 200.
 2. NSF approved and marked for potable water use.
 3. Joints shall be integral bell with flexible elastomeric seal.
 4. Working pressure rated at 200 psi.
- C. Above-Grade Fittings (size 3-inch through 48-inch).
1. Ductile Iron Flanged Fittings, AWWA C110.

2. Cement lined interior AWWA C104.
3. Exterior shall be bituminous coated.
4. Working pressure rated to 350 psi.
5. Face and drill in accordance with ANSI B16.1 for Class 125 flanges.

D. Above-Grade Fittings (smaller than 3-inch).

1. Galvanized steel, ASTM A53.
2. Standard wall; threaded.

2.3 COUPLINGS:

A. Flanged Coupling Adapters:

1. Conform with ASTM A126, Class B, Cast Iron.
2. Products: Dresser Style 127, Uni-Flange Series 400, or approved equal.

B. Flexible Couplings:

1. Type: Gasketed, sleeve type, straight cast.
2. Products: Dresser Style 38 or style 162 (transition coupling), or equal.
3. Service: Supply couplings with working pressures which meet or exceed the joining pipe rating.

2.4 BOLTS AND GASKETS:

A. Gaskets shall be 1/16-inch cloth insert, red rubber, full face.

B. Bolts shall be in accordance with the following:

1. Non-Pressure Applications: ASTM A307A.
2. Pressure Applications: ASTM A307B.
3. Submerged/Splashed: 316 stainless steel.

2.5 VALVES:

A. Gate Valves (3-inch through 48-inch).

1. Type: Solid wedge, resilient-seat type.
2. Standard: AWWA C509.
3. Working Pressure: Rated to 200 psi minimum.
4. Stem: Non-rising stem with O-ring valve packing and 2-inch square not, except as shown otherwise.
5. Joints: Mechanical (buried); Flanged (above grade).

6. Opening: Counterclockwise.
7. Finish: Ferrous surfaces of valve interior epoxy-coated, AWWA C550.
8. Wrapping: Wrap valve body with 8 mil polyethylene encasement in a manner which will not interfere with valve operation, buried service.

B. Gate Valves (smaller than 3-inch):

1. Type: Iron body, bronze-mounted, double disc, parallel seat.
2. Standard: AWWA C500.
3. Working Pressure: Rated to 200 psi minimum.
4. Stem: Non-rising stem with O-ring valve packing and 2-inch square nut, except as shown otherwise.
5. Joints: Mechanical (buried); Flanged (above ground).
6. Opening: Counterclockwise.
7. Finish: Ferrous surfaces of valve interior epoxy-coated, AWWA C550.
8. Wrapping: Wrap valve body with 8 mil polyethylene encasement in a manner which will not interfere with valve operation, buried service.

C. Butterfly Valves:

1. Type: Full lug butterfly valve in full lugged body style.
2. Pressure Rating: 200 psi.
3. Valve body: Ductile Iron, ASTM A395.
4. Valve disc: Bronze - ASTM B-62.
5. Valve seat: EPDM Phenolic reinforced.
6. Shaft: 416 Stainless steel.
7. Operator: 10 position lever operated.
8. Manufacturer: Milliken, Watts, or Engineer approved equal.
9. All wetted parts of valve shall be NSF approved for potable water service.
10. Valve shall have bubble-tight shut off in both directions.

11. Connections: Flat faced flanges with full face gaskets, 125 pound pattern.

12. Installation: Install as shown and in accordance with manufacturer's instruction. Hydrostatically test valves in conjunction with adjacent piping. Replace or repair valve as required to correct leaks. No visible leaks will be accepted.

D. Ball Valves:

1. Below grade:

a. Thermoplastic ball valves shall be True Union Industrial type manufactured to ASTM F 1970 and constructed from PVC Type I, ASTM D 1784 Cell Classification 12454 or CPVC Type IV, ASTM D 1784 Cell Classification 23447.

b. O-rings shall be EPDM or FKM.

c. Valves shall have Safe-T-Shear® stem with double O-ring stem seals.

d. Valve handles shall be polypropylene with built-in lockout mechanism.

e. Valve union nuts shall have Buttress threads.

f. Seal carriers shall be Safe-T-Blocked®.

g. Valve components shall be replaceable.

h. EPDM valves shall be certified by NSF® International for use in potable water service.

i. Valves shall be installed with 6-inch Sched 40 PVC valve box with appropriate lid.

2. Above grade:

a. Ball valves shall be bronze and shall have a minimum 400 psi wog rating and 150 psi wsp rating, PTFE seats, chrome plated ball, separate packing nut, and bottom-loaded stem.

b. Temperature range -20 to 180 degrees F.

c. Valves shall meet Federal Specification WW-V-35.

2.6 ACCESSORIES:

A. Retainer Glands: To be installed on all below ground fittings and valves, 3" and greater.

1. Mechanical joint fittings to PVC: Ductile iron, ASTM A536, Grade 65-45-12.
 - a. Product: EBAA Iron Series 2000 PV, or approved equal.
 2. Mechanical joint fittings to Ductile Iron: Ductile Iron ASTM A536 Grade 60-40-10.
 - a. Product: EBAA Iron Megalug Series 1100, or approved equal.
- B. Tapping Sleeves:
1. Materials:
 - a. Shells: 304 Stainless Steel.
 - b. Lugs: 304 Stainless Steel.
 - c. Bolts, Washers and Nuts: NC Rolled Thread, 304 Stainless Steel.
 - d. Gaskets: Virgin SBR compounded for water service.
 - e. Flange: 304 Stainless Steel or Ductile Iron, ASTM 536-80, Grade 65-45-12.
- C. Valve Boxes/Covers:
1. Produce: 6-inch diameter Sched 40 PVC valve box cut to length so cover is flush with ground surface, or approved equal.
 2. Cover: Cast Iron, marked, "Water" with a tight fit to valve box.
- D. Metallic Marking Tape:
1. To be installed in trench with PVC Pipe as shown on Drawings.
 2. Tape shall have total thickness of 5 mil. Consisting of 1 mil. polypropylene clear film with reverse printing laminated to 0.5 mil. aluminum foil core, and 3.5 mil. polyethylene back.
 3. Tape shall be detectable with a non-ferrous metal detector.
 4. Tape shall have an ASTM D822 tensile strength of 35 lb/in. And 80% elongation according to ASTM D888-75B. Tape shall be provided by Pro-Line Safety Products Co., West Chicago, IL or approved equal.
 5. Contractor shall furnish appropriate color for non-potable water and tape shall be marked with "Caution - Buried Water Line Below" or approved equal. Tape shall be installed in trench before last lift is placed and compacted providing 12" finished cover above tape.

E. Tracer Wire:

1. Tracer wire for open cut/open ditch and through casing pipe shall be a #14 AWG HS-CCS high-strength copper clad steel conductor (HS-CCS), insulated with a 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation, and rated for direct burial use at 30 volts.
2. HS-CCS conductor must be at 21% conductivity for locate purposes, break load 250 lbs. minimum.
3. HDPE insulation shall be RoHS compliant and utilize virgin grade material. Insulation color shall meet the APWA color code standard for identification of buried utilities.
 - a. Manufacturers supplying copper clad steel tracer wire must have available detailed performance data including 5 years of underground testing in terms of durability related to damage of protective insulation and effects of potential corrosion of the specific copper clad steel used. Origin of copper clad steel manufacturer is required and steel core must be manufactured in the United States. If manufacturer has not completed 5 year corrosion testing, a 5 year warranty must be provided.
 - b. Tracer wire shall be Copperhead™ HS-CCS HDPE 30 mil or pre-approved equal and made in the USA.
 - i. Part# 1430B-HS in appropriate spool length.
 - ii. Utilize the least amount of connection/splice points as possible. Spools come in 500', 1000', and 2500' lengths to maximize continuous wire runs.

B. Anode:

1. The tracer wire system shall be terminated and grounded at all dead end points with the appropriate anode to complete the electrical circuit.
2. Anode shall be Copperhead™ Anode must be used or a pre-approved equal and made in the USA. Part # (Ano-1005), 1# x 1.315"D x 18.5"L, Magnesium Drive in Anode.
3. The anode provided is intended to include an HDPE cap and 10' of factory installed Copperhead™ red 14 AWG copper clad steel tracer wire with 30 mil high-density high molecular weight polyethylene (HDPE) insulation. The factory installed wire is rated for direct burial use at 30 volts. HDPE insulation shall be RoHS compliant and utilize virgin grade material. Package includes one Copperhead SnakeBite™ connector, part # SCB-01-SR, which is filled with non-hardening, dielectric, moisture displacement silicon for corrosion protection.

The connector is provided to splice the factory installed anode tracer wire to the mainline tracer wire.

C. Connector:

1. Connectors shall be Copperhead™ SnakeBite Locking Connector or pre-approved equal and made in the USA, Part # LSC1430B-25.
2. Wire Type: Copperhead™ CCS 30 mil copper clad steel tracer wire, Range: Min #14 / Max #10.
3. Molded Plastic Temperature Rating: -45°C (-49°F) to 125°C (257°F).
4. Vertellus Moisture Displacement Gel Material Temperature Rating: 154°C (309°F).

D. Test Stations:

1. Test stations shall be Copperhead™ SnakePit™ or pre-approved equal and made in the USA, Part number LD14B Lite Duty Box.
2. The appropriate test station is intended to include encapsulated magnet, corrosion-resistant insulated brass wire lug, wax pad to cover wire connections after installation of wire, color-coded and tamper-proof locking lid with top access connection point. Lid removal shall not be required to use station.
3. Test stations shall be located at the beginning and the end of each continuous run of new water line installed, and at intervals along water line as recommended by the manufacturer.

PART 3 EXECUTION

3.1 PREPARATION:

- A. Stake locations of fittings, valves, and accessories prior to installation for review by Engineer.
- B. Prior to installing valves, remove foreign matter from within the valves. Inspect the valves in open and closed position to verify that parts are in satisfactory working condition.

3.2 SETTING VALVES AND VALVE BOXES:

- A. Install valves and valve boxes where shown. Set valves plumb and as detailed. Center valve boxes on valves. Locate valves away from roads or streets. Carefully tamp earth around each valve box for a minimum radius of 4 feet, or to undisturbed trench face if less than 4 feet.

3.3 PIPE INSTALLATION:

- A. Preparation:

1. Do not lay pipe in water, or when trench or weather are unsuitable for work. Keep water out of trench until jointing is complete and bedding is placed to top of pipe. When work is not in progress, close ends of pipe and fittings securely so that no trench water, earth or other substances will enter pipes or fittings.
 2. Keep inside of pipe free from foreign matter during operations by plugging or other approved method.
 3. Place pipe so that full length of each section rests solidly upon pipe bed, with recesses excavated to accommodate bells and joints. Take up and re-lay pipe when grade or joint is disturbed after laying.
 4. Handle pipe and accessories so that pipe placed in trench is sound and undamaged. Take particular care not to injure pipe coating when applicable.
 5. Cut neatly, using approved type mechanical cutter without damaging pipe. Use wheel cutters when practicable.
 6. Wrap ductile iron pipe fittings, and valves with 8 mil polyethylene film, AWWA C105, with edges overlapped and securely taped with duct tape to prevent contact between pipe and surrounding bedding. Repair punctures with duct tape to restore the protective continuous wrap before backfilling.
- B. Pipe Bedding and Backfill: In accordance with Section 331000, Excavating, Backfilling and Compacting for Utilities.
- C. Placing and Laying:
1. Bury water lines as shown.
 2. Do not exceed 75 percent of pipe manufacturer's recommendations for deflections from straight line or grade as required by vertical curves, horizontal curves, or offsets. If alignment requires deflections in excess of these limitations, use fittings.
 3. Intersecting lines shall be joined by an appropriate fitting.
 4. Perform no pipe work in fill areas until embankment or fill has been properly completed to at least 2 feet above top of pipe elevation.
- D. Joints:
1. Install mechanical joints in accordance with manufacturer's recommendations.
 2. Make push-on joints in accordance with manufacturer's recommendations.

- E. Anchorage of Fittings - Anchor tees, bends and plugged, valved or capped ends of lines of water mains with mechanical restraints as shown in accordance with manufacturer's instructions.

3.4 FIELD QUALITY CONTROL TESTING:

- A. Hydrostatic tests: Pressure test completed water lines hydrostatically. Water will be available from existing water wells on site to pressure the lines. Provide pumps, gauges, meters, and other equipment necessary for performance of tests.
 - 1. Hydrostatic leakage rate shall not exceed the amount allowed or recommended by AWWA formulas.
 - 2. Tests shall be performed only after the pipeline has been properly filled, flushed, and purged of air. The specified test pressure shall be applied by means of an approved pumping assembly connected to the pipe in a manner satisfactory to the Engineer. The test pressure shall not exceed the design pressure of the pipe, fittings, valves, or thrust restraints. If necessary, the test pressure shall be maintained by additional pumping for the specified time. During tests, the system and exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage. Visible leaks shall be stopped. Defective elements shall be repaired or removed and replaced and the test repeated until the test requirements have been met.
 - 3. Test duration: The duration of the hydrostatic test shall be 2 hours.
 - 4. Test pressure: The hydrostatic test pressure shall not be less than 1.25 times the stated anticipated maximum sustained working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the stated sustained working pressure at the lowest elevation of the test section. However, in no case shall the test pressure exceed the rated working pressure for any joint, thrust restraint, valve, fitting, or other connected appurtenance of the test section.
 - 5. Test allowance: The testing allowance shall be defined as the quantity of water that must be supplied to the pipe section being tested to maintain a pressure within 5 psi of the specified hydrostatic test pressure. No installation will be accepted if the quantity of makeup water is greater than that determined by the formula:

$$Q = \frac{LD\sqrt{P}}{148,000}$$

Where:

Q = quantity of makeup water, in gallons per hour

L = length of pipe section being tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)

6. Visible leaks: Visible leaks shall be repaired regardless of the amount of leakage.
7. Maintain records of:
 - a. Date tests were performed.
 - b. Names of people in attendance.
 - c. Location of test section.
 - d. Brand name of pipe and pressure rating.
8. Failed test sections shall be repaired and retested at the Contractor's expense.

END OF SECTION

SECTION 33 31 11

PIPES AND PIPE FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Ductile Iron Pipe and Fittings.
- B. Polyvinyl Chloride (PVC) Pipe and Fittings.
- C. Sanitary Waste, Drain, and Vent (DWV) Pipe and Fittings.
- D. Miscellaneous Small Piping.

1.2 REFERENCES:

- A. AWWA C151--Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- B. AWWA C150--Thickens Design of Ductile Iron Pipe.
- C. ANSI B16.1--Cast Iron Pipe Flanges and Flanged Fittings.
- D. ASTM D3033--Type PSP Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- E. ASTM D3034--Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- F. ASTM D1784--Rigid Poly(Vinyl Chloride).
- G. ASTM D2241--Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series).
- H. ASTM D2564--Solvent Cement for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- I. ASTM A53--Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- J. AWW C110--Ductile-Iron and Gray Iron Fittings, 3-inch Through 48 inch, for Water and Other Liquids.

1.3 REGULATORY REQUIREMENTS:

- A. Conform to applicable code for piping and component requirements.

PART 2 PRODUCTS

2.1 PIPE:

- A. Ductile Iron Pipe: Ductile Iron Pipe and fittings for large diameter filter piping shall be provide flanged fittings as shown.

- B. Flanged joints (ANSI B16.1, Class 125) shall be used in all exposed and inside piping except where otherwise indicated. Where mechanical groove type joints are used, the type and fittings shall be radius cut grooved in accordance with the current edition of AWWA C606.
- C. Polyvinyl Chloride (PVC) Pipe: PVC pipe 4" in diameter or smaller shall conform to the requirements of ASTM D 2241 using PVC 1120 plastic. The pipe shall have a wall thickness of SDR 26, Schedule 40, or 80 as shown.
- D. Drain Waste and Vent (DWV) Piping: Piping for sanitary DWV piping shall be acrylonitrile-butadiene-styrene (ABS) sewer pipe and fittings. ABS pipe shall meet the requirements of the Uniform Plumbing Code, 1991 Edition and ASTM D2751.
- E. Miscellaneous Small Piping:
 - 1. Galvanized Steel Pipe: Steel pipe 3 inch diameter and smaller and not otherwise specified shall be galvanized standard wall and shall meet the requirements of ASTM Designation A 53. The pipe joints and fittings shall be threaded. Provide threaded flanges for connections to flanged equipment.
 - 2. Copper Pipe: Copper pipe installed underground shall be Type "L", soft temper. All exposed copper pipe shall be Type "M", hard temper. Solder type wrought copper fittings shall be used, except on buried potable water lines, which shall utilize compression fittings.

2.2 PIPE FITTINGS:

- A. General:
 - 1. Pipe fittings shall be of the type and design especially suitable for use with the type of piping with which they are installed. Fittings shall have a pressure rating equal to that of the pipe with which they are used but in no case less than 150 psi. All flanged fittings shall be faced and drilled in accordance with ANSI B 16.1 for Class 125 flanges.
- B. Ductile Iron:
 - 1. Ductile iron fittings for use with ductile iron pipe.
- C. Drain Waste and Vent (DWV):
 - 1. DWV pipe fittings shall be the same material as piping and meet Uniform Plumbing Code.
- D. Polyvinyl Chloride (PVC):
 - 1. PVC fittings shall be constructed of the same material and have the same pressure rating as the pipe to which they are joined. Fittings shall be socket-weld type as indicated or specified.

2.3 PIPE HANGERS AND PIPE SUPPORTS:

- A. All exposed piping shall be suitably supported by pipe hangers or pipe supports. Supports and hangers shall be of the types specified herein or shown on the drawings with the spans between adjacent supports or hangers being as shown on the drawings. Supports or hangers for small piping shall be spaced so that no deflection of the piping will occur between adjacent supports. Perforated strap is not acceptable for pipe supports or hangers.
- B. All supports and hangers shall be installed and adjusted so that the loads are equally distributed throughout any one run of piping.
- C. Small piping shall be supported from continuous concrete inserts and trapeze hangers, wall brackets, or other accessories as required by the particular installation. Small piping supports shall be Grinnell, Unistrut, Beeline, or approved equivalent.
- D. All pipe supports shall be 316 stainless steel unless specified or shown otherwise.

2.4 FLEXIBLE COUPLINGS:

- A. Provide flexible pipe couplings of the gasketed, sleeve type where shown on the drawings. Supply couplings with working pressures which meet or exceed the joining pipe rating. Provide connecting bolts constructed of ASTM A-276, type 316 stainless steel.

2.5 INCIDENTAL VALVES:

- A. General: Incidental valves are those valves in the piping system of this Section that are 3 inches diameter and smaller, and intended for ON/OFF service. Valves shall be pipeline size and type per this Section unless shown or specified otherwise. This Section does not include solenoid valves, control valves, butterfly valves, or other special valves.
- B. PVC Piping Valves: Valves for use in PVC chemical piping shall be PVC ball valves, true union-type, with socket ends. Valves in PVC piping for potable or other water service shall be ball-type, brass with threaded ends. Jamesbury 211100TT, Jenkins 32A, or equal for potable water.
- C. When necessary, connect threaded valves or other threaded devices to PVC piping using male or female threaded adapters. Do not thread PVC pipe.
- D. Galvanized Steel Pipe: Valves in galvanized steel piping shall be ball-type with threaded ends. Valves shall be Jamesbury 211100TT, Jenkins 32A, or equal for potable water. Valve shall be line size unless noted otherwise.
- E. Copper Piping: Valves for copper piping systems shall be ball-type, brass with solder ends, for potable water service. Valves shall be line size unless noted otherwise.

PART 3 EXECUTION

3.1 PIPE INSTALLATION:

- A. General. All pipe and accessories required for the work specified herein shall be unloaded, handled, laid, jointed, tested for defects and for leakage and chlorinated in the manner herein specified.
- B. Inspection. The pipe, fittings, valves, and accessories shall be inspected upon delivery and during the progress of the work and any material found to be defective will be rejected by the Engineer and the Contractor shall remove such defective material from the site of the work.
- C. Responsibility for Materials. The Contractor shall be responsible for all material furnished by him and he shall replace, at his own expense, all material that is found to be defective in manufacturer or has become damaged in handling after delivery.
- D. Excavation and Trenching:
 - 1. The trench shall be excavated to the lines and grades as established by the Engineer. The minimum depth of cover for all pipe lines shall be thirty-six (36) inches, unless otherwise specifically shown on the drawings.
 - 2. The minimum width of the trench shall be the outside diameter of the pipe plus twelve (12) inches and maximum width shall be the outside diameter of the pipe plus eighteen (18) inches. The trenching equipment shall be maintained on a sufficiently level road bed to provide substantially vertical trench walls. The maximum horizontal offset of the trench wall from bottom of trench to the top of the trench (undercutting) shall be four (4) inches.
 - 3. The trench shall be excavated to an even grade so that the bottom of the pipe will rest on the bottom of the trench throughout the entire length of the pipe. In order to obtain a true even grade, the trench shall be fine graded by hand.
 - 4. Any part of the trench excavated below grade shall be corrected by filling with approved material and thoroughly compacting.
 - 5. If ledge rock, rock fragments or other unyielding material is encountered in the bottom of the trench, it shall be removed to a depth of three inches below grade, refilled with selected material and thoroughly compacted.
 - 6. Bell holes of ample dimensions shall be dug at each joint to permit the joining of pipe to be made properly, and of sufficient depth to prevent the bell of the pipe from resting on undisturbed materials.
 - 7. Wherever necessary to prevent caving, the trench shall be adequately braced and sheeted in accordance with the current requirements of the Occupational Safety and Health Administration.

8. Trench digging machinery may be used to make trench excavations except in places where operation of same would cause damage to existing structures either above or below ground; in such instances, hand methods shall be employed. The Contractor shall locate all existing underground lines, of which he has been advised, whether or not they are shown on the drawings, sufficiently in advance of trenching operations to prevent any damage thereto. Extreme care shall be used to prevent such damage and the Contractor shall be fully responsible for damage to any such lines.
9. There will be no classification of or extra payment for excavated materials and all materials encountered shall be excavated as required. Adjacent structures shall be protected from damage by construction equipment. All excavated material shall be piled in a manner which will not endanger the work or existing structures and which will cause the least obstruction to roadways.
10. Excess trench excavation, not used for backfilling, shall be disposed of by the Contractor, and at the Contractor's expense.

E. Pipe Laying:

1. General. All pipe shall be laid and maintained to the specified lines and grades shown on the drawings or established by the Engineer.
2. Wherever it is necessary to deflect pipe from a straight line either in a vertical or horizontal plane to avoid obstructions or to plumb valves, or where vertical or horizontal curves are shown or permitted, the degree of deflection at each joint shall not exceed the maximum deflection recommended by the manufacturer of the particular kind of pipe being laid and the degree of deflection shall be approved by the Engineer.
3. After the trench grade has been completed, all bell holes dug and the grade inspected, the pipes and accessories may be placed in the trench. All pipe, fittings and valves shall be carefully lowered into the trench piece by piece by means of derricks, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to the material in any way. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.
4. Before lowering into the trench, the pipe shall be inspected again for defects and cast iron pipe, while suspended, shall be lightly hammered to detect cracks. Any defective, damaged or unsound pipe and material shall be rejected.
5. All foreign matter or dirt shall be removed from the inside of the pipe and from all bells, spigots or parts of the pipe used in forming the joint, before the pipe is lowered into the trench, and it shall be kept clean by approved means during and after laying.
6. All pipe to be encased or cradled in concrete shall be laid carefully to grade and supported above the trench bottom to ensure that the proper thickness of concrete is placed under the pipe. Precautions shall be

taken to prevent floating the pipe. Concrete shall have a 2500 psi compressive strength after 28 days, and be placed to properly cradle or encase the pipe as shown on the drawings.

7. The ring groove shall be clean before installation of the rubber ring. The ring shall be carefully installed in the groove as recommended by the manufacturer. The spigot end of the pipe shall be wiped clean and lubricated using the recommended lubricant. The spigot end shall be carefully inserted into the bell end until the reference mark on the spigot end is flush with the end of the bell.

F. Laying and Jointing Ductile Iron Pipe:

1. General. Unless otherwise directed, pipe shall be laid with bells facing in direction of laying; and for lines on appreciable slopes, bells shall, at the discretion of the Engineer, fact up grade.
2. Cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or the cement lining.
3. The jointing shall be completed for all pipe laid each day, in order not to leave open joints in the trench overnight. at times when pipe laying is not in progress, the open ends of the pipe shall be closed by approved means, and no trench water shall be permitted to enter the pipe.
4. Mechanical Joint Piping. The last 8 inches outside of the spigot and inside of the bell of mechanical-joint pipe shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter from the joint, and then painted with a soap solution prepared specifically for this purpose. The cast-iron gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket, or bell end. The rubber gasket shall be painted with the soap solution and placed on the spigot end with the thick edge toward the gland.

The entire section of the pipe shall be pushed forward to seat the spigot end in the bell. The gasket shall then be pressed into place within the bell; care shall be taken to locate the gasket evenly around the entire joint. The cast-iron gland shall be moved along the pipe into position for bolting, all of the bolts inserted, and the nuts screwed up tightly with the fingers. All nuts shall be tightened with a suitable torque-limiting wrench.

Nuts spaced 180 degrees apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland.

5. Flanged Joints. Flanged joints where used shall be bolted with flange bolts of best quality milk steel and of the size and length required by AWWA C-115; bolts and nuts shall be provided with standard hexagonal heads. Gasket rings shall be used and shall be made of best quality rubber composition sheet packing one-eighth (1/8) inch thick, of a brand and quality approved by the Engineer.

The pipe and fittings shall be properly aligned and free to move in any direction while bolting, and the bolts shall be gradually tightened at a uniform rate around the entire flange.

6. Push-On-Joints. The inside of the bell and the outside of the spigot end shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket.

A thin film of gasket lubricant shall be applied to either the inside surface of the gasket or the spigot end of the pipe or both. Gasket lubricant shall be as supplied by the pipe manufacturer.

The spigot end of the pipe shall be entered into the socket with care. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack-type tool or other device. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint. Field-cut pipe lengths shall be filed or ground to resemble the spigot end of the pipe as manufactured. Complete assembly instructions are available from the pipe manufacturer.

At times when laying is not in progress, the open ends of pipe shall be closed by approved means, and no trench water shall be permitted to enter the pipe.

The jointing shall be completed for all pipe laid each day, in order not to leave open joints in the trench overnight. At times when pipe laying is not in progress, the open ends of the pipe shall be properly plugged. No pipe shall be laid in water, or when trench conditions or weather is unsuitable for such work.

If water gets in the trench before the joint is completed, or if the pipe is disturbed from line and grade after being laid, the pipe shall be taken up, the joints cleaned and the pipe relaid.

Immediately after completion of the jointing, sufficient bedding and backfill material shall be placed around and over the pipe to hold the pipe to line and grade.

Premolded joints shall be made in accordance with the recommendations of the manufacturer of the pipe. The surfaces of the jointing material on both the bell and the spigot at each joint shall be wiped with the solvent recommended by the pipe manufacturer. The spigot shall then be firmly forced into the bell using a bar or other similar level and a block of wood to prevent damage to the pipe.

G. Laying and Joint PVC Pipe:

1. PVC pipe shall be handled and installed in strict accordance with the recommendations of the manufacturer. Special care shall be exercised in handling PVC pipe, in preparation of the trench for pipe laying, and in compacting the bedding under and around each side of the pipe.

2. Solvent weld pipe shall be thoroughly cleaned before installation. Solvent application and joining shall be done in accordance with the manufacturer's written recommendations.
3. The ring groove shall be clean before installation of the rubber ring. The ring shall be carefully installed in the groove as recommended by the manufacturer. The spigot end of the pipe shall be wiped clean and lubricated using the recommended lubricant. The spigot end shall be carefully inserted into the bell end until the reference mark on the spigot end is flush with the end of the bell.

H. Backfilling:

1. Backfill Material. All backfill material shall be free from cinders, ashes, refuse, vegetable or organic material, boulders, rocks or stones, or other unsuitable material. From 1 foot above the top of the pipe to the existing ground, however, material containing stones up to 4-inches in their greatest dimension may be used. Selected materials from trench excavation shall be used for backfilling except where special material is required.
2. Backfilling Under Pipe. Pipes shall be installed in a layer of special bedding material placed on the trench bottom. The special bedding material shall be crushed rock, screened gravel, or a combination thereof with a maximum size of 1/2-inch. The material shall have a minimum thickness beneath the pipe of 3-inches, and shall extend up the sides of the pipe one-fourth of the outside diameter of the pipe.

The material shall be placed in 3-inch layers, moistened if necessary, and thoroughly compacted under and on each side of the pipe. Backfill material shall be deposited in the trench for its full width on each side of the pipe, fitting, and appurtenance simultaneously.
3. Backfilling Over Pipe. From the centerline of the pipe, or from the top of the bedding, to a depth of 1 foot above the top of the pipe, the trench shall be backfilled by hand or by approved mechanical methods using materials free from rocks or boulders. The Contractor shall use special care in placing this portion of backfill so as to avoid injuring or moving the pipe.
4. Backfilling to Grade. From 1 foot above the top of the pipe to finish grade shall be backfilled by tamping. When tamping, the material shall be placed in 6-inch layers, moistened if necessary, and thoroughly compacted with mechanical tampers to a density of at least 95% of maximum density at optimum moisture as determined by ASTM Designation D-1557, Method B.

All trenches shall be backfilled to grade as soon as possible after laying of the pipe. The Contractor shall backfill over all pipe laid each day to minimize the amount of open trench left overnight.

5. Setting Valves, Valve Boxes and Fittings. Valves and fittings shall be set at the locations shown on the plans or at locations as established by the Engineer, and shall be set and jointed to the pipe in the manner heretofore specified for pipe installations. All valves buried in the ground shall have a valve box set over the valve. All valves shall be thoroughly inspected and checked for operation before installation. Concrete blocking shall be provided for all buried valves as required for design flows, pressures, thrusts, etc.

Valve boxes shall be firmly supported and maintained centered and plumb over the wrench nut of the valve, with box cover flush with the surface of the ground or at such level as directed.

Valves supplied with operating nuts shall be provided with a suitable operating wrench.

6. Plugging Dead Ends. Standard plugs shall be inserted into the bells of all dead ends and pipes; tees, or crosses and spigot ends shall be capped. Plugs or caps shall be jointed to the pipe or fittings in the same manner used in jointing the pipe.
7. Anchorage of Bends, Tees and Plugs, Etc. Thrust restraint shall be applied to all pipe lines at all tees, plugs, caps, and at bends deflecting 11-1/4 degrees or more. Use mechanical thrust restraining glands per Drawings and in accordance with manufacturer's instructions.

3.2 EXPOSED PIPING:

- A. All exposed piping shall be installed in a neat and workmanlike manner. All piping runs shall be truly horizontal or vertical and parallel to adjacent building construction except where specifically shown otherwise on the drawings. Piping shall be adequately supported by temporary supports during installation. Permanent supports, as specified and as shown on the drawings, shall then be placed so that the pipe loads are supported thereon. Small piping installed along walls or beneath roof slabs shall be adequately supported with approved devices. Spacing of such supports shall be required to prevent deflection of the pipe between supports. Spacing between supports shall not exceed 8 feet.
- B. Copper pipe shall be insulated from supports. Copper pipe shall be wrapped with two layers of plastic adhesive tape (30 mill thickness) at each pipe support to prevent contact with other metals.

3.3 COPPER PIPE JOINTS:

- A. Join, above ground, copper piping and fittings with solder joints.
- B. Solder shall have maximum of 0.2 percent lead concentration.

3.4 DRAIN WASTE AND VENT PIPING:

- A. Drain, waste, and vent piping shall be installed in accordance with the Uniform Plumbing Code (UPC). Minimum sizing shall be the larger of that shown or required by UPC.

3.5 LINE TESTING:

- A. After the pipe is laid and the joints completed, each section or run of piping, except gravity flow lines, shall be tested as specified herein. The Contractor shall bear all costs of providing all equipment materials, labor and other incidentals required to test pipe lines as specified herein. Water of sufficient pressure to test the pipe lines will not be available and the Contractor shall provide suitable means for filling the lines and developing the required pressure in the lines.
- B. Each section of pipe line shall be tested. Any joint or device showing visible leakage shall be repaired or replaced and the hydrostatic test repeated.
- C. Gravity lines will be tested. Any joint or device showing visible leakage shall be repaired or replaced and the test repeated.

3.6 LINE CLEANING:

- A. After testing, flush all piping to remove all dirt, solder, flux, or other debris in piping.

END OF SECTION

SECTION 40 05 00

CHECK VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Standard check valves suitable for raw wastewater service.

1.2 REFERENCES:

- A. ASTM A48--Standard Specification for Composition Bronze or Ounce Metal Castings Class 30.
- B. ASTM A240--Standard Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
- C. ASTM A270--Standard Specification for Seamless and Welded Austenitic Stainless Steel Sanitary Tubing.
- D. ASTM A276--Standard Specification for Stainless Steel Bars and Shapes.
- E. ASTM B124--Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes.

1.3 SUBMITTALS:

- A. Provide the following information:
 - 1. Manufacturer's catalog information.
 - 2. Manufacturer's installation, operation, and maintenance instructions.
 - 3. Recommended list of spare parts with illustration drawing.

1.4 SYSTEM DESCRIPTION:

- A. Full body flange type swing check valve with full size domed access cover and 100% unrestricted flow area suitable for operation up to 150 pounds per square inch pressure.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Storage: Store all valves and appurtenances in accordance with the manufacturer's written instructions. Protect all valves and appurtenances from damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

- A. Val-Matic, **Swing Flex** Series #7200, Surgebuster® Check Valve
- B. or Engineer-approved equal.

2.2 MATERIALS:

- A. Valve Body and Cover: Ductile Iron ASTM A536, Grade 65-45-12
- B. Flange: ANSI B16.1, Class 125
- C. Disk/Flapper: Buna-N w/Alloy Steel and Nylon reinforcement
- D. Disc Accelerator: Type 302 stainless steel
- E. Cover Bolts, Nuts & Washers: Stainless Steel ASTM A276
- F. Mechanical Indicator: Aluminum Bronze, 17-4 Stainless Steel
- G. Interior Coating: Fusion-bonded Epoxy Coating
- H. Exterior Coating: Fusion Bonded Epoxy Coating

2.3 SIZE:

- A. Match adjacent piping where shown.

2.4 ACCESSORIES:

- A. Mechanical disc position indicator.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. Install check valves in accordance with manufacturer's instructions and as shown.
- B. Protect check valves from damage until final acceptance by Owner.

3.2 FINAL TESTING:

- A. Demonstrate that materials or equipment furnished under this Specification are operating properly at the time of project final acceptance.
- B. Rework or replace materials as required for proper operation.

END OF SECTION

SECTION 40 71 33

FLOW METERING SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Flow meter for measuring well water flow to the pressure tank.
- B. Flow rate and totalizer measurement.

1.2 SYSTEM DESCRIPTION:

- A. The equipment supplied under this Section must be furnished by a single supplier who shall assume complete responsibility for a complete and operable system.
- B. This Specification provides for a complete flow metering system to measure both flow rate and totaled flow.

1.3 SUBMITTALS:

- A. Product Data:
 - 1. Submit product data for approval. As a minimum include the following:
 - a. Materials of construction.
 - b. Rated capacity and performance ranges.
- B. Shop Drawings:
 - 1. Submit shop drawings that depict (at a minimum):
 - a. A schematic representation of the complete flow measuring system. This drawing shall show and identify each component in the system.

Each component shall be identified by the manufacturer's model and part numbers. The schematic shall be in sufficient detail to guide field installation.
 - b. Schematic shall identify electrical requirements.
- C. Submit operation and maintenance information to include: procedures for installation, programming, data retrieval, routine maintenance; parts lists with illustrations; and recommendations.

PART 2 PRODUCTS

2.1 FLOW METER:

<u>Parameter</u>	<u>Units</u>	<u>Desired Range</u>
<u>Flowmeter</u>		
Flow rate	U.S. gallons per minute (g.p.m.)	0 to 50 gpm
	U.S. gallons per day (gpd)	0 to 10,000 gpd
Totalizer	U.S. gallons (1,000)	

2.2 MANUFACTURERS:

A. Master Meter, or engineer-approved equal.

2.3 EQUIPMENT:

- A. Type: bottom load, multi-jet residential.
- B. Display: direct read indicating flow rate and totalizer for total flow.
- C. Register Sealing - permanently sealed with a scratch resistant glass lens, stainless steel base and wrap-around gasket to prevent intrusion of dirt or moisture.
- D. Test Circle - Large center sweep hand with one hundred(100) clearly marked gradations on the periphery of the dial face.
- E. Design/Operation - Velocity-type flow measurement. Water that is evenly distributed by multiple converging inlet ports flows past an impeller in the measuring chamber, creating an impeller velocity directly proportional to water flow rate. The meter's register integrates that velocity into totalized flow.
- F. Strainer - A rugged, 360-degree advance polymer basket strainer to protect the critical measuring element from damage. The strainer design shall provide smooth flow of water entering the meter creating a laminar flow.
- G. Measuring Chamber - The measuring chamber housing and measurement element shall be an advanced synthetic polymer. Measurement surfaces shall provide sustained accuracy despite the presence of entrained solids in the water. The wear surface shall be synthetic sapphire bearing with radially balanced water flows. The chamber housing shall be constructed in two parts to allow access to the impeller. Bottom plates shall be constructed of bronze.
- H. Size: one (1) inch.
- I. Warranty: minimum one (1) year.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. Install the equipment in accordance with the Drawings, shop drawings and applicable manufacturer's written instructions.
- B. Meter shall be installed with appropriate straight runs both upstream and downstream of the meter to ensure accurate flow measurement, as recommended by the manufacturer.
- C. Provide and install all equipment necessary for the meter provided to be fully operational as specified and as shown on the drawings.

3.2 SET-UP AND CALIBRATION:

- A. Provide factory-trained and certified representative to supervise and verify installation, calibrate the flow meter, and train Owner's personnel in operation and maintenance of flow meter and associated equipment.
- B. Provide written and dated certification to Owner of proper installation and meter calibration at start-up.

END OF SECTION

SECTION 43 41 00

PRE-ENGINEERED FIBERGLASS REINFORCED PLASTIC (FRP) BUILDING

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. This Section specifies a pre-engineered, prefabricated, single-room structure to house the well, chlorination system, well pressure tank, and filter system (where applicable).

1.2 SYSTEM DESCRIPTION:

- A. Industrial duty, monolithic, fiberglass shelter.
- B. Width and Length as indicated on drawings. Seven (7) foot wall height with pitched roof.

1.3 SUBMITTALS:

- A. Product Data:
 - 1. Submit product data for approval. As a minimum, include the following:
 - a. Materials of Construction.
- B. Shop Drawings:
 - 1. Overall dimensions and location of appurtenances.
 - 2. Layout drawings.
- C. Operation and Maintenance:
 - 1. Provide complete information describing the use, maintenance, and repair.
 - 2. Provide parts lists and illustrations showing all replaceable parts.

1.4 WARRANTY:

- A. Warranty against premature corrosion, finish degradation or defects in materials, parts or craftsmanship.
- B. Warranty to cover all parts and labor required for repair.
- C. Standard term: one (1) year from delivery to project site.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

- A. Packaged building unit shall be pre-engineered unit, as manufactured by:

Wildlife Management Area Wells – Matador & Gene Howe
Texas Parks & Wildlife Department
Project No: 1110162

Pre-Engineered Fiberglass
Reinforced Plastic (FRP) Building
March 8, 2021

1. Associated Fiberglass Enterprises, 2417 Weaver Street, Fort Worth TX 76117, ph: (817) 838-6786 or (800) 798-6561.
2. or Engineer-approved equal.

2.2 PRE-ENGINEERED BUILDING:

A. Provide prefabricated, fiberglass, insulated building, pre-wired with corrosion resistant fixtures, ready to install with all components factory mounted.

B. Lifting & Loading Provisions: Shelters shall be provided with lifting attachment points or forklift pockets to facilitate loading, transportation and placement.

1. Top Lift Configuration Shelters: Top lift shelters shall be supplied with or without a shelter base, and shall be provided with fixed or removable lifting eye bolts at client's preference, that are sized dependent on weight and lifting point factors.

C. Shelter Design Load Provisions: All industrial duty fiberglass shelters shall meet or exceed the following load provisions:

1. Tensile Strength, psi (ASTM D638) 14,000 psi
2. Flexural properties, (ASTM D790)
 - a. Strength, psi 25,000
 - b. Modulus psi 9.65 10⁵ psi
3. Shear Strength, psi, (ASTM D732) 12,000
4. Barcol Hardness, (ASTM D2583) 55
5. Foam Walls, Roof and Door:
 - a. Density, (ASTM D1622) 2.0 pcf
 - b. Compression Strength, (ASTM D1621) 20 psi
 - c. Flame Spread, (ASTM E84) 25-60
 - d. Smoke Developed, (ASTM E84) 75-160
 - e. Water Vapor Transmission, (ASTM E96) < 1.5 perm
 - f. Water Absorption, (ASTM C209) < 1% Vol.
 - g. Dimensional Stability, (ASTM D2126) < 2% Linear Change
 - h. Service Temperatures 250% F max
 - i. LTRR R- 6.7
 - j. Roof live loads 20 PSF
 - k. Roof Snow Loads 30 PSF
 - l. Wind pressure: per ASCE 7-10 for basic wind of 150 mph
6. Compliances:
 - a. ASTM C1289 Type 2, Class 1
 - b. International Building Code (ICC) Chapter 26 Section, 2603 Foam Plastic
 - c. ASHRAE 90.1

- d. Miami-Dade County Product Control Approved
- e. Florida Product Approval (FL11207)
- f. RR 25378, City of Los Angeles Research Report
- g. U.L. Listed standards: 790, 1256, 263

2.3 ACCESSORIES:

A. Door and Frame:

- 1. Standard door, one 3' x 6'-8" x 13 /4";
- 2. Metal frame encased in fiberglass with foam core 1 3/4" thick;
- 3. Tamper-proof hinges;
- 4. Door shall provide tight seal against rain and wind.

B. Door Hardware:

- 1. Panic hardware, with optional deadbolt lock;
- 2. Adjustable mechanical door hold-open arm; door stop and holder; rain guard.
- 3. Lockable from outside.

C. Exhaust Fan, Damper, and Intake Louver:

- 1. Corrosion-resistant 120 volt air exhaust fan, 150 cfm (min), controlled by a separate switch on the interior of the room adjacent to the light switch by the door. Provide aluminum, motorized damper and intake louver, with 120 volt spring return damper and insect screen. Seal louver and provide flange on discharge side. Open damper when fan operates, close when fan is off.

D. Electric Heater:

- 1. 1500 watt, 240 volt, single-phase electric heater with dedicated outlet. Provide NEMA 4X thermostat for control.

2.4 MATERIALS – ELECTRICAL

- A. All interior conduits shall be Schedule 80 PVC. All liquid tight flexible conduit and fittings shall be non-metallic UL listed.
- B. All interior boxes shall be PVC.
- C. All hardware shall be stainless steel. All supports shall be fiberglass or stainless steel.
- D. All wiring shall be 600 volt, THHN copper, minimum #12 AWG.
- E. All electrical panels and other equipment shall be provided with minimum NEC front clearances.
- F. Light switches shall be 20 ampere specification grade. Provide Crouse-Hinds DS185 cover in FD box. Provide light switches on the interior of the room, on the strike plate side of the door.

- G. Interior Lights. Provide LED fixtures as follows:
 - 1. Provide two LED strip lights, Lithonia CDS, or approved equal.
- H. Electrical Panel: 120/240 volt distribution panel, single-phase, 3-wire, 60 ampere, with 60amp, 2-pole main breaker, minimum 18 circuits. Provide NEMA 4X enclosure located in the well pump room as indicated on the drawings. Provide circuit breakers for equipment provided. Locate panel as indicated on the drawings. Provide typed schedule with all loads. Provide the following minimum circuit breakers.
 - 1. 1 - 20 ampere, 1-pole circuit breaker for the interior Well Pump Room wall receptacle circuit.
 - 2. 1 - 20 ampere, 1-pole circuit breaker for the building exterior receptacle circuit.
 - 3. 1 - 20 ampere, 1-pole circuit breaker for the interior lighting circuit.
 - 4. 1 - 15 ampere, 1-pole circuit breaker for the exhaust fan.
 - 5. 1 - 20 ampere, 2-pole circuit breaker for the room heater circuit.
 - 6. 1 - 15 ampere, 1-pole circuit breaker for the chlorine metering pump receptacle.
 - 7. 2 - 20 ampere, 1-pole spare circuit breakers.
- I. Provide NEMA 3R, non-fused disconnect on the exterior of the building as indicated on the drawings.
- J. Provide one 120 volt, 20 ampere specification grade ground fault interrupters (GFI) wall mounted receptacle appropriately located in the room for control of the chlorine metering pump. The receptacle shall be tied into the well pump control circuit such that the receptacle is energized whenever the well pump is operating and off whenever the well pump is off. Provide control relay as required to control receptacle.
- K. Provide two 120 volt, 20 ampere specification grade ground fault interrupter (GFI), wall mounted receptacles in the room. Provide one adjacent to the distribution panel and another on the opposite wall.
- L. Provide one building mounted exterior, 120 volt, 20 ampere specification grade ground fault interrupter (GFI), wall mounted receptacle. Exterior weatherproof covers shall be metallic aluminum meeting the requirements of NEC article 406.9(B)(2)(a). Install receptacle in cast aluminum box.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. Install concrete slab for building, in accordance with specifications and as shown on the drawings. Ensure slab is square and level.

- B. Install the building to include anchorage as indicated on the drawings and in accordance with the manufacturer's written instructions. Ensure building is plumb and squarely mounted on slab.
- C. Install the filtration and disinfection equipment within the building as indicated on the drawings and in accordance with the manufacturer's written instructions.
- D. Install the necessary piping for the filtration and disinfection building as shown on the Drawings.
- E. Provide electrical service to the building in accordance with Section 260000.

3.2 FIELD QUALITY CONTROL:

- A. Tests:
 - 1. Pressure test all piping and repair any leaks noted.
 - 2. Demonstrate acceptable filtration and/or disinfection throughout the designated range of flow conditions prior to acceptance by the Owner.

END OF SECTION

SECTION 46 13 12

WELL PRESSURE TANK

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. This section specifies the well pressure tanks, the on-off pressure switch/low pressure cut-off switch, and pressure relief valve that will provide sustained pressure to the distribution system that supplies potable water to meet demand.

1.2 GENERAL DESCRIPTION:

- A. The intention is to install the total number of pressure tanks at each well location shown on the drawings that meet the required total storage capacity.
- B. If more than one tank is installed, the pressure tanks shall be constructed in parallel and connected to the system via a manifold system as shown on the drawings, such that all tanks can operate together simultaneously. The connection to each tank, however, shall include an isolation valve such that each tank can individually be removed from the system for maintenance.
- C. A single pressure control valve located on the well pressure tank manifold shall maintain a pressure between 40 and 60 psig in the water distribution system. On a multiple tank installation, the tap for the pressure switch shall be installed on the pipeline as close to the center of the tanks as possible.
- D. The pressure tank shall be filled via the submersible well pump. System demand shall cause the well tank to discharge when pressure drops downstream of tank. The water well pump shall be commanded "ON" when the well tank pressure drops to 40 psig. The water well pump shall be commanded "OFF" when well tank pressure reaches pressure switch shut-off setpoint of 60 psig. As flow is again demanded from the system, the well tank will empty, and the system pressure will drop to the pressure switch start setpoint (40 psig) triggering a pump start. An adjustable low-pressure cut-off switch shall also be included on well tank manifold to stop pump in the event of low system pressure.
- E. A pressure relief valve shall be installed on well tank manifold (see drawings for location) as secondary protection against over-pressurization of the water distribution system. The relief valve shall open at 90 psig.

1.3 QUALITY ASSURANCE:

- A. All equipment discussed herein shall be provided to the Contractor by a single manufacturer/supplier. The manufacturer/supplier shall be responsible for the successful integration of all components into a unified system. This includes but is not limited to supplying field supervision/consulting services, testing and plant trials, and coordination of all components associated with the system.
- B. The system manufacturer/supplier shall have at least five years' experience in

manufacturing/supplying equipment of similar capacity and service capability to the equipment described herein.

1.4 WARRANTY:

- A. The manufacturer shall warrant the equipment to be free of defects in material and workmanship for a period of seven (7) years from date of equipment installation.

PART 2 PRODUCTS

2.1 WELL TANK:

A. Manufacturers:

- 1. Well-X-Trol Model WX-350, as manufactured by Worthington Industries Inc., 1400 Division Rd., West Warwick, RI 02893;, Ph: (401) 884-6300.
- 2. ELBI Model DWT-450V, as manufactured Elbi Of America, Inc., 15882 Diplomatic Plaza Suite 170 Houston, TX 77032; Ph: (713) 674-2900.
- 3. or Engineer-approved equal.

B. Materials:

- 1. Shell: High Strength Steel with welded seams.
- 2. Diaphragm: Heavy Duty Butyl.
- 3. Liner: Antimicrobial.
- 4. System Connection: 304L Stainless Steel.
- 5. Stand: Coated Steel or Patented DuraBase®.
- 6. Finish: Tuf-Kote™ HG Blue, or equal.
- 7. Water Circulator: Patented Turbulator™, or equal.
- 8. Air Valve: Projection Welded.
- 9. With Factory Pre-charge of 38 psi.

C. Construction:

- 1. All wetted parts to comply with NSF/ANSI Standard 61.

D. Performance:

- 1. Max. Operating Temperature: 200° F.
- 2. Max. Working Pressure: 150 PSIG.
- 3. Max. Relief Valve Setting: 125 PSIG.
- 4. Adjustable Operating Pressure Range: 40 to 60 psi.

E. Size:

- 1. Individual tank capacity: 119 gallons.
- 2. Diameter: 26 inches.
- 3. Height (max.): 62 inches.
- 4. One tank required at each well location.

F. Configuration:

1. The pressure tanks shall be provided with a pressure release device and an easily readable pressure gauge.
2. Connection size: 1 ¼-inch NPTM.
3. Pressure tank should be equipped with slow closing valves and time delay pump controls to eliminate water hammer and reduce the chance of tank failure.

2.2 PRESSURE ELEMENT/SWITCH:

- A. An ON-OFF pressure switch and low-pressure cut-off switch shall be utilized for control of water well pump. The ON-OFF pressure switch shall be capable of starting the pump motor at a predetermined low pressure and stop the pump motor at predetermined higher pressure.
- B. The low pressure cut off switch shall be capable of stopping the pump motor at a predetermined low pressure and restarting the pump motor at a predetermined higher pressure.
- C. The on-off pressure switch and the low pressure cut off switch shall be an Allen Bradley #AB836C7A or an approved equal. Pressure switches shall be installed in a NEMA 4X enclosure with a pressure gauge plumbed into the inlet of the pressure switches below and outside of the enclosure. A copper or poly tube shall be installed at the inlet of the pressure switches and gauge and shall be attached at the other end to a tee connection located as close to the center of the pressure tanks as possible.

2.3 PRESSURE RELIEF VALVE:

- A. Pressure relief valve shall be Cla-Val CRL Pressure Relief Control or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. Install tanks and valves in accordance with manufacturer's instructions.
- B. Install the pressure switch assembly as close to the center of the tanks as possible.
- C. The well tank shall be flushed a minimum of five (5) times prior to use.
- D. The pressure relief valve discharge piping shall be routed outside of the building. The end of the discharge piping shall be covered with stainless steel screen (16-mesh) and securely clamped in-place with stainless steel bands.

3.2 TESTING:

- A. Test valve by adjusting set points and observing operation.

B. Open one or more fixtures to reduce pressure and initiate a pump cycle. Cycle the system multiple times to check for smooth operation. Make adjustments only when the tank is empty of water and the system is off.

C. It may be necessary to adjust the pressure switch settings or the air cell pre-charge to optimize system performance.

3.3 ADJUSTING PRE-CHARGE AFTER INSTALLATION:

A. Drain tank of all water. Check pre-charge pressure in the tank.

B. Release or add air as necessary to set the pre-charge pressure 2 psig below the pressure switch pump cut-in setting.

3.4 START-UP AND OPERATOR TRAINING:

A. Provide the services of a factory trained representative for start-up and operator training. Minimum one (1) hour on-site.

1. Provide field report certifying the equipment is properly installed, fully functional and ready for use.

B. Use approved O&M Literature for training.

C. Start-up and operation prior to Owner acceptance shall be accomplished so as to not void manufacturer's warranty.

END OF SECTION

SECTION 46 33 00

LIQUID CHLORINE FEED EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. This Section specifies equipment for applying liquid chlorine to a potable water supply system for disinfection. System accessories and prefabricated housing structure are also specified.

1.2 REFERENCES:

- A. ASTM D1693--Test Method for Environmental Stress--Cracking of Ethylene Plastics.
- B. ASTM D2737--Polyethylene Plastic Tubing.
- C. ASTM D1785--Standard Specification for PVC Plastic Pipe.

1.3 SYSTEM DESCRIPTION:

- A. The equipment specified in this Section will have one supplier, providing a fully-coordinated system in accordance with this Section.
- B. Systems will inject chlorine via a fixed-throat injector into a tap in a single fill pipe as water is pumped from the well through inlet piping to a diaphragm pressure tank. Maximum pressure at point of injection is 60 psi.
- C. The disinfection equipment shall provide manually adjustable chlorination of water entering the system, to maintain an adjustable chlorine residual between 0.5 mg/L and 2 mg/L at each location, throughout the following range of well production:
 - 1. Min 10 gpm
 - 2. Max 20 gpm
 - 3. The planned well discharge for the chlorine injection system is 15 gpm.

1.4 SUBMITTALS:

- A. Product Data:
 - 1. Submit product data for approval. As a minimum, include the following:
 - a. Materials of Construction.
 - b. Rated capacity and performance ranges.
- B. Shop Drawings:
 - 1. Overall dimensions and piping connection sizes for all units.
 - 2. Process drawings and schematics.

- C. Operation and Maintenance:
 - 1. Provide complete information describing the use, maintenance, and repair.
 - 2. Provide complete instructions for the chemical system operation including start-up, normal operation, shutdown, and emergency procedures.
 - 3. Provide parts lists and illustrations showing all replaceable parts.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

A. Chlorination System:

- 1. STS Series combination tank/pump system, as manufactured by Stenner Pump Company, 3174 DeSalvo Road, Jacksonville, FL 32246, ph: (800) 683-2378.

2.2 MATERIALS:

- A. Flexible tubing: white polyethylene tubing meeting, ASTM D-1693 with a 0.25 inch diameter.
- B. All equipment will be comprised of materials suitable for handling liquid chlorine bleach.
- C. All wetted parts of the chlorination system shall be NSF-61 approved.

2.3 CHLORINATION SYSTEM:

- A. Provide and install Model 45MHP2.
- B. Tank and pump system shall be vertically-mounted for solution containment.
- C. System is intended to use NSF-approved household bleach (approx. 6% chlorine) that is blended in the storage tank at a 50:50 ratio with distilled water, provided a final chlorine concentration of approx. 3% for injection.
- D. Tank shall be translucent white in color for indoor installation.
- E. Tank capacity shall be 15 gallons.
- F. Peristaltic injection pump shall operate at 120V/60Hz and provide output range of 0.2 to 3.0 gallons per day with a discharge pressure of 26-100 psi.
- G. Piping, connecting nuts and ferrules shall be ¼-inch.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. Install concrete slab around well for building, in accordance with specifications and as shown on the drawings. Ensure slab is square and level.
- B. Install the building to include anchorage as indicated on the drawings and in accordance with the manufacturer's written instructions. Ensure building is plumb and squarely mounted on slab.
- C. Install the chlorination equipment within the building as indicated on the drawings and in accordance with the manufacturer's written instructions.
- D. Install the necessary tubing for the chlorine injection feed line between the feed equipment and the injection point.
- E. Install ¼-inch Female NPT pipe tee fitting in the pump discharge line for the chlorine injection fitting.
- F. Provide electrical service to the chlorination building in accordance with Section 260000 series.
- G. Ensure any wall penetrations in the chlorine room are sealed air-tight with a silicone sealant.

3.2 FIELD QUALITY CONTROL:

- A. Tests:
 - 1. Pressure test all piping and repair any leaks noted.
 - 2. Demonstrate accurate proportional chlorine feed throughout the designated range of flow conditions prior to acceptance by the Owner.

3.3 FIELD SERVICE:

- A. Provide a factory-trained representative to inspect, review, and start up the equipment provided and train Owner's personnel.
- B. Representative shall present a minimum 4-hour training session for the Owner's personnel. Representative shall prepare in advance for training session with prepared instruction outline and hand out materials.
- C. Training shall not be done until all equipment is operational.
- D. Training timing shall be devoted only to training and instruction of Owner's personnel. Troubleshooting, check-out, and/or adjustment of system shall not be completed during the training period.

3.4 SPARE PARTS:

- A. Supply 50 extra feet of appropriate diameter polyethylene tubing for peristaltic chemical injection pump.

END OF SECTION

SECTION 46 61 53

CARTRIDGE FILTERS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK:

- A. This section covers the cartridge filter to be installed for the groundwater system. The cartridge filter shall remove particulate matter larger than 1.0 micron using an engineered porous filtration media through surface filtration.
- B. The Contractor shall furnish all labor, materials, equipment and incidentals necessary to install the cartridge filters as shown on the Drawings and as specified herein.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS:

A. Reference Standards:

- 1. American Society of Mechanical Engineers (ASME).
 - a. ASME Boiler and Pressure Vessel Code, Section VIII.
- 2. American Society for Testing and Materials (ASTM).
 - a. ASTM A182 – Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - b. ASTM A193 – Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
 - c. ASTM A240 – Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
- 3. American National Standards Institute (ANSI).
 - a. ANSI B16.5 - Pipe Flanges and Flanged Fittings.
 - b. ANSI B36.19 – Stainless Steel Pipe.
- 4. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.3 SUBMITTALS:

- A. Shop Drawings: Shop drawings submittals shall be made in accordance with the requirements of Part II Section II of the specifications, except as modified herein.
 - 1. Provide Manufacturers catalog sheets with the selected model numbers and accessories clearly indicated.

2. Submit certified fabrication drawings of the equipment.
3. Submit spare parts list.
4. Submit operating and installation instructions.
5. The cartridge filter and installation provided under this Section shall be designed in accordance with the provisions of the latest edition of the Uniform Building Code (UBC). Submittals shall be certified that designs are in conformance with the UBC and that all applicable loads, including seismic, have been included. The calculations shall include consideration of all primary components as well as accessories and modifications to those components (e.g., cutouts, supports for pipes, lifting lugs, etc.). Equipment support and anchorage calculations shall be prepared and submitted with drawing submittals.

1.4 QUALITY ASSURANCE:

- A. General: All equipment furnished under this specification shall be new and shall be the standard product of a manufacturer who is fully experienced, reputable, qualified and regularly engaged for at least 5 years in the manufacture of the equipment to be furnished.
- B. Certification: The Contractor shall assume responsibility for the satisfactory installation and operation of the cartridge filter as specified. Upon completion of the cartridge filter installation, the manufacturer shall inspect and shall submit a certificate of proper installation.

PART 2 PRODUCTS

2.1 GENERAL:

- A. Description:
 1. Tangential Entry, Up-Flow Cartridge Filter Housing with Swing Bolt Closure and Flanged Connections.
- B. Equipment Supply:
 1. The manufacturer shall provide one (1) vertical cartridge filter assembly complete with inlet, outlet, internal filter support assemblies, bottom outlet drain connection, full load of filter cartridges, and all other accessories for a complete and fully functional filtering system.
 2. The filter must have been tested by an independent, third party in accordance with the challenge study requirements as specified in Title 40 of the Code of Federal Regulations (CFR) §141.719(a)(2).
 3. Cartridge filters shall be constructed as rigid, self-supporting filter elements housed in pressure vessels in which flow is from the outside of the cartridge to the inside.

4. The cartridge filtration system shall meet surface water treatment requirements, specifically with regard to meeting log removal credits under the Long-Term Enhanced Surface Water Treatment Rule Stage 2 (LT2) and approved for use by the TCEQ.

5. All wetted parts shall be NSF-61 listed.

C. Manufacturer:

1. Harmsco MUNI-1-2FL-304.

2.2 HOUSINGS:

A. Configuration: Vertical, with the tangential influent connection located on side of the vessel and filtrate connection located on bottom end.

B. Design Pressure: 150 psig.

C. Construction:

1. Code Compliance: Vessel construction shall comply with requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Div.1.

2. Materials: Welded components shall be constructed of electropolished 304 stainless steel. All other components (including cover lift and bolting) shall be electropolished 304 stainless steel. Cover wing nuts shall be stainless steel alloy per ASTM A-193 B7. Vessel cover seal shall be EPDM. Interior and exterior surfaces and all welded components shall be passivated. All welds to wetted surface materials shall be pickled and passivated.

3. Head Assembly: The vessel head shall swing out to permit loading of filter cartridges. The head and vessel body shall include guides to facilitate alignment of the head. The head shall be sealed to the vessel with permanently attached swing bolts and hex head nuts. The cover shall have EPDM O-ring closure seal.

4. Drains (Qty 2): ¾" Female NPT (FPT) Couplings, Class 1000.

5. Ball Valves (Qty 2) 316 S.S. included.

6. Vent: ½" Female NPT (FPT) Coupling, Class 1000.

7. Gauge Ports with Pressure Gauges (Qty 2): ½" Female NPT (FPT) Coupling, Class 1000.

8. Closure Gasket is EPDM 70 Durometer O-ring.

9. Flow Rate – 100 GPM Max. with HC/170-LT2 cartridge.

2.3 FILTER ELEMENTS:

- A. Type: Cylindrical pleated cartridges.
- B. Manufacturer: Harmsco Filtration Products Model HC/170-LT2, or engineer-approved equal.
- C. Flow Configuration: Outside to inside.
- D. Rating: One (1) micron.
- E. Filter Media: FDA borosilicate microglass with acrylic binder.
- F. Support Media: spun-bonded polyester laminated on both upstream and downstream sides.
- G. Center Tubes: rigid PVC with perforations.
- H. Materials: FDA Listed Materials: Manufactured from materials which are listed for food contact applications in Title 21 of the U.S. Code of Federal Regulations.
- I. Certification: NSF-61 listed filter media removes cyst-sized particles for safe, cyst-free drinking water.
- J. Number: Supply cartridges to load each filter housing initially and two filter change outs.

2.4 SPARE PARTS:

- A. Cover Seals: Provide one (1) spare seals for each vessel provided.
- B. Replacement Filter Cartridges: Provide two (2) sets of spare cartridge filters.

2.5 ANCHORAGE:

- A. The cartridge filters furnished and installed under this Section shall be securely supported and anchored. All anchor bolts shall be Type 304 stainless steel. The Contractor shall coordinate requirements for cast-in-place anchorage devices with the corresponding equipment pad.

2.6 ACCESORIES:

- A. PRESSURE GAUGES:
 - 1. Type: Oil-filled with 316 S.S. bourdon tube or 316 S.S. bellows.
 - 2. Dial: 3½" or 4½" with pressure range 0 to 100 psi.
 - 3. Housing: Stainless steel case with stem, surface or flush mounting, lower or back connections.
 - 4. Accessories: S.S. needle valve and pressure snubber.

5. Manufacturer: Wika, Ashcroft, Ametek U.S. Gauge, or Engineer-approved equivalent.

B. GAUGE COCKS:

1. Gauge cocks shall be Gemini, Wika, or Engineer-approved equivalent. The exposed threads of each gauge cock shall be protected by a brass plug.

PART 3 EXECUTION

3.1 SHIPMENT, HANDLING, AND STORAGE:

A. The equipment specified herein, shall be factory assembled and ready for installation and connection to the piping as shown on the drawings. The parts and assemblies that are shipped unassembled, shall be packaged and tagged in a manner that will protect the equipment from damage and facilitate the final assembly in the field.

B. Weight, handling instructions, type of storage required, and instructions for protective maintenance during storage shall be included with each shipment to the project site.

3.2 INSTALLATION:

A. The Contractor shall be responsible for the proper installation of the cartridge filters. Installation of system components and interconnections between system components and other plant systems shall be in accordance with the Specifications, manufacturer's printed instructions, and approved shop drawings.

B. The cartridge filters shall be installed on a concrete equipment pads and grouted underneath per the details on the Drawings.

END OF SECTION