

SECTION 01 91 00 - COMMISSIONING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Commissioning description.
  2. Closeout submittals.
  4. Examination.
  5. Verification Check and Startup Procedures.
  6. Functional performance test procedures.
  7. Function performance test methods.
  8. Deficiencies and test approvals.
  9. Demonstration.

1.2 COMMISSIONING DESCRIPTION

- A. Commissioning: Systematic process of ensuring systems perform interactively according to design intent and Owner's operational needs. Commissioning process encompasses and coordinates system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training, and verification of actual performance.
- B. Commissioning Intent:
1. Verify equipment and systems are installed according to manufacturer's instructions, industry accepted minimum standards, and Contract Documents.
  2. Verify equipment and systems receive adequate operational checkout by Contractor.
  3. Verify and document proper performance of equipment and systems.
  4. Verify complete operation and maintenance documentation is delivered to Owner.
  5. Verify system operator is adequately trained.
- C. Commissioning does not relieve Contractor of responsibility to provide finished and fully functioning Project.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements contains requirements for closeout submittals.
- B. Operation and Maintenance Data: Submit operation and maintenance manuals as specified in individual equipment and system Specifications.
- C. Final Commissioning Report: Commissioning Authority will submit one (1) copy of final commissioning report including the following:
1. For Each Piece of Commissioned Equipment: Include statement regarding compliance with Contract Documents in the following areas:
    - a. Equipment installation.
    - b. Functional performance and efficiency.
    - c. Equipment documentation and design intent.
    - d. Operator training.
  2. Include recommendations for improvement to equipment or operations, future actions, and commissioning process changes.

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3. List outstanding deficiencies referenced to specific functional test, inspection, trend log, or other record where deficiency is documented.

### PART 2 PRODUCTS –NOT USED

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify equipment and systems are installed according to individual Specification Sections.
- B. Verify utility and power connections are complete and services operational.

#### 3.2 VERIFICATION CHECK AND STARTUP PROCEDURES

- A. Verification Check and Startup:
  1. Perform verification check and startup according to approved verification check and startup plan.
  2. Complete entire plan for each piece of equipment or system indicated to be commissioned.
  3. Complete each procedure in sequence performed by party assigned to each procedure.
  4. Record completion of each procedure. Indicate results of procedure where required. Sign and date plan by individual performing procedure.
  5. Identify items not completed successfully.
  6. Sign and date plan indicating completion of entire plan.
- B. Deficiencies and Approvals:
  1. Engineer will review verification check and startup reports and issue deficiency report or approval.
  2. Correct deficiencies and resubmit updated verification check and startup report with statement indicating corrections made for Commissioning Authority approval.
  3. Repeat process until verification check and startup report are approved.

#### 3.3 FUNCTIONAL PERFORMANCE TEST PROCEDURES

- A. Complete the following before performing functional tests:
  1. Verification check and startup.
- B. Engineer will direct, witness, and document results of functional performance tests.
- C. Demonstrate that each piece of equipment and system is operating according to documented design intent and Contract Documents.
  1. Conduct testing proceeding from components, to subsystems, to systems.
  2. Bring equipment and systems to condition capable full dynamic operation.
  3. Verify performance of individual components and systems.
  4. Verify performance of interactions between systems.
  5. Identify and correct areas of deficient performance.
- D. Operate each piece of equipment and system through each specified mode of operation including seasonal, occupied, warmup, cool-down, partial load, and full load conditions.
  1. Verify each sequence in sequences of operation.
  2. Test for proper responses to power failure, freezing, overheating, no flow, equipment failure, and other abnormal conditions.

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**3.4 FUNCTIONAL PERFORMANCE TEST METHODS**

- A. Perform testing and verification by using manual testing or by monitoring performance and analyzing results using control system trend log capabilities or by standalone data loggers as specified for each piece of equipment or system.
- B. Perform each function and test under conditions simulating actual conditions as close as is practically possible.
  - 1. Provide materials, system modifications, and other items or steps necessary to produce flows, pressures, temperatures, and other responses to execute test according to specified conditions.
  - 2. At completion of test, return modified equipment and systems to pretest condition.

**3.5 DEFICIENCIES AND TEST APPROVALS**

- A. Deficiencies:
  - 1. Engineer will record and report deficiencies to Owner.
  - 2. Minor deficiencies may be corrected during tests at Commissioning Authority's discretion. Deficiency and resolution will be documented on procedure form.
  - 3. When deficiency is identified, Engineer will discuss issue with party executing test.
- B. Test Approval: Engineer notes each satisfactorily demonstrated function on functional performance test form.

**3.6 DEMONSTRATION**

- A. Demonstrate equipment and systems and train Owner's personnel as specified in individual equipment and system Specifications.

END OF SECTION

**SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Formwork for cast-in-place concrete.
  - 2. Shoring, bracing, and anchorage.
  - 3. Architectural form liners.
  - 4. Form accessories.
  - 5. Form stripping.
- B. Related Sections:
  - 1. Section 03 39 00 – Concrete Curing.

**1.2 REFERENCES**

- A. American Concrete Institute:
  - 1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
  - 2. ACI 301 - Specifications for Structural Concrete.
  - 3. ACI 318 - Building Code Requirements for Structural Concrete.
  - 4. ACI 347 - Guide to Formwork for Concrete.
- B. ASTM International:
  - 1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

**1.3 DESIGN REQUIREMENTS**

- A. Design and construct formwork, shoring and bracing in accordance with ACI 318 to conform to applicable code requirements to achieve concrete shape, line and dimension as indicated on Drawings.

**1.4 QUALITY ASSURANCE**

- A. Perform Work in accordance with ACI 301.
- B. Perform Work in accordance with Teller County building department requirements.

**1.5 COORDINATION**

- A. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

**PART 2 PRODUCTS**

**2.1 WOOD FORM MATERIALS**

- A. Form Materials: At discretion of Contractor.

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2.2 PREFABRICATED FORMS

- A. Furnish materials in accordance with Teller County building department requirements.
- B. **Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.**
- C. **Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.**
- D. **Pan Type: Steel of size and profile required.**
- E. **Steel Forms: Sheet steel, suitably reinforced, and designed for particular use indicated on Drawings.**
- F. **Form Liners: Smooth, durable, grainless and non-staining hardboard, unless otherwise indicated on Drawings.**
- G. **Framing, Studding and Bracing: Stud or No. 3 structural light framing grade.**

PART 3 EXECUTION

3.1 EXAMINATION

- A. **Section 01 30 00 - Administrative Requirements: Coordination and project conditions.**
- B. **Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.**
- C. **When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Engineer.**

3.2 INSTALLATION

- A. **Earth Forms:**
  - 1. **Earth forms are not permitted.**
- B. **Formwork - General:**
  - 1. **Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.**
  - 2. **Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.**
  - 3. **Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.**
  - 4. **Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.**
  - 5. **Complete wedging and bracing before placing concrete.**
- C. **Forms for Smooth Finish Concrete:**
  - 1. **Use steel, plywood or lined board forms.**

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2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
3. Install form lining with close-fitting square joints between separate sheets without springing into place.
4. Use full size sheets of form lines and plywood wherever possible.
5. Tape joints to prevent protrusions in concrete.
6. Use care in forming and stripping wood forms to protect corners and edges.
7. Level and continue horizontal joints.
8. Keep wood forms wet until stripped.

### D. Architectural Form Liners:

1. Erect architectural side of formwork first.
2. Attach form liner to forms before installing form ties.
3. Install form liners square, with joints and pattern aligned.
4. Seal form liner joints to prevent grout leaks.
5. Dress joints and edges to match form liner pattern and texture.

### E. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

### F. Framing, Studding and Bracing:

1. Space studs at 16 inches on center maximum for boards and 12 inches on center maximum for plywood.
2. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Construct beam soffits of material minimum of 2 inches thick.
4. Distribute bracing loads over base area on which bracing is erected.
5. When placed on ground, protect against undermining, settlement or accidental impact.

### G. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.

### H. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

### I. Obtain Engineer's approval before framing openings in structural members not indicated on Drawings.

### J. Do not reuse wood formwork more than one time for concrete surfaces to be exposed to view. Do not patch formwork.

## 3.3 APPLICATION - FORM RELEASE AGENT

### A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

### B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

### C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

### D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in

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accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Install formed openings for items to be embedded in or passing through concrete work.
- B. Locate and set in place items required to be cast directly into concrete.
- C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
- D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Install water stops continuous without displacing reinforcement.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.
- H. Form Ties:
  - 1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
  - 2. Place ties at least 1 inch away from finished surface of concrete.
  - 3. Leave inner rods in concrete when forms are stripped.
  - 4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.
- I. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- J. Construction Joints:
  - 1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
  - 2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
  - 3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
  - 4. Arrange joints in continuous line straight, true and sharp.
- K. Embedded Items:
  - 1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
  - 2. Do not embed wood or uncoated aluminum in concrete.
  - 3. Obtain installation and setting information for embedded items furnished under other Specification sections.
  - 4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
  - 5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.
- L. Openings for Items Passing Through Concrete:

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1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
2. Coordinate work to avoid cutting and patching of concrete after placement.
3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

### M. Screeds:

1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
2. Slope slabs to drain where required or as shown on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

### N. Scream Supports:

1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
2. Staking through membrane is not be permitted.

### O. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

## 3.5 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

## 3.6 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Engineer.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.
- D. Leave forms in place for minimum number of days as specified in ACI 347.

## 3.7 ERECTION TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301.

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**3.8 FIELD QUALITY CONTROL**

- A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.**
- B. Notify Engineer after placement of reinforcing steel in forms, but prior to placing concrete.**
- C. Schedule concrete placement to permit formwork inspection before placing concrete.**

**END OF SECTION**

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete for the following:
  - 1. Tank foundation.
  - 2. Building foundation and slab.
- B. Related Sections:
  - 1. Section 03 10 00 - Concrete Forming and Accessories
  - 2. Section 03 39 00 - Concrete Curing.

1.2 REFERENCES

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 318 - Building Code Requirements for Structural Concrete.
- B. ASTM International:
  - 1. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
  - 2. ASTM C33 - Standard Specification for Concrete Aggregates.
  - 3. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  - 4. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
  - 5. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
  - 6. ASTM C150 - Standard Specification for Portland Cement.
  - 7. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
  - 8. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
  - 9. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
  - 10. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
  - 11. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
  - 12. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
  - 13. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.3 SUBMITTALS

- A. Design Data:
  - 1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required.
  - 2. Identify mix ingredients and proportions, including admixtures.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301.

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- B. Acquire cement and aggregate from one source for Work.
- C. Perform Work in accordance with Teller County Building department requirements and Geotechnical Engineering Report recommendations.

1.5 COORDINATION

- A. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement: Per Drawings.

2.2 CONCRETE MIX

- A. Select proportions for normal weight concrete in accordance with ACI 301.
- B. Site Mixed Concrete: Mix concrete in accordance with ACI 318.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Remove laitance, coatings, and unsound materials.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- C. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- D. Remove water from areas receiving concrete before concrete is placed.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301.
- B. Notify testing laboratory and Engineer minimum 24 hours prior to commencement of operations.

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- C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints are not disturbed during concrete placement.
- D. Install Barrier Bac VB-250 vapor retarder under interior slabs on grade in accordance with ASTM E1643. Lap joints minimum 6 inches and seal watertight by adhesive applied between overlapping edges and ends.
- E. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight.
- F. Separate slabs on grade from vertical surfaces with 1/2 inch thick joint filler.
- G. Place joint filler in pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- H. Install construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- I. Place concrete in continuous operation for each panel or section determined by predetermined joints.
- J. Consolidate concrete.
- K. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- L. Place concrete continuously between predetermined expansion, control, and construction joints.

### 3.4 CONCRETE FINISHING

- A. Provide formed concrete surfaces to be left exposed concrete with smooth rubbed finish.
- B. Finish concrete floor surfaces in accordance with ACI 301.
- C. Steel trowel surfaces which are indicated to be exposed.
- D. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1/4 inch per foot nominal.

### 3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed by Owner's testing laboratory in accordance with ACI 318.
- B. Provide free access to Work and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- D. Concrete Inspections:
  - 1. Continuous Placement Inspection: Inspect for proper installation procedures.
  - 2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.

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- E. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

3.6 PATCHING

- A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.
- C. Patch imperfections in accordance with ACI 301.

3.7 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

3.8 SCHEDULE - CONCRETE TYPES AND FINISHES

- A. Building Foundation: 4,500 psi 28 day concrete.

END OF SECTION

**SECTION 03 39 00 - CONCRETE CURING**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Section includes initial and final curing of horizontal and vertical concrete surfaces.
- B. Related Sections:
  - 1. Section 03 30 00 - Cast-In-Place Concrete.

**1.2 REFERENCES**

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
  - 3. ACI 308.1 - Standard Specification for Curing Concrete.
  - 4. ACI 318 - Building Code Requirements for Structural Concrete.
- B. ASTM International:
  - 1. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.

**1.3 QUALITY ASSURANCE**

- A. Perform Work in accordance with ACI 301.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- A. Water: Potable, not detrimental to concrete.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Verify substrate surfaces are ready to be cured.

**3.2 INSTALLATION - HORIZONTAL SURFACES**

- A. Cure concrete in accordance with ACI 308.1.
- B. Spraying: Spray water over floor slab areas and maintain wet for five (5) days.

**3.3 INSTALLATION - VERTICAL SURFACES**

- A. Cure concrete in accordance with ACI 308.1.
- B. Spraying: Spray water over surfaces and maintain wet for five (5) days.

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3.4 PROTECTION OF FINISHED WORK

- A. Do not permit traffic over unprotected floor surface.

END OF SECTION

SECTION 31 05 13 - SOILS FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Subsoil materials.
  - 2. Topsoil materials.
- B. Related Sections:
  - 1. Section 31 23 17 - Trenching.
  - 2. Section 31 23 23 - Fill.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and a 18-in. drop.
- B. ASTM International:
  - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup>).
  - 2. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

1.3 SUBMITTALS

- A. Samples: Submit, in air-tight containers, 10 lb sample of each type of fill to independent testing laboratory for analysis.
- B. Materials Source: Submit name of imported materials source.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Existing Native Material
  - 1. Excavated and re-used material.
  - 2. Graded.
  - 3. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
- B. Structural Import Type 1: CDOT Class 1

2.2 SOURCE QUALITY CONTROL

- A. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D698.
- B. Testing and Analysis of Topsoil Material: Perform in accordance with ASTM D698.

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- C. When tests indicate materials do not meet specified requirements, notify engineer, change material and retest.
- D. Furnish materials of each type from same source throughout the Work.

**PART 3 EXECUTION**

**3.1 EXCAVATION**

- A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.
- B. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.
- C. Remove excess excavated materials, subsoil, and topsoil not intended for reuse, from site.

**3.2 STOCKPILING**

- A. Stockpile materials on site at locations designated by Engineer.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Prevent intermixing of soil types or contamination.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

**3.3 STOCKPILE CLEANUP**

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 22 13 - ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Excavating topsoil.
  - 2. Excavating subsoil.
  - 3. Cutting, grading, filling, rough contouring, compacting, site for concrete tanks and buildings.
  
- B. Related Sections:
  - 1. Section 31 05 13 – Soils for Earthwork.
  - 2. Section 31 23 16 – Excavation.
  - 3. Section 31 23 17 – Trenching.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and a 18-in. drop.
  
- B. ASTM International:
  - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup>).
  - 3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - 4. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C136, ASTM D2419, and ASTM D2434.
  
- B. Perform Work in accordance with Teller County Building Department.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil: Type as specified in Section 31 05 13.
  
- B. Subsoil Fill: Type as specified in Section 31 05 13.

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- C. Structural Fill: Type as specified in Section 31 05 16.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify survey benchmark(s) and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

- A. Call Local Utility Line Information service at 811 not less than three working days before performing Work.  
1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Protect utilities indicated to remain from damage.
- D. Protect bench marks, survey control points, and existing structures, from excavating equipment and vehicular traffic.

3.3 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion. Stockpile material on impervious material and cover over with same material, until disposal.
- D. Remove excess topsoil not intended for reuse, from site.

3.4 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, relandscaped, or regraded.
- B. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.
- C. When excavating through roots, perform Work by hand and cut roots with sharp axe.
- D. Remove excess subsoil not intended for reuse, from site.

3.5 FILLING

- A. Fill areas to contours and elevations with unfrozen materials.

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- B. Place fill material in continuous layers and compact at a minimum of Geotechnical Engineer's recommendations.
- C. Place material in continuous layers as follows:
  - 1. Subsoil Fill: Maximum 8 inches compacted depth.
  - 2. Structural Fill: Maximum 8 inches compacted depth.
  - 3. Granular Fill: Maximum 8 inches compacted depth.
- D. Maintain moisture content of fill materials -2 to 2% of optimum moisture content to attain required compaction density.
- E. Slope grade away from building minimum 5 percent slope for minimum distance of 10 ft, unless noted otherwise.
- F. Make grade changes gradual. Blend slope into level areas.
- G. Repair or replace items indicated to remain damaged by excavation or filling.

3.6 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus ½ inch from required elevation.

3.7 FIELD QUALITY CONTROL

- A. Perform laboratory material tests in accordance with ASTM D1557.
- B. Perform in place compaction tests in accordance with the following:
  - 1. Density Tests: ASTM D2922.
  - 2. Moisture Tests: ASTM D3017.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

END OF SECTION

SECTION 31 23 16 - EXCAVATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Excavating for site structures and buried tanks.
- B. Related Sections:
  - 1. Section 31 22 13 - Rough Grading: Topsoil and subsoil removal from site surface.
  - 2. Section 31 23 17 - Trenching: Excavating for utility trenches.
  - 3. Section 31 23 23 - Fill.

1.2 QUALITY ASSURANCE

- A. Perform Work in accordance with Teller County Building Department requirements.

PART 2 PRODUCTS - Not Used.

PART 3 EXECUTION

3.1 PREPARATION

- A. Call Local Utility Line Information service at 811 not less than three working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.

3.2 EXCAVATION

- A. Excavate subsoil to accommodate utilities and construction operations.
- B. Do not interfere with 45 degree bearing splay of foundations.
- C. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- D. Trim excavation. Remove loose matter.
- E. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.
- F. Notify Engineer of unexpected subsurface conditions.
- G. Correct areas over excavated as directed by Engineer.
- H. Remove excess and unsuitable material from site.

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- I. Repair or replace items indicated to remain damaged by excavation.

**3.3 FIELD QUALITY CONTROL**

- A. Request inspection of excavation and controlled fill operations if required by Teller County Building Department requirements.
- B. Request visual inspection of bearing surfaces by Engineer before installing subsequent work.

**3.4 PROTECTION**

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

**END OF SECTION**

SECTION 31 23 17 - TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating trenches for utilities from 5 feet outside building to utility service.
2. Compacted fill from top of utility bedding to subgrade elevations.
3. Backfilling and compaction.

B. Related Sections:

1. Section 31 05 13 - Soils for Earthwork: Soils for fill.
2. Section 31 22 13 - Rough Grading: Topsoil and subsoil removal from site surface.
3. Section 31 23 16 - Excavation: General building excavation.
4. Section 31 23 23 - Fill: General backfilling.
5. Section 33 11 13 - Public Water Utility Distribution Piping.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and a 457-mm 18-in. drop.

B. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup>).
2. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 DEFINITIONS

- A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with Teller County Building Department requirements.

1.5 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.6 COORDINATION

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

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**PART 2 PRODUCTS**

**2.1 FILL MATERIALS**

- A. Native Material or Structural Import Type 1.

**PART 3 EXECUTION**

**3.1 LINES AND GRADES**

- A. Lay pipes to lines and grades indicated on Drawings.
  - 1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- B. Use laser-beam instrument with qualified operator to establish lines and grades.

**3.2 PREPARATION**

- A. Call Local Utility Line Information service at 811 not less than three working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Protect plant life, lawns, rock outcropping and other features remaining as portion of final landscaping.
- D. Protect benchmarks and existing structures from excavating equipment and vehicular traffic.
- E. Maintain and protect above and below grade utilities indicated to remain.

**3.3 TRENCHING**

- A. Excavate subsoil required for utilities.
- B. Cut trenches to width indicated on Drawings. Remove water or materials that interfere with Work.
- C. Excavate bottom of trenches maximum 2 feet wider than outside diameter of pipe.
- D. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.
- E. Do not interfere with 45 degree bearing splay of foundations.
- F. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- G. Correct over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.

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H. Remove excess subsoil not intended for reuse, from site.

3.4 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Place fill material in continuous layers no thicker than 8 inches and compact to 95% of the material's standard Proctor maximum dry density.
- D. Employ placement method that does not disturb or damage utilities in trench
- E. Maintain moisture content of fill materials -2 to +2% of optimum moisture content to attain required compaction density.
- F. Do not leave more than 10 feet of trench open at end of working day.
- G. Protect open trench to prevent danger to Owner and public.

3.5 TOLERANCES

- A. Top Surface of Backfilling: Plus or minus 1/2 inch from required elevations.

3.6 FIELD QUALITY CONTROL

- A. Perform laboratory material tests in accordance with ASTM D1557.
- B. Perform in place compaction tests in accordance with the following:
  - 1. Density Tests: ASTM D698.
  - 2. Moisture Tests: ASTM D3017.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

3.7 PROTECTION OF FINISHED WORK

- A. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

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**SECTION 31 23 23 - FILL**

**PART 1 GENERAL**

**1.1 SUMMARY**

**A. Section Includes:**

1. Backfilling building perimeter to subgrade elevations.
2. Backfilling site structures to subgrade elevations.
3. Fill under slabs-on-grade.

**B. Related Sections:**

1. Section 31 05 13 - Soils for Earthwork: Soils for fill.
3. Section 31 22 13 - Rough Grading: Site filling.
4. Section 31 23 16 - Excavation.
5. Section 31 23 17 - Trenching: Backfilling of utility trenches.
6. Section 33 11 13 - Public Water Utility Distribution Piping.

**1.2 REFERENCES**

**A. American Association of State Highway and Transportation Officials:**

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and a 457-mm 18-in. drop.

**B. ASTM International:**

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup>).
2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>).
3. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

**1.3 QUALITY ASSURANCE**

- A. Perform Work in accordance with Teller County Building Department requirements.**

**PART 2 PRODUCTS**

**2.1 FILL MATERIALS**

- A. Subsoil Fill: Type as specified in Section 31 05 13.**
- B. Structural Fill: Type as specified in Section 31 05 13.**

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**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.
- C. Verify structural ability of unsupported walls to support loads imposed by fill.

**3.2 PREPARATION**

- A. Compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.
- C. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

**3.3 BACKFILLING**

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Place material in continuous layers as follows:
  - 1. Subsoil Fill: Maximum 8 inches compacted depth.
  - 2. Structural Fill: Maximum 8 inches compacted depth.
- D. Employ placement method that does not disturb or damage other work.
- E. Maintain optimum moisture content of backfill materials to attain required compaction density.
- F. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.
- G. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.
- H. Make gradual grade changes. Blend slope into level areas.
- I. Remove surplus backfill materials from site.
- J. Leave fill material stockpile areas free of excess fill materials.

**3.4 COMPACTION**

- A. Native Subgrade:

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1. Scarified and compacted soils beneath footings, tank bottom, and structural fill. Minimum 95% compaction.

**B. Fill Soils:**

1. Beneath foundations. Minimum 95% compaction.
2. Tank bottom. Minimum 95% compaction.
3. Embankments and backfill in non-structural areas. Minimum 90% compaction.

**3.5 TOLERANCES**

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top Surface of Backfilling: Plus or minus 1 inch from required elevations.

**3.6 FIELD QUALITY CONTROL**

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

**3.7 PROTECTION OF FINISHED WORK**

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished work.
- B. Reshape and re-compact fills subjected to vehicular traffic.

**END OF SECTION**

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SECTION 31 25 00 - EROSION AND SEDIMENTATION CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Erosion Control Fence.
  - 2. Erosion Control Log.
  
- B. Related Sections:
  - 1. Section 31 05 13 - Soils for Earthwork.
  - 2. Section 31 10 00 - Site Clearing.
  - 3. Section 31 23 16 - Excavation.
  - 4. Section 31 23 23 - Fill.

1.2 QUALITY ASSURANCE

- A. Perform Work in accordance with Drawings and Teller County Building Department requirements.

PART 2 PRODUCTS

2.1 GEOTEXTILE MATERIALS

- A. Geotextile Fabric: Refer to Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify gradients and elevations of base or foundation for other work are correct.
- C. Install Work in accordance with Teller County Building Department requirements.

3.2 SITE STABILIZATION

- A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.
- B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.
- C. Stockpile and waste pile heights shall not exceed 10 feet. Slope stockpile sides at 2: 1 or flatter.

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- D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
  - 1. During non-germinating periods, apply mulch at recommended rates.
  - 2. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one year.
- E. Stabilize diversion channels, sediment traps, and stockpiles immediately.

**3.3 FIELD QUALITY CONTROL**

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order within one working day of discovery of any deficiencies.

**3.4 CLEANING**

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment off site.
- C. Do not damage structure or device during cleaning operations.
- D. Do not permit sediment to erode into construction or site areas or natural waterways.
- E. Clean channels when depth of sediment reaches approximately one half channel depth.

**END OF SECTION**

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**SECTION 33 05 07 – TRENCHLESS INSTALLATION OF UTILITY PIPING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

**A. Section Includes:**

1. Casing and jacking pipe.
2. Steel tunnel liner.
3. Carrier pipe.
4. Excavation for approach trenches and pits.

**B. Related Requirements:**

1. Section 31 23 16 - Excavation: Dewatering measures and excavation supports.
2. Section 31 23 23 - Fill: Compaction requirements.
3. Section 33 11 13 - Public Water Utility Distribution Piping: Piping and carrier pipe requirements.

**1.2 UNT PRICE - MEASUREMENT AND PAYMENT**

**A. Section 01 20 00 - Price and Payment Procedures: Contract Sum/Price modification procedures.**

**B. [Jacked Pipe] [Tunnel]:**

1. Basis of Measurement: By linear [foot] < \_\_\_\_\_ >, measured on invert of [jacked pipe] [tunnel] from face of [jacked pipe] [tunnel].
2. Basis of Payment: Includes excavation, [jacked pipe] [tunnel], [carrier pipe] [duct], grout, accessories, tests, and backfill.

**1.3 REFERENCE STANDARDS**

**A. American Association of State Highway and Transportation Officials:**

1. AASHTO HB-17 - Standard Specifications for Highway Bridges.
2. AASHTO M133 - Standard Specification for Preservatives and Pressure Treatment Processes for Timber.
3. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 10-lb Rammer and a 18-in. drop.

**B. American Railway Engineering and Maintenance-of-Way Association:**

1. AREMA - Manual for Railway Engineering.

**C. American Welding Society:**

1. AWS D1.1/.

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**D. ASTM International:**

1. ASTM A36/A.
2. ASTM A53/.
3. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
4. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
5. ASTM A1011/.
6. ASTM C33/.
7. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
8. ASTM C150/.
9. ASTM C361 - Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
10. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
11. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
12. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>).
13. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>).
14. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

**E. National Utility Contractors Association:**

1. NUCA - Guide to Pipe Jacking and Microtunneling Design.

**1.4 COORDINATION**

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with [State] [Municipality] of < \_\_\_\_\_ > [Highways] [Public Works] and utilities within construction area.

**1.5 PREINSTALLATION MEETINGS**

- A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum [one week] [< \_\_\_\_\_ > weeks] prior to commencing Work of this Section.

**1.6 SUBMITTALS**

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information regarding tunnel liner plate, showing sizes, shapes, methods of attachment, connection details, and details of grout holes.
- C. Shop Drawings:

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1. Indicate details of casing, jacking head, sheeting, and other falsework for trenches and pits, and support for [facility]< \_\_\_\_\_ >, field sketches, and other details to complete Work.
  2. Indicate relationship of proposed installation to [facility] [natural features] over installation, angle of installation, right-of-way lines, and general layout of built facilities.
  3. Indicate cross-section(s) from field survey, showing installation in relation to actual profile of [ground] [facility].
  4. Submit description of proposed construction plan, dewatering plan, and plan to establish and maintain vertical and horizontal alignments.
- D. **Manufacturer's Certificate:** Certify that products meet or exceed specified requirements.
- E. **Welder Certificates:** Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.
- F. **Delegated Design Submittals:** Submit signed and sealed Shop Drawings with design calculations and assumptions for tunnel liner.
- G. Submit [State] [Municipality] of < \_\_\_\_\_ > [Highways] [Public Works] occupancy permit for installations [along] [under] public thoroughways and lands.
- H. Submit emergency response procedures to handle situations when conduit is compromised and jeopardizes safety or integrity of installation.
- I. Submit written report results of [visual check]< \_\_\_\_\_ > of entire length of [casing] [liner] prior to installation of [carrier] [concrete invert] to verify that there are no voids or defective joints.
- J. **Field Quality-Control Submittals:** Indicate results of Contractor-furnished tests and inspections.
- K. **Qualifications Statements:**
1. Submit qualifications for installer and licensed professional.
  2. **Welders:** Qualify procedures and personnel according to AWS D1.1/D1.1M.

**1.7 SUSTAINABLE DESIGN SUBMITTALS**

- A. **Section 01 81 13 - Sustainable Design Requirements:** Requirements for sustainable design submittals.
- B. **Manufacturer's Certificate:**
1. Certify that products meet or exceed specified sustainable design requirements.
  2. **Materials Resources Certificates:**
    - a. Certify source and origin for [salvaged] [and] [reused] products.
    - b. Certify recycled material content for recycled content products.
    - c. Certify source for regional materials and distance from Project Site.
- C. **Product Cost Data:**
1. Submit cost of products to verify compliance with Project sustainable design requirements.

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2. Exclude cost of labor and equipment to install products.
3. Provide cost data for following products:
  - a. Salvaged, refurbished, and reused products.
  - b. Products with recycled material content.
  - c. Regional products.
  - d. Certified wood products.
  - e. < \_\_\_\_\_ >.

1.8 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of casing or tunnel liner, carrier pipe, and invert elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.9 QUALITY ASSURANCE

- A. Perform Work according to AREMA, NUCA, and < \_\_\_\_\_ > guidelines.
- B. Obtain occupancy permit when boring, jacking, or tunneling under or within rights-of-way of [state] [municipal] highways and railroads.
- C. Perform Work according to < \_\_\_\_\_ > standards.
- D. Maintain < \_\_\_\_\_ > [copy] [copies] of each standard affecting Work of this Section on Site.

1.10 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this Section with minimum [three]< \_\_\_\_\_ > years' [documented] experience [and approved by manufacturer].
- B. Welders: AWS qualified within previous 12 months for employed weld types.
- C. Licensed Professional: [Professional engineer]< \_\_\_\_\_ > experienced in design of specified Work and licensed [at Project location] [in State of < \_\_\_\_\_ >].

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Handling: Support casing and carrier pipes with nylon slings during handling.

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D. Storage:

1. Store products according to manufacturer instructions.
2. Use wooden shipping braces between layers of stacked pipe.
3. Stack piping lengths no more than three layers high.
4. Store field joint materials in original shipping containers.

E. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide temporary end caps and closures on piping and fittings and maintain in place until installation.
3. Protect piping [system pieces] [systems] from entry of foreign materials and water by installing temporary covers, completing sections of Work, and isolating parts of completed system.
4. Provide additional protection according to manufacturer instructions.

1.12 AMBIENT CONDITIONS

- A. Section 015000 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Storage Temperature: Maintain 60 to 85 degrees F.

1.13 EXISTING CONDITIONS

- A. Field Measurements:
  1. Verify field measurements prior to fabrication.
  2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 CASING AND JACKING PIPE

A. Manufacturers:

1. Pipe Industries Corporation.
2. Southland Pipe & Supply Co.
3. Valiant Steel and Equipment, Inc.
4. Substitutions: [As specified in Section 016000 - Product Requirements] [Not permitted].
5. Furnish materials according to < \_\_\_\_\_ > standards.

B. Steel Casing Pipe:

1. Comply with ASTM A53/A53M.

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2. Minimum Yield Strength: **[35,000] [42,000]** psi.
3. Minimum Wall Thickness: 0.375 inch.
4. Welded Joints:
  - a. Comply with AWS D1.1/D1.1M.
  - b. Full circumference.

C. Concrete Casing Pipe:

1. Pipe:
  - a. Comply with ASTM **[C76] [C361]**, Class V wall.
  - b. Loading: Type C.
  - c. Type: **[Reinforced] [Nonreinforced]**.
2. Joints:
  - a. Comply with ASTM C443.
  - b. Joints: Butt.
  - c. Collar Bands: **[Steel] [or] [fiberglass-reinforced pipe]**.
  - d. Sealing Ring: Elastomeric material.

D. Performance and Design Criteria:

1. Casing Pipe and Tunnel Liner: Leakproof.
2. Loading:
  - a. Highways:
    - 1) Earth cover.
    - 2) H-20 live loading, according to AASHTO HB-17.
    - 3) Impact loading according to AASHTO HB-17 **[plus 50 percent]**.
  - b. Railways:
    - 1) Earth cover.
    - 2) Comply with AREMA - Manual for Railway Engineering.
    - 3) Impact loading according to AREMA guidelines **[plus 50 percent]**.
3. Bracing, Backstops, and Jacks: Of sufficient rating for continuous jacking without stopping except to add pipe sections, and to minimize tendency of ground material to freeze around casing pipe.

2.2 STEEL TUNNEL LINER

- A. Comply with AREMA guidelines.
- B. Plates:
  1. Material: Structural steel.
  2. Comply with ASTM A1011/A1011M.

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3. Minimum Grade: 40.

C. Bolts and Nuts Used with Lapped Seams:

1. Minimum Diameter: 5/8 inch.
2. Bolts for Plate Thicknesses Greater Than or Equal to 0.209 Inches: Comply with ASTM A449.
3. Bolts for Plate Thicknesses Less Than 0.209 Inches: Comply with ASTM A307, Grade A.
4. Nuts: Comply with ASTM A307, Grade A.

D. Bolts and Nuts Used with Four-Flanged Plates:

1. Comply with ASTM A307, Grade A.
2. Thread: Coarse.
3. Diameter:
  - a. Plate Thicknesses up to and Including 0.179 Inch: Minimum 1/2 inch.
  - b. Plate Thicknesses Greater Than 0.179 Inch: Minimum 5/8 inch.

2.3 CARRIER PIPE

A. Site Water Distribution System Piping: As specified in Section [331416 - Site Water Utility Distribution Piping]<\_\_\_\_\_ - \_\_\_\_\_>.

2.4 MATERIALS

A. Soil Backfill for Trench Approaches and Pits to Finish Grade:

1. Soil Type [S1] [S2], as specified in Section [334200 - Stormwater Conveyance]<\_\_\_\_\_ - \_\_\_\_\_>.
2. Subsoil with no rocks 6 inches in diameter or greater, frozen earth, or foreign matter.

B. Filling and Sealing Grout at Pipe Ends: Concrete grout fill as specified in Section [036000 - Grouting]<\_\_\_\_\_ - \_\_\_\_\_>.

C. Pressure-Grout Mix: One part portland cement and six parts mortar sand, mixed with water to consistency applicable for pressure grouting.

D. Mortar Sand: Comply with [ASTM C33/C33M] [ASTM C404]<\_\_\_\_\_>.

E. Portland Cement:

1. Comply with [ASTM C150/C150M]<\_\_\_\_\_>.
2. Type: [I] [V]<\_\_\_\_\_>.

2.5 ACCESSORIES

A. Timber Supports and Insulators:

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1. Description:
  - a. Furnish notches to accommodate fastening.
  - b. Treat notches at time of pipe installation.
2. Wood Preservative or Pressure Treatment: [Creosote; AASHTO M133]<\_\_\_\_\_>.
3. Species: [Redwood]<\_\_\_\_\_>.

### B. Steel and Plastic Supports and Insulators:

1. Bands: [14-gage stainless steel] [Polyethylene].
2. Flange Bolts: 5/16-inch stainless steel.
3. Liner: Heavy-duty PVC.
4. Skids: [Polyethylene] [or] [phenolic].

### C. Steel Strapping: Comply with ASTM A36/A36M.

### D. Tunnel Liner Coating: [Zinc] [Bituminous].

## 2.6 FABRICATION - STEEL TUNNEL LINER

### A. Description: Fabricate plates to fit cross-section of tunnel and for connection by bolts on both longitudinal and circumferential seams or joints for erection from inside.

### B. Grout Holes:

1. Description: To permit grouting as erection of liner plates progresses.
2. Diameter: [2 inches] [As indicated on Drawings].

### C. Plates:

1. Cold-form plates to provide pattern of corrugations or panels in skin section, which, along with circumferential flanges, develop effective sectional properties as shown in AREMA guidelines.
2. Width: [16] [18] <\_\_\_\_\_> inches.
3. Length: Adequate to obtain circumferential wall coverage in two or more multiples equivalent to 6, 12, 14, or 16 inches of diameter.
4. Maximum Weight of Single Plate without Bolts: 90 lb..

### D. Plate Joints:

1. Description:
  - a. Drill plates for bolting on both longitudinal and circumferential seams or joints.
  - b. Fabricate to permit complete erection from inside.
2. Circumferential Flanges: Furnish bolt spacing not greater than 9-1/2 inches center-to-center and in multiples of plate length such that plates having same curvature are interchangeable and to permit staggering of longitudinal seams.
3. Longitudinal Flanges:

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- a. Four-Flanged Plates: Three bolts in 16 inches of plate width.
- b. Two-Flanged Plates: Four bolts per foot in lapped seams.

E. Coatings:

1. Galvanized Liner Plates: < \_\_\_\_\_ >.
2. Bituminous Coating: < \_\_\_\_\_ >.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that connection [to existing piping system] < \_\_\_\_\_ >, sizes, locations, and invert elevations are as indicated on [Shop] Drawings.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Identify required lines, levels, contours, and datum locations.
- C. Existing Utilities:
  1. Locate and identify utilities indicated to remain and protect from damage.
  2. Notify [utility company] < \_\_\_\_\_ > to remove [and relocate] utilities.
  3. Establish minimum separation of < \_\_\_\_\_ > from [other services] [sanitary sewage piping] < \_\_\_\_\_ > according to [< \_\_\_\_\_ > code] < \_\_\_\_\_ >.
- D. Establish elevations of [casing] [tunnel] with not less than < \_\_\_\_\_ > feet of cover.
- E. Maintain access to existing [facilities] < \_\_\_\_\_ > and other active installations requiring access.

3.3 INSTALLATION

- A. Dewatering:
  1. As specified in Section [312316 - Excavation] [312316.13 - Trenching] < \_\_\_\_\_ - \_\_\_\_\_ >.
  2. Intercept and divert surface drainage precipitation and ground water away from excavation through use of dikes, curb walls, ditches, pipes, sumps, or other methods.
  3. Develop substantially dry subgrade for subsequent operations.
  4. Comply with requirements of local and state authorities for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.

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**B. Pits or Approach Trenches:**

1. Excavate approach trenches or pits [according to installation plan] [, as indicated on Shop Drawings] [, and] as Site conditions require.
2. Ensure that [casing] [tunnel] entrance faces as near perpendicular in alignment as conditions permit.
3. Establish vertical entrance face at least 1 foot above top of [casing] [tunnel lining].
4. Install excavation supports as specified in Section [312316 - Excavation] [312316.13 - Trenching]<\_\_\_\_\_ - \_\_\_\_\_>.

**C. Casing Pipe:**

1. Boring:
  - a. Push pipe into ground with boring auger rotating within pipe to remove soil.
  - b. Do not advance cutting head ahead of casing pipe, except for distance necessary to permit cutting teeth to maintain clearance for pipe.
  - c. Arrange machine bore and cutting head to be removable from within pipe.
  - d. Arrange face of cutting head to provide barrier to free flow of soft material.
  - e. If unstable soil is encountered during boring, retract cutting head into casing to permit balance between pushing pressure and ratio of pipe advancement to quantity of soil.
  - f. Grout to fill voids if voids develop greater than OD of pipe by approximately 1 inch.
  - g. If boring is obstructed, relocate jack or tunnel as directed by Architect/Engineer.
2. Jacking:
  - a. Construct adequate thrust wall normal to proposed line of thrust.
  - b. Impart thrust load to pipe through suitable thrust ring sufficiently rigid to ensure uniform distribution of thrust load on full pipe circumference.
3. Drilling and Jacking:
  - a. Use oil-field-type rock roller bit or plate bit made up of individual roller cutter units solidly welded to pipe.
  - b. Turned and push pipe for its entire length by drilling machine to give bit necessary cutting action.
  - c. Inject high-density slurry (oil field drilling mud) to head as cutter lubricant.
  - d. Inject slurry at rear of cutter units to prevent jetting action ahead of pipe.
4. Mining and Jacking: Use manual hand-mining excavation from within casing pipe as casing is advanced with jacks, allowing minimum ground standup time ahead of casing pipe.

**D. Tunneling:**

1. Liner Plates:
  - a. Advance excavation for tunnel lining in increments sufficient for erection of one ring of liners.
  - b. Install liner plates immediately after each increment of excavation.

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- c. Excavate to minimize voids behind liner plates.
    - d. Force-grout voids immediately, using pressure as necessary to completely fill voids.
  2. Excavate to lines, grades, dimensions, and tolerances as indicated on Drawings to accommodate initial support and permanent lining.
  3. Tunnel Linings:
    - a. Do not damage lining or coating.
    - b. Ensure that edges are clean and free of material capable of interfering with proper bearing.
    - c. Install liner plates and bolts according to liner plate manufacturer instructions, and replace liner plates or bolts not meeting these requirements.
    - d. Use liner plates for full length of tunnel of one type only, using either flanged or lapped-seam type of construction.
  4. Place concrete invert.
- E. Pressure Grouting: Pressure-grout annular space between casing pipe and surrounding earth.
- F. Carrier Pipe:
  1. Clean, inspect, and handle pipe as specified in Section [337119 - Electrical Underground Ducts, Ductbanks, and Manholes] [335213 - Fuel-Oil Distribution] [336100 - Hydronic Energy Distribution] [336300 - Steam Energy Distribution] [331416 - Site Water Utility Distribution Piping] [333100 - Sanitary Sewerage Piping] [334213 - Stormwater Culverts] [334200 - Stormwater Conveyance].
  2. Placement:
    - a. Place carrier pipe as specified in Section [337119 - Electrical Underground Ducts, Ductbanks, and Manholes] [335213 - Fuel-Oil Distribution] [336100 - Hydronic Energy Distribution] [336300 - Steam Energy Distribution] [331416 - Site Water Utility Distribution Piping] [333100 - Sanitary Sewerage Piping] [334213 - Stormwater Culverts] [334200 - Stormwater Conveyance].
    - b. Prevent damage to pipe joints as carrier pipe is placed in casing.
  3. Supports:
    - a. Support pipeline within casing such that no external loads are transmitted to carrier pipe.
    - b. Attach supports to barrel of carrier pipe; do not rest carrier pipe on bells.
  4. Grout ends of casing to seal.

3.4 TOLERANCES

- A. Section 0140 00 - Quality Requirements: Requirements for tolerances.
- B. Excavation: Do not overcut excavation by more than 1 inch greater than OD of casing pipe.

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- C. Casing Pipe Vertical and Horizontal Alignment: Plus or minus 3 inches prior to installation of carrier pipe.
- D. Pipe Bells: Minimum 1/2-inch clearance to casing.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Compaction Testing:
  - 1. Comply with [ASTM D1557] [ASTM D698] [ASTM D6938] [AASHTO T 180].
  - 2. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
  - 3. Testing Frequency: < \_\_\_\_\_ >.
- D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than < \_\_\_\_\_ > [days] [hours] on Site for technical assistance during following periods of [casing] [tunnel] installation:
  - 1. Unloading of [casing] [tunnel] materials and components.
  - 2. Prior to commencing excavation and during excavation.

3.6 CLEANING

- A. Section 017000 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Remove temporary facilities for [casing] [tunnel] installation and [jacking] [tunneling] operations as specified in Section [015000 - Temporary Facilities and Controls] < \_\_\_\_\_ - \_\_\_\_\_ >.

3.7 PROTECTION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect plant life, lawns, [rock outcroppings,] and other features of final landscaping.
- C. Protect bench marks, survey control points, [existing structures,] [fences,] [sidewalks,] [paving,] [and] [curbs] from excavating equipment and vehicular traffic.

END OF SECTION

**SECTION 33 11 12 – POTABLE WATER SUPPLY WELLS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

**A. Section Includes:**

1. Drilling and casing of water well.
2. Pump and controller.
3. Hydropneumatic tanks.
4. Water and system testing and certification.

**B. Related Requirements:**

1. Section 31 23 16 - Excavation: Excavating for conduit and pipe from well head to building.
2. Section 31 23 16.13 - Trenching: Backfilling and excavating for conduit and pipe from well head to building.
3. Section 31 23 23 - Fill: Backfilling for conduit and pipe from well head to building.

**1.2 DEFINITIONS**

- A. Suspended Solids:** Small solid particles that do not dissolve in water.

**1.3 UNIT PRICE - MEASUREMENT AND PAYMENT**

- A. Section 01 20 00 - Price and Payment Procedures:** Contract Sum/Price modification procedures.

**B. Water Well:**

1. Basis of Measurement: By vertical [foot] < \_\_\_\_\_ > of well depth.
2. Basis of Payment: Includes drilling, casing, backfilling, pump test, and water quantity [and water quality] tests.

**C. Grouting:**

1. Basis of Measurement: By cubic foot.
2. Basis of Payment: Includes materials and placement of grout.

**D. Pump:**

1. Basis of Measurement: By each.
2. Basis of Payment: Includes pump controller, motor drive, fittings, sensor, and accessories; conduit, wire, pipe, and pipe fittings from well to water storage tank; accessories; and pump.

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**1.4 REFERENCE STANDARDS**

**A. American Society of Mechanical Engineers:**

1. ASME Boiler and Pressure Vessel Code Section VIII - Rules for Construction of Pressure Vessels Division 1.

**B. ASTM International:**

1. ASTM A53/.
2. ASTM C150/C150M - Standard Specification for Portland Cement.
3. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

**C. American Water Works Association:**

1. AWWA A100 - Water Wells.
2. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.

**D. National Electrical Manufacturers Association:**

1. NEMA MG 1 - Motors and Generators.
2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

**1.5 PREINSTALLATION MEETINGS**

**A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.**

**B. Convene minimum one week prior to commencing Work of this Section.**

**1.6 SUBMITTALS**

**A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.**

**B. Product Data:**

1. Submit manufacturer information regarding well pump and controller, including rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
2. Submit manufacturer information regarding well casing.

**C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.**

**D. Manufacturer Instructions:**

1. Submit detailed instructions on installation requirements, including storage and handling procedures.
2. Indicate rigging and assembly.

**E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.**

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F. Qualifications Statements:

1. Submit qualifications for manufacturer and drilling firm.

1.7 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of well, depth, subsoil strata, and drilling difficulties encountered.
- C. Submit signed copy of driller's logbook statements.
- D. Submit executed certification of well pump after performance testing.
- E. Submit documents required by Colorado Department of Natural Resources.

1.8 QUALITY ASSURANCE

- A. Perform Work according to AWWA A100.

1.9 QUALIFICATIONS

- A. Drilling Firm: Company specializing in performing Work of this Section with minimum 3 years' experience and licensed.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Water well with following characteristics:

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1. Minimum Water Production: < \_\_\_\_\_ > gpm.
2. Upper Drill Hole: < \_\_\_\_\_ >-inch diameter and < \_\_\_\_\_ > feet deep.
3. Lower Drill Hole: < \_\_\_\_\_ >-inch diameter and < \_\_\_\_\_ > feet deep.
4. Casing Size: < \_\_\_\_\_ >-inch ID and < \_\_\_\_\_ > feet deep.
5. Grout Seal Depth: < \_\_\_\_\_ > feet.
6. Total Well Depth: < \_\_\_\_\_ > feet.
7. Pump Depth: < \_\_\_\_\_ > feet.

**B. Performance and Design Criteria:**

1. Maximum Suspended Solids in Delivered Water: < \_\_\_\_\_ > mg/L.
2. Maximum Settleable Solids in Delivered Water: < \_\_\_\_\_ > ppm.
3. Well Pump:
  - a. Design Flow Rate: < \_\_\_\_\_ > gpm.
  - b. Design Flow Total Dynamic Head: < \_\_\_\_\_ > feet.
  - c. Minimum Efficiency at Design Flow Rate: < \_\_\_\_\_ > percent.
  - d. Maximum Flow Rate: < \_\_\_\_\_ > gpm.
  - e. Maximum Flow Total Dynamic Head: < \_\_\_\_\_ > feet.
  - f. Minimum Efficiency at Maximum Flow Rate: < \_\_\_\_\_ > percent.
  - g. Net Positive Suction Head Available: < \_\_\_\_\_ > feet.
  - h. Maximum Pump Speed: < \_\_\_\_\_ > rpm.
  - i. Maximum Motor Speed: < \_\_\_\_\_ > rpm.

**2.2 WELL PUMPS**

**A. Manufacturers:**

1. Gorman-Rupp Company (The).
2. Goulds Water Technology: a Xylem brand.
3. Grundfos Pumps Corporation U.S.A.
4. Or Approved Equal

**B. Description:**

1. Type: Close-coupled, multi-stage submersible.
2. Lubrication: [Water lubricated] [Oil filled].
3. Shaft: Vertical.
4. Suitable for insertion in [3-inch] [4-inch] [5-inch] [6-inch] diameter pipe.

**C. Casing:**

1. Casting: [Cast iron] [Bronze].
2. Housing and Intake Screen: Stainless steel.
3. Check Valve: Stainless-steel stem and valve seat with rubber seal built into discharge casting.

**D. Impellers and Diffusers: [Bronze] [Glass-reinforced thermoplastic with stainless-steel wear rings]< \_\_\_\_\_ >.**

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E. Shaft and Sleeve: Stainless steel.

F. Operation:

1. Electrical Characteristics:

- a. As specified in Section 260583 - Wiring Connections.
- b. [         > hp] [         > RLA].
- c. Voltage: <          > V, [single] [three] phase, 60 Hz.
- d. Maximum [Fuse Size] [Circuit Breaker Size] [Overcurrent Protection]:  
<          > A.
- e. Minimum Circuit Ampacity: <          >.
- f. Minimum Power Factor: <          > percent at rated load.

2. Motors:

- a. As specified in Section 220513 - Common Motor Requirements for Plumbing Equipment.
- b. NEMA MG 1 submersible type.

3. Pump Controller:

- a. NEMA 250 Type [1] [3R] <          > enclosure with main disconnect interlocked with door.
- b. Single-point power connection and grounding lug.
- c. Across-the-line electric motor starter with starting relay [and ambient compensate quick trip overloads in each phase with manual trip button and reset button].
- d. Circuit breaker.
- e. Control transformer.
- f. HAND-OFF-AUTO selector switches.
- g. Pilot lights.

4. Pressure-Sensing Switch:

- a. Type: Low-voltage relay.
- b. Settings:
  - 1) [Fixed] [Adjustable].
  - 2) Start pump at [20] [30] <          > psig and de-energize pump at [40] [50] <          > psig.
  - 3) [Low pressure cutoff set at 20 psig] [Low pressure cutoff set at <          > psig].

5. Control Voltage: [120 V ac] [24 V dc] <          >.

G. Pump Lift Cable:

1. Description: Stainless-steel, multi-stranded aircraft cable with high tensile strength.
2. Cable Ends: Fitted with closed loop fittings.
3. Length: Depth of shaft plus [20] <          > feet.

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H. Screen Material: [Stainless steel]< \_\_\_\_\_ >.

2.3 WELL CASINGS

A. Description:

1. Material:

- a. Schedule [40] [80] galvanized-steel pipe.
- b. Comply with ASTM A53/A53M, Grade [A] [B].

2. Nominal Internal Diameter: [3] [4] [5] [6] < \_\_\_\_\_ > inches.
3. Accessories: Pitless adaptor and ventilated well cap.

B. Description:

1. Material:

- a. Schedule [40] [80] PVC.
- b. Comply with AWWA C900.

2. Material:

- a. PVC, SDR [21]< \_\_\_\_\_ >.
- b. Comply with ASTM D2241.

3. Nominal Internal Diameter: [3 inches] [4 inches] [5 inches] [6 inches].
4. Accessories: Pitless adaptor and ventilated well cap.

2.4 WELL SCREENS

A. Description:

1. Configuration: Continuous slot; wire wound.
2. Circumferentially wrap triangularly shaped wire around circular array of rods or perforated channels.
3. Wire configuration to produce inlet slots with sharp outer edges, widening inwardly to minimize clogging.
4. Material: [Type < \_\_\_\_\_ > stainless steel] [PVC]< \_\_\_\_\_ >.

2.5 MATERIALS

A. Filter Packs:

1. Description: Clean, well rounded, smooth, and uniform; mostly grains.
2. Material:
  - a. Siliceous.
  - b. Calcareous Material: Not more than 5 percent by weight.

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c. Minimum Specific Gravity: 2.5.

3. Grading:

- a. Determination: From sieve analyses of aquifer materials.
- b. Passing Size: Four to six times thirty-percent passing size of aquifer sample having finest grain-size distribution.

4. Minimum Uniformity Coefficient: 2.5.

2.6 MIXES

A. Grout:

1. Type:

- a. Portland cement.
- b. Comply with ASTM C150/C150M, Type 1.

2. Mixture: Not more than 5 gal. of water per 94-lb. bag of cement.

3. Obtain approval of [Architect/Engineer] < \_\_\_\_\_ > to use bentonite or other additives, up to 6 percent by weight of cement, to reduce shrinkage permeability, increase fluidity, or control setting time.

B. Grout: Mixture of bentonite clay with minimum amount of clean water required to facilitate placement.

2.7 ACCESSORIES

A. Pitless Adapters:

1. Manufacturers:

- a. Flint & Walling; Zoeller Company.
- b. Merrill Manufacturing.
- c. Pentair Water.
- d. Substitutions: [As specified in Section 016000 - Product Requirements] [Not permitted].
- e. Furnish materials according to < \_\_\_\_\_ > standards.

2. Description: Two-piece bronze.

B. Well Seals:

1. Manufacturers:

- a. Campbell Manufacturing, Inc.
- b. Merrill Manufacturing.
- c. Simmons Manufacturing Co.

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- d. Substitutions: [As specified in Section 016000 - Product Requirements] [Not permitted].
  - e. Furnish materials according to < \_\_\_\_\_ > standards.
2. Materials:
- a. Plate: Painted cast iron.
  - b. Seal: Molded rubber.
  - c. Bolts and Nuts: Zinc-plated steel.
- C. Well Caps:
- 1. **Manufacturers:**
    - a. Campbell Manufacturing, Inc.
    - b. Merrill Manufacturing.
    - c. Simmons Manufacturing Co.
    - d. Substitutions: [As specified in Section 016000 - Product Requirements] [Not permitted].
    - e. Furnish materials according to < \_\_\_\_\_ > standards.
  - 2. Description: Watertight, lockable.
  - 3. Material: [Cast iron] [ABS] [Aluminum] [Aluminum/ABS].
- D. Riser Pipes:
- 1. Schedule [40]< \_\_\_\_\_ > threaded [steel] pipe.
  - 2. Nominal Diameter: < \_\_\_\_\_ > inches.
- E. Cable Ties: [Threaded plastic strap]< \_\_\_\_\_ >.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that Site conditions are capable of supporting equipment for performing drilling operations and testing.

**3.2 PREPARATION**

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Protect structures near well from damage.

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3.3 INSTALLATION

A. Drilling:

1. Drilling Equipment: [Reverse] [Direct] [Air] rotary.
2. Drill concentric well shaft to diameters and depths as [indicated on Drawings] [required to meet performance criteria].
3. Remove loose material from shaft bottom.
4. Allow inspection of casing prior to placement of grout.
5. Place grout tight to surrounding Work according to [regulatory requirements]< \_\_\_\_\_ >.
6. Shaft Top:
  - a. Cut off shaft top [24] < \_\_\_\_\_ > inches above [grade]< \_\_\_\_\_ >.
  - b. Prevent metal cuttings from entering casing.
7. Record accurate log of materials penetrated to determine depths and thicknesses of underlying formations.
8. Prepare electric log recording resistivity, spontaneous potential, and gamma for total depth of borehole.
9. Record caliper, temperature, fluid conductivity, and optical or acoustic televiewer logs to total depth of borehole.
10. Casing and Screen:
  - a. Place well casing and screen assembly immediately after drilling.
  - b. Keep casing and screen under tension during filter packing.
11. Install filter packing.
12. Test borehole for plumbness according to [AWWA A100]< \_\_\_\_\_ >.
13. Remove loose material from shaft bottom.
14. Maintain well opening and casing free of contaminating materials.

B. Disinfection: Disinfect well [as specified in Section 330110.58 - Disinfection of Water Utility Piping Systems]< \_\_\_\_\_ >.

C. Installation Standards: Install Work according to < \_\_\_\_\_ > standards.

D. Well Pump:

1. Electrical Connections: As specified in Section [260583 - Wiring Connections]< \_\_\_\_\_ - \_\_\_\_\_ >.
2. Secure pump lifting cable to pump.
3. Install pump onto threaded riser pipe.
4. Set pump intake < \_\_\_\_\_ > feet below [finished] [existing] grade.
5. Secure wiring harness to pump column at < \_\_\_\_\_ >-foot intervals.
6. Install pitless adapter to set pump discharge at < \_\_\_\_\_ > feet below [finished] [existing] grade.
7. Install pump column < \_\_\_\_\_ > feet above [finished] [existing] grade with well seal between pump column and well casing.

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**3.4 TOLERANCES**

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation From Plumb: [Comply with AWWA A100] [1/2 inch] [< \_\_\_\_\_ > inch]  
[Not to exceed 2/3 of casing diameter per 100 feet of well depth].
- C. Maximum Offset From Indicated Alignment: [1] < \_\_\_\_\_ > inch.

**3.5 FIELD QUALITY CONTROL**

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Performance Testing:
  - 1. Notify Engineer at least three days prior to flow-rate testing.
  - 2. Test flow rate and certify.
  - 3. Water Quantity: < \_\_\_\_\_ >.
  - 4. Water Quality: < \_\_\_\_\_ >.
  - 5. Sand Content: < \_\_\_\_\_ >.
- D. Acceptance: Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.

**END OF SECTION**

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SECTION 33 11 13 - PUBLIC WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings for public line, including potable water line and site distribution.
2. Underground pipe markers.
3. Pipe support systems.
4. Bedding and cover materials.

B. Related Requirements:

1. Section 03 30 00 - Cast-in-Place Concrete: Concrete for thrust restraints.
2. Section 31 05 13 - Soils for Earthwork: Soils for backfill in trenches.
3. Section 31 23 16 - Excavation: Product and execution requirements for excavation and backfill required by this Section.
4. Section 31 23 17 - Trenching: Execution requirements for trenching required by this Section.
5. Section 31 23 23 - Fill: Requirements for backfill to be placed by this Section.
6. Section 33 13 00 - Disinfecting of Water Utility Distribution: Disinfection of water piping.

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 10-lb Rammer and a 457-mm 18-in. drop.

B. American Society of Mechanical Engineers:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

C. American Water Works Association:

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.
3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
5. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
6. AWWA C153 - Ductile-Iron Compact Fittings.
7. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances.
8. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

1.3 SUBMITTALS

A. Submittals required to verify compliance with Project requirements.

B. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

C. Product Data: Submit data on pipe materials, pipe fittings, valves, and accessories.

D. Shop Drawings: Indicate piping layout, including piping specialties.

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**1.4 QUALITY ASSURANCE**

- A. Valves: Mark valve body with manufacturer's name and pressure rating. Perform Work according to Cheyenne Board of Public Utilities standards.**

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.**
- B. Deliver and store valves in shipping containers with manufacturer's labeling in place and inspect for damage.**
- C. Block individual and stockpiled pipe lengths to prevent moving.**
- D. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.**

**1.6 EXISTING CONDITIONS**

- A. Field Measurements:**
- 1. Verify field measurements prior to fabrication.**
  - 2. Indicate field measurements on Shop Drawings.**

**PART 2 PRODUCTS**

**2.1 High Density Polyethylene Pipe:**

- A. Comply with AWWA C901/C906, ASTM D2239, ASTM D2737, ASTM D3035, PE 4710, ANSI/NSF-14.**

**2.2 Underground Pipe Markers**

- B. Manufacturers:**
- 1. Submit to Engineer.**
- C. Plastic Ribbon Tape:**
- 1. Brightly colored, continuously printed with applicable text.**
  - 2. Minimum 6 inches wide by 4 mil thick.**
  - 3. Manufactured for direct burial service.**
- D. Trace Wire:**
- 1. Electronic detection materials for nonconductive piping products.**
  - 2. Unshielded, 10 AWG, THWN-insulated copper wire.**
  - 3. Conductive tape.**

**2.3 MATERIALS**

- A. Bedding and Cover:**
- 1. Bedding: Fill Type as specified in Section 31 05 13 - Soils for Earthwork.**
  - 2. Cover: Fill Type, as specified in Section 31 05 13 - Soils for Earthwork.**
  - 3. Soil Backfill from above pipe cover to Finish Grade:**

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- a. Soil Type, as specified in Section 31 0513 - Soils for Earthwork.
- b. Subsoil with no rocks over 3 inches in diameter, frozen earth, or foreign matter.

**PART 3 EXECUTION**

**A. EXAMINATION**

1. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
  1. Verify that existing utility water main size, location, and invert are as indicated on Drawings.

**B. PREPARATION**

1. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
2. Pipe Cutting:
  - a. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
  - b. Use only equipment specifically designed for pipe cutting; use of chisels or hand saws is not permitted.
3. Grind edges smooth with beveled end for push-on connections.
4. Remove scale and dirt on inside and outside before assembly.
5. Prepare pipe connections to equipment with flanges or unions.

**C. INSTALLATION**

1. Excavation:
  - a. Excavate pipe trench as specified in Section 31 23 17 - Trenching.
  - b. Hand trim excavation for accurate placement of pipe to elevations as indicated on Drawings.
2. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.
3. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 8 inches compacted depth, and compact to 95 percent of maximum density.
4. Piping:
  - a. Install pipe according to AWWA C600.
  - b. Handle and assemble pipe according to manufacturer instructions and as indicated on Drawings.
  - c. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.
  - d. Maintain 10 feet horizontal separation of water main from sewer main.
  - e. Install ductile-iron piping and fittings according to AWWA C600.
  - f. Weld pipe according to AWWA C206, and weld joints according to AWWA C205.
  - g. Flanged Joints: Not to be used in underground installations except within structures.
  - h. Route pipe in straight line; re-lay pipe that is out of alignment or grade.
  - i. High Points:
    - a) Install pipe with no high points.

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- b) If unforeseen field conditions arise that necessitate high points, install air release valves as directed by Engineer.
5. **Bearing:**
    - a. Install pipe to have bearing along entire length of pipe.
    - b. Excavate bell holes to permit proper joint installation.
    - c. Do not lay pipe in wet or frozen trench.
  6. Prevent foreign material from entering pipe during placement.
  7. Install pipe to allow for expansion and contraction without stressing pipe or joints.
  8. Close pipe openings with watertight plugs during Work stoppages.
  9. Install access fittings to permit disinfection of water system performed under Section 33 13 00 - Disinfecting of Water Utility Distribution.
  10. **Cover:**
    - a. Establish elevations of buried piping with not less than 7 feet of cover (8 feet if water line is not looped).
    - b. Measure depth of cover from final surface grade to top of pipe barrel.
  11. **Pipe Markers:**
    - a. Install plastic ribbon tape and trace wire continuous buried 36 inches below finish grade, above piping.
    - b. Coordinate with trench Work as specified in Section 31 23 23 - Fill.
  12. **Polyethylene Encasement:**
    - a. Encase piping in polyethylene where indicated on Drawings to prevent contact with surrounding backfill material.
    - b. Comply with AWWA C105.
    - c. Terminate encasement 3 to 6 inches above ground where pipe is exposed.
  13. **Thrust Restraints:**
    - a. Provide valves, tees, bends, caps, and plugs with concrete thrust blocks.
    - b. Pour concrete thrust blocks against undisturbed earth.
    - c. Locate thrust blocks at each elbow or change of pipe direction to resist resultant force and to ensure that pipe and fitting joints will be accessible for repair.
    - d. Install tie rods, clamps, setscrew retainer glands, or restrained joints.
    - e. Protect metal-restrained joint components against corrosion by applying a bituminous coating or encasing metal area using concrete mortar.
    - f. Do not encase pipe and fitting joints to flanges.
    - g. Install thrust blocks, tie rods, and joint restraint at dead ends of water main.
  14. **Backfilling:**
    - a. Backfill around sides and to top of pipe with cover fill in maximum lifts of 6 inches, tamp in place, and compact to 95 percent of maximum density.
    - b. Place and compact material immediately adjacent to pipes to avoid damage to pipe and prevent pipe misalignment.
    - c. Maintain optimum moisture content of bedding material to attain required compaction density.
  15. **Disinfection of Potable Water Piping System:**
    - a. As specified in Section 33 13 00 - Disinfecting of Water Utility Distribution.

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**D. TOLERANCES**

1. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
2. Install pipe to indicated elevation within tolerance of 5/8 inch.

**E. FIELD QUALITY CONTROL**

1. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
2. Pressure test system according to AWWA C600 and following:
  - a. Test Pressure: Not less than 200 psig or 50 psi in excess of maximum static pressure, whichever is greater.
  - b. Conduct hydrostatic test for at least two hours.
  - c. Slowly fill section to be tested with water; expel air from piping at high points. Install corporation cocks at high points. Close air vents and corporation cocks after air is expelled. Raise pressure to specified test pressure.
  - d. Observe joints, fittings, and valves under test. Remove and renew cracked pipes, joints, fittings, and valves showing visible leakage. Retest.
  - e. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate. Maintain pressure within plus or minus 5 psi of starting test pressure. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
  - f. Compute maximum allowable leakage using following formula:

a)L =  $SD \times \sqrt{P/C}$ .

(1)L = testing allowance, gph.

(2)S = length of pipe tested, feet.

(3)D = nominal diameter of pipe, inches.

(4)P = average test pressure during hydrostatic test, psig.

(5)C = 148,000.

b)If pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

3. Leakage:

- a)If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.
- b)Correct visible leaks regardless of quantity of leakage.
- c)If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

END OF SECTION

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SECTION 33 13 00 - DISINFECTING OF WATER UTILITY DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes disinfection of site potable water piping; and testing and reporting results.
- B. Related Sections:
  - 1. Section 33 11 16 - Site Water Utility Distribution Piping Product and Execution requirements for installation, testing, of site domestic water distribution piping.

1.2 REFERENCES

- A. American Water Works Association:
  - 1. AWWA B300 - Hypochlorites.
  - 2. AWWA B301 - Liquid Chlorine.
  - 3. AWWA C651 - Disinfecting Water Mains.

1.3 SUBMITTALS

- 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. Name of person collecting samples.
  - 5. Initial and 24 hour disinfectant residuals in treated water in ppm for each outlet tested.
  - 6. Date and time of flushing start and completion.
  - 7. 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.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with AWWA C651.
- B. Maintain one copy of each document on site.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

- A. Chemicals: Sodium Hypochlorite - NaOCl.

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**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify piping system has been cleaned, inspected, and pressure tested.
- C. Perform scheduling and disinfecting activity with start-up, water pressure testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

**3.2 INSTALLATION**

- A. Inject treatment disinfectant into piping system.
- B. Maintain disinfectant in system for 24 hours.
- C. Provide bacteriological sampling reports to Client for approval.
- D. Once approval is provided by Client, flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.
- E. Replace permanent system devices removed for disinfection.

**3.3 FIELD QUALITY CONTROL**

- A. Disinfection, Flushing, and Sampling:
  - 1. Upon completion of retention period required for disinfection, flush pipeline until chlorine concentration in water leaving pipeline is no higher than 1.0 ppm.
  - 2. Legally dispose of chlorinated water. When chlorinated discharge may cause damage to environment, apply neutralizing chemical to chlorinated water to neutralize chlorine residual remaining in water.

END OF SECTION

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SECTION 33 13 13 - WATER STORAGE TANK DISINFECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Water tank disinfection.
  - 2. Bacteriological testing.
- B. Related Sections:
  - 1. Section 43 41 11 – Bolted Steel Tanks.

1.2 REFERENCES

- A. American Water Works Association:
  - 1. AWWA C652 - Disinfection of Water Storage Facilities.

1.3 SUBMITTALS

- A. Disinfection Procedure: Submit procedure description including type of disinfectant and calculations indicating quantities of disinfectants required to produce specified chlorine concentration in accordance with Section 3 and 4 of AWWA C652.
- B. Test Reports: Indicate results of bacteriological and residual chlorine laboratory test reports.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with AWWA C652.
- B. Perform Work in accordance with Colorado Department of Public Health and Environment.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Store disinfectants in cool, dry place away from combustibles such as wood, rags, oils and grease.
- C. Handle disinfectants with caution; protect skin and eyes from contact; avoid breathing vapors; wear gloves, aprons, goggles, and vapor masks.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Furnish personnel working inside tank during disinfection with equipment to comply with Federal and State regulations for work conducted in hazardous atmosphere.
- B. Neutralize disinfectant solution before disposal.
- C. Legally dispose of disinfection solution off Project site.

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- D. Repair damage caused by disinfectant solution and disinfection procedures.

**PART 2 PRODUCTS**

**2.1 DISINFECTANTS**

- A. Chlorine Forms: In accordance with AWWA C652, Section 3.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Conduct inspection of tank interior before beginning disinfection.
  - 1. Verify tank is clean and free of polluting materials.
  - 2. Verify tank pipe and vent connections are properly made and clear of obstructions.
  - 3. Verify paint is thoroughly cured in accordance with paint manufacturer's instructions.

**3.2 PREPARATION**

- A. Protect aquatic life and vegetation from damage from disinfectant solution purged from tank.

**3.3 APPLICATION**

- A. Use any one or a combination of the three methods for disinfecting tank specified in Section 4 of AWWA C652:
  - 1. Chlorination Method 1.
  - 2. Chlorination Method 2.
  - 3. Chlorination Method 3.

**3.4 FIELD QUALITY CONTROL**

- A. Collect samples of water from filled tank for bacteriological analysis in accordance with Section 4.4 of AWWA C652; take inlet and outlet water samples.
- B. Test water samples for residual chlorine and bacteriological contaminants.
- C. When water samples fail to meet State Health Standards for potable water perform the following corrective measures until water quality conforms to State Health Standards:
  - 1. Inlet and Outlet Water Sample Failure: Eliminate source of contamination in water supply, repeat disinfection, and retest water quality.
  - 2. Outlet Water Sample Failure: Repeat disinfection, and retest water quality.

**END OF SECTION**

**SECTION 40 05 23.15 - GATE VALVES**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Section Includes:**
  - 1. Resilient-seated gate valves.
- B. Related Requirements:**
  - 1. Section 40 05 23 - Common Work Results for Process Valves

**1.2 REFERENCE STANDARDS**

- A. American Society of Mechanical Engineers:**
  - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
  - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.
  - 3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
  - 4. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
- B. American Water Works Association:**
  - 1. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.

**1.3 SUBMITTALS**

- A. Product Data:**
  - 1. Submit catalog information, indicating materials of construction and compliance with indicated standards.
- B. Operation and Maintenance Manual.**

**1.4 WARRANTY**

- A. Manufacturer's warranty.**

**PART 2 PRODUCTS**

**2.1 RESILIENT-SEATED GATE VALVES**

- A. Manufacturer List:**
  - 1. Mueller A-2360
  - 2. Approved Equal.
- B. Description:**
  - 1. AWWA C509-01.
  - 2. Minimum Working Pressure: 250 psig.
  - 3. End Connections: Mechanical joint.

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4. Provide gear actuators conforming to AWWA C509 for manual valves.

C. Operation:

1. Rising stem.

2.2 SOURCE QUALITY CONTROL

A. Testing: Test gate valves according to AWWA C509.

B. Engineer shall be notified of test before it occurs.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install according to manufacturer's instructions.

B. Support valves in plastic piping to prevent undue stresses on piping.

END OF SECTION

**SECTION 43 41 11 - BOLTED STEEL TANKS**

**GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Factory-coated bolted steel tanks.**
- B. Related Requirements:**
  - 1. Project Geotechnical Report - Available Project Information: Subsurface investigation report, bore hole locations, and findings of subsurface materials.**

**1.2 DEFINITIONS**

- A. Purchaser: Contractor, as used in AWWA D103.**
- B. Tank Low Level: Level when emptied through specified discharge fittings unless otherwise indicated on Drawings.**

**1.3 REFERENCE STANDARDS**

- A. American Water Works Association:**
  - 1. AWWA D103-09.**
- B. NSF International:**
  - 1. NSF 61 - Drinking Water System Components - Health Effects.**
  - 2. NSF 372 - Drinking Water System Components - Lead Content.**
- C. Occupational Safety and Health Administration:**
  - 1. OSHA 29 CFR 1910 - Occupational Safety and Health Standards.**

**1.4 COORDINATION**

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.**
- B. Coordinate Work of this Section with location and placement of utilities, piping, and tank foundation.**

**1.5 PREINSTALLATION MEETINGS**

- A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.**
- B. Convene minimum one week prior to commencing Work of this Section.**

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1.6 SCHEDULING

A. Schedule Work of this Section after Work for support pad and prior to connecting piping Work.

1.7 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit data for expansion joint fittings and other pipe specialty fittings.
2. Submit data for ladder and ladder safety devices.
3. Submit information concerning materials of construction, fabrication, and coatings.

C. Shop Drawings:

1. Indicate:
  - a) Complete plan, elevation, and sectional Drawings showing critical dimensions.
  - b) Structural plate and support member sizes and thickness.
  - c) Weld types and sizes.
  - d) Water supply and overflow piping details, including fittings, expansion joints, and pipe support methods.
  - e) Ladder and ladder safety device details.
  - f) Handrail details.
  - g) Access hatch details.
  - h) Foundation ring structural design.

D. Manufacturer's Certificate:

1. Certify that tanks and appurtenances meet or exceed specified requirements.
2. Owner Installation Certificate: Obtain from equipment manufacturer's representative and submit, attesting that equipment has been properly installed and is ready for startup and testing.

E. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for tank structural calculations.

F. Test and Evaluation Reports:

1. Submit mill test reports.
2. Written Report Certifying Work: Prepare and submit as indicated in AWWA D103.
3. Submit Installation Certificate from equipment manufacturer's representative as described in PART 3.

G. Manufacturer Instructions: Submit detailed instructions on installation requirements, including tank component handling procedures, anchoring, and layout.

H. Source Quality-Control Submittals: Indicate results of shop tests and inspections.

I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

J. Manufacturer Reports: Certify that tank has been installed according to manufacturer instructions.

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**1.8 CLOSEOUT SUBMITTALS**

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.**
- B. Project Record Documents: Record actual location and orientation of tank and appurtenances.**

**1.9 QUALITY ASSURANCE**

- A. Perform Work according to AWWA D103.**
- B. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.**
- C. Perform Work according to Teller County standards.**

**1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.**
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.**
- C. Storage:**
  - 1. Store materials in areas protected from weather and moisture and according to manufacturer instructions.**
  - 2. Do not store products directly on ground.**
- D. Handling: Handle materials in a manner to prevent damage to interior or exterior surfaces.**
- E. Protection:**
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.**
  - 2. Provide additional protection according to manufacturer instructions.**

**1.11 EXISTING CONDITIONS**

- A. Field Measurements:**
  - 1. Verify field measurements prior to fabrication.**
  - 2. Indicate field measurements on Shop Drawings.**

**1.12 WARRANTY**

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.**
- B. Furnish five-year manufacturer's warranty for bolted steel tank.**

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PRODUCTS

2.1 TANKS

A. Manufacturers:

1. Tank Connection.
2. Approved Equal.

B. Description:

1. Design, fabricate, and erect 100,000 gallon ground-level, bolted steel potable water reservoir and accessories.

C. Performance and Design Criteria:

1. Conform design to requirements listed in AWWA D103, unless supplemented or modified in this Section:
  - a. Bottom capacity level (BCL) and top capacity level (TCL) above top of foundation.
  - b. Roof and Bottom: As indicated on Drawings.
  - c. Location of Site: As indicated on Drawings.
  - d. Snow Loading:
    - 1) Comply with AWWA D103, Section 5.2.3.1 and Teller County Building Department Requirements.
  - e. Wind Loading:
    - 1) Comply with AWWA D103, Section 5.2.4 and Teller County Building Department Requirements.
  - f. Earthquake Loading:
    - 1) Comply with AWWA D103, Section 5.2.5 and Teller County Requirements.

2.2 TANK CONSTRUCTION

A. Comply with requirements listed in AWWA D103, unless supplemented or modified below:

1. Pipe and Fittings for Fluid Conductors: Modify to indicate only welded joints for conductors are acceptable.
2. Roof Support: According to AWWA D103.
3. Pipe and Pipe Connections:
  - a. Silt Stop: Provide removable stainless-steel silt stop and mechanical joint gland.
  - b. Provide other accessories as indicated on Drawings.
4. Overflow:
  - a. As indicated on Drawings.
  - b. Provide welded joint steel overflow pipe as indicated on Drawings, suitably supported and extending to grade level.
  - c. Overflow Diameter: As indicated on Drawings.
  - d. Terminate overflow pipe at 2 feet above finished grade to provide air break.
  - e. Provide #24 aluminum or bronze mesh insect screen and screen holder over air break opening.
5. Roof Ladder: As indicated on Drawings.
6. Safety Devices:
  - a. Comply with OSHA standards.
7. Specification Sheet for Seismic Data: According to AWWA D103.

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**2.3 INLET AND OUTLET PIPE**

A. Description: ASTM A53 (A53M), Grade B, Schedule 40, steel pipe, welded joints.

**2.4 OVERFLOW PIPE**

A. Description: ASTM A53 (A53M), Grade B, Schedule 40, steel pipe, welded joints.

**2.5 MATERIALS**

A. Furnish materials complying with this Section, as indicated on Drawings, and according to AWWA D103.

**2.6 FABRICATION**

A. Materials, Design, and Fabrication: According to AWWA D103.

**2.7 SOURCE QUALITY CONTROL**

A. Provide shop inspection and testing of component parts.

**EXECUTION**

**3.1 EXAMINATION**

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for erection examination.

B. Verify layout and orientation of tank accessories and piping connections.

**3.2 PREPARATION**

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for erection preparation.

B. Support Pad:

1. Thoroughly clean tank pad, removing loose concrete, dust, and other debris.
2. Place building paper on pad according to tank manufacturer's recommendations prior to placing tank.

**3.3 INSTALLATION**

A. According to AWWA D103, as indicated on Drawings, and according to manufacturer instructions.

B. Connect piping to tank.

C. To complete installation, install tank accessories not factory mounted.

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D. Touch-up Painting and Coating: According to manufacturer instructions.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

B. Inspection and Testing:

1. Hydrostatic Testing:

- a. Test completed and cleaned tank for liquid tightness by filling tank to its overflow elevation with water provided by Owner.
- b. Correct leaks disclosed by this test.
- c. Drain and legally dispose of test water.

C. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.

D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

END OF SECTION