Addendum No. 1

Project:	**South Knox Steel Gas Pipeline**
Control No:	**1075**
Issued:	**To all listed plan holders**
Date:	**December 6, 2017**

This addendum forms a part of the Agreement described above. The original Contract Documents and any prior addenda remain in full force and effect except as modified by the following, which shall take precedence over any contrary provisions in prior documents.

1. Section 15210 – Natural Gas Steel Pipeline Specification

- ADD Section 15210, attached as part of this addendum. This specification was inadvertently left off the CD which contains the project specifications.

END

Each Bidder/Proposer shall acknowledge receipt of this addendum by affixing his signature below, by noting this addendum on his Bid/Proposal Form, and by attaching this addendum to his Bid/Proposal. **Failure to acknowledge this addendum could be cause for bid/proposal rejection.**

ACKNOWLEDGMENT

The undersigned acknowledges receipt of this addendum and the Bid submitted is in accordance with information, instructions and stipulations set forth herein.

BIDDER / PROPOSER _____

AUTHORIZED SIGNATURE_____

DATE _____

15210

Construction Specifications for Natural Gas Steel Pipeline

Combined Standards

Scope:
This standard covers the general requirements for pipeline construction performed by the CONTRACTOR. All work shall be performed in strict compliance with all applicable federal, state, and local laws, orders, rules, regulations, rights-of-way, and permits. The CONTRACTOR shall comply in strict accordance with all referenced attachments and the articles of the Contract, and perform those duties necessary to complete the work.

TABLE OF CONTENTS

1. REFERENCES

1.1. The references listed below are based on current editions as of February 2016. In the event a listed reference is updated, the updated version supersedes the version listed in table. In the event any conflict with Specification 15210 arises from an updated reference, the updated reference supersedes the specification.

Pipeline and Hazardous Materials Safety Administration (PHMSA)	
29 CFR Part 1910	Occupational Safety and Health Standards
49 CFR 192	Transportation of Natural and Other Gas by Pipeline
49 CFR 195	Transportation of Hazardous Liquids by Pipeline
American Society of Mechanical Engineers (ASME)	
B31.3-2010	Process Piping
B31.4-2006	Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids
B31.8-2007	Gas Transmission and Distribution Piping Systems
2007BPVC Section IX	Welding and Brazing Qualifications
ASME PCC-1-2010	Guidelines for Pressure Boundary Bolted Flange Joint Assembly
2007 ASME Boiler and Pressure Vessel Code	Section V - Non-Destructive Examination Section VIII Div. 1 - Rules for Construction of Pressure Vessels Section IX - Welding and Brazing Qualifications
ASME B16.5-2009	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
American Petroleum Institute (API)	
API 5L	Specification for Line Pipe, 44th Edition
API 6D	Specification for Pipeline Valves, 23rd Edition
API 1102	Steel Pipelines Crossing Railroads and Highways, 7th Edition
API 1104	Welding of Pipelines and Related Facilities - 20th Edition
API RP 1110	Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids or Carbon Dioxide, 5th Edition
API Bulletin D20	Directional Drilling Survey Calculation Methods and Terminology
API RP 13B/ISO 10414-1	Recommended practice for field testing water-based drilling fluids.
API RP 13D	Rheology and hydraulics of oil-well drilling fluids.
API RP 2201	Safe Hot Tapping Practices in the Petroleum and Petrochemical Industries, 5th Edition
API RP 686	Recommended Practice for Machinery Installation
Specification 13A/ISO 13500	Specification for Drilling Fluids Materials

American Welding Society	
AWS A5.1	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS A5.5	Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding
D1.1	Structural Steel Welding Code, 22nd Edition
International Association of Drilling CONTRACTORs (IADC)	
IADC	Drilling Manual
Occupational Safety and Health Administration (OSHA)	
29 CFR 1926	Safety and Health Regulations for Construction
American Society of Nondestructive Testing (ASNT)	
SNT-TC-1A	Recommended Practice for Personnel Qualification
American Society of Testing and Materials (ASTM)	
ASTM Specifications A193 Grade B7 and Grade B8	Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM Specifications A194 Grade 2H and Grade 8	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products
ASTM A385	Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM B695	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM D1193	Standard Specification for Reagent Water
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM G14	Standard Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)
ASTM B766	Standard Specification for Electrodeposited Coatings of Cadmium
ASTM D2201	Standard Practice for Preparation of Zinc-Coated and Zinc-Alloy-Coated Steel Panels for Testing Paint and Related Coating Products
ASTM D3359	Standard Test Methods for Measuring Adhesion by Tape Test
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
International Organization for Standardization (ISO)	
ISO 8501-1	Preparation of Steel Substrates before Application of Paints and Related Products
National Association of Corrosion Engineers International (NACE)	
RP0188	Holiday Testing of New Protective Coatings on

	Conductive Substrates
RP0274	High-Voltage Electrical Inspection of Pipeline Coatings
NACE	Guide to Qualification of Tradesman Industrial Maintenance Painters
RP0287	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape
RP0394	Application, Performance and Quality Control of Plant-Applied, Fusion-Bonded Epoxy External Pipe Coating
SP0490	Holiday Detection of Fusion – Bonded Epoxy External Pipeline Coatings of 10 to 30 mil (0.25 to 0.76 mm)
Steel Structures Painting Council (SSPC)	
SSPC	Steel Structures Painting Manual, Volume 1, "Good Painting Practice"
SSPC	Steel Structures Painting Manual, Volume 2 – Systems and Specifications
SSPC PA 1	Shop, Field, and Maintenance Painting
SSPC PA 2	Measurement of Dry Paint Thickness with Magnetic Gages Measurement of Dry Coating Thickness with Magnetic Gauges
SSPC SP 1	Solvent Cleaning
SSPC SP 2	Hand Tool Cleaning
SSPC SP 3	Power Tool Cleaning
SSPC SP 5/NACE No.1	White Metal Blast Cleaning
SSPC SP 6/NACE No.3	Commercial Blast Cleaning
SSPC SP 7/NACE No.4	Brush-Off Blast Cleaning
SSPC SP 10/NACE No. 2	Near-White Blast Cleaning
SSPC SP 11	Power Tool Cleaning to Bare Metal
SSPC SP 12/NACE No. 5	High and Ultra-High Pressure Water Jetting
SSPC Vis 1 89	Visual Standard for Abrasive Blast Cleaned Steel
SSPC Vis 3	Visual Standard for Power and Hand Tool Cleaned Steel
SSP Manual, Volume 1	Good Painting Practice

2. INTRODUCTION

2.1. General

2.1.1. This document lists the “OWNER’S” Pipeline Construction Specifications, hereinafter referred to as "Specifications" to be utilized during the fabrication and/or installation of pipelines and/or facilities for the Knoxville Utilities Board. The Specifications describe requirements for the fabrication, testing, painting, coating, handling, transportation, and installation of pipelines and related facilities. The directions, provisions, and requirements of these Specifications pertain to the Scope of Work. This specification covers all OWNER natural gas steel pipeline construction.

2.1.2. Local, state, and federal regulations, ordinances, statutes, or codes shall govern where compliance is mandatory. Requirements, however, of these Specifications shall apply when they are more exacting or do not conflict with such regulations, ordinances, statutes or codes. (Ref Specification 00514 Article 6)

2.1.3. Adherence to the Specification is not intended to relieve CONTRACTOR of the responsibility to perform the Scope of Work as an independent CONTRACTOR in accordance with all applicable governmental and regulatory requirements.

2.1.4. All references to codes, standards, or other specifications shall be construed to be the most current issue in effect at the time the Contract is executed, and shall be considered as being a part of this Specification. (Reference Specification 00700 Paragraph 3.02)

2.2. Sanitation Facilities:

2.2.1. CONTRACTOR shall provide portable toilets, garbage containers, and services to empty and clean these facilities at all work sites. Waste shall be transported off-site for disposal. CONTRACTOR shall perform a daily worksite cleanup and verify all garbage, consumables, dunnage, scrap, etc. is placed in an appropriate storage container for disposal.

2.3. Pre-Construction Meeting:

2.3.1. Prior to commencement of work, a pre-construction meeting shall be held among CONTRACTOR, RPR , and/or OWNER’s third-party inspection personnel to assure that all parties involved fully understand the scope of work and applicable requirements and to familiarize OWNER’s third-party inspection

personnel with CONTRACTOR's personnel, equipment, and work processes. (Reference Specification Section 00700 Paragraph 2.06)

2.4. Notification:

2.4.1. No part of the work may be subcontracted without written notification to the OWNER. (See Specification 00514 Article 7 and Specification 00700 6.06 for additional Subcontractor information)

2.5. OWNER Inspection and Access:

2.5.1. Resident Project Representative shall have free access at all times to all areas where work on this Contract is being performed.

2.5.2. OWNER reserves the right to inspect, photograph, and/or videotape any part of the work and may reject at CONTRACTORS expense any element(s) that fail to conform to the Contract, jeopardize the safety of personnel, or impose a hazard of damage to OWNER property.

2.5.3. RPR shall be notified whenever any portion of the work is to be performed that will prevent subsequent inspection of another portion. If a portion of the work subject to inspection has been rendered inaccessible without inspection, CONTRACTOR shall remove any items required to permit inspection and repair to the satisfaction of RPR at no additional cost to OWNER.

2.5.4. The CONTRACTOR shall furnish the equipment necessary for assuring the Work performed is in accordance with the requirements and the intent of the Specifications and Contract. If the RPR so requests, the CONTRACTOR shall, at CONTRACTOR expense, at any time before acceptance of the Work, remove or uncover such portions of the finished Work as may be directed. After examination, the CONTRACTOR shall restore said portion of the Work to the standard required by the Specifications. (Reference Specification 00514 Article 10) and (Reference Specification 00700 Paragraph 13.04)

2.6. Progress Meetings:

2.6.1. CONTRACTOR shall keep Resident Project Representative advised of the progress of all phases of the work on a daily, weekly, and monthly basis.

2.6.2. CONTRACTOR and OWNER shall conduct regular weekly progress meetings at a time and location acceptable to both parties. The meetings shall include, but are not limited to, safety concerns and accidents (including near misses), progress to date, technical issues and changes, and any contractual issues such as extra work claims, invoicing, and the like.

3. Material Handling

3.1. Control of Materials/Quality of Materials:

3.1.1. Material not furnished by the Owner shall be new and approved by the RPR. If the sources of supply do not furnish a uniform product or if the product proves unacceptable at any time, the CONTRACTOR shall furnish approved material from other sources.

3.1.2. No materials shall be used in the Work which has in any way become unfit for use after acceptance.

3.1.3. When one material is specified by name and "or equal to" is written thereafter, the material mentioned by name is the material desired. If the CONTRACTOR desires to use another material in lieu thereof, approval of the RPR shall be obtained before making the substitution. (Reference Specification 00700 paragraph 6.05)

3.1.4. Whenever the words "approved by" or "satisfactory to" or similar phrases are used in this Specification, they shall be understood to mean that the item or material referred to shall be approved by and be satisfactory to the RPR.

3.2. Handling Materials

3.2.1. All pipe, valves, fittings, and appurtenances shall be loaded and unloaded by lifting with slings, hoists or other means to avoid shock or damage.

3.2.2. The CONTRACTOR shall handle all pipes with a vacuum hoe, or brass, aluminum, or neoprene lined hooks to avoid damage to beveled ends and shall handle all coated pipe with padded hooks, slings, forks, etc. Padding may be rubber, Teflon, neoprene, or equal to eliminate any pipe contact with truck bolsters or other hard surfaces. All hooks, padding, slings, tie-down lines, etc., shall meet with approval of the RPR. Vehicles hauling coated pipe (excluding concrete coated) shall have fenders or other protection to prevent mud and rocks from being thrown upon the pipe, damaging the coating

3.2.3. The CONTRACTOR shall dispose of banding material and dunnage from rail cars or other carriers in a manner acceptable to the RPR, and shall clean-up unloading areas to the RPR's satisfaction.

3.3. Traceability

3.3.1. Traceability of pipe, fittings and valves shall be maintained with respect to the following: Pipe Manufacturer, Heat Number, Pipe Number and RPR Tally Number

3.3.2. CONTRACTOR shall maintain an electronic tally sheet, in an Excel format, of all pipe received by CONTRACTOR which includes the information outlined above.

3.3.3. At RPR's option, CONTRACTOR shall operate a computerized pipe tracking system that will ensure full traceability of each individual pipe at all stages of the stringing process. CONTRACTOR shall provide a daily updated electronic copy of the tally sheet showing all pipe received.

3.4. Storing Material

3.4.1. Materials shall be stored to preserve their quality and fitness for the Work and must follow all manufactures specifications for storage and handling.

3.4.2. The interior of all pipe fittings and other appurtenances shall be kept free from dirt and foreign matter at all times. Valves and accessories shall be drained and stored in a manner which will protect them from damage from freezing. All Valves shall have all ends covered with RPR pre approved end caps, either aluminum, plastic, or like.

3.5. Defective Material

3.5.1. All materials not conforming to the requirements of this Specification shall be rejected and shall be removed immediately from the site of the Work unless permitted to remain by the RPR. Rejected materials, the defects of which have been subsequently corrected, shall have the status of new material once approved by the RPR.

3.6. Issuing Material to CONTRACTOR

3.6.1. OWNER-furnished material and/or stored material for the project will be issued by the RPR to the CONTRACTOR's authorized representative who shall acknowledge, in writing, the receipt of the material and shall be responsible for all such material thereafter. CONTRACTOR shall be responsible for providing all equipment necessarily to load, unload and transport all project related materials.

OWNER supplied pipe is located at:

1740 Riverside Dr
Knoxville, TN
37915

All other OWNER supplied materials are located at:

1015 E Jackson Ave.
Knoxville, TN
37915

4505 Middlebrook Pike
Knoxville, TN
37921

3.7. Manufacturer's Instructions

3.7.1. All manufactured articles, material, and equipment shall be handled, transported, stored, applied, installed, connected, erected, used, cleaned, conditioned, tested, operated, etcetera in accordance with the manufacturer's specifications, instructions, requirements unless otherwise specified herein.

3.8. Tools and Equipment

3.8.1. If, at any time during the progress of the Work, tools or equipment appear to the RPR to be insufficient, or inappropriate to secure the quality of work required, or allow the work to proceed in a safe manner the RPR may request that the CONTRACTOR address the issue.

3.8.2. All activities involving fuels and lubricants shall be performed in accordance with the CONTRACTOR's Spill Prevention Control Plan (SPCP)

3.8.3. Both the Pipeline Installation CONTRACTOR and the TTE SUBCONTRACTOR shall satisfy the requirements of appropriate regulatory agencies by providing a means to contain, monitor, and abate turbidity (if required) in the marine environment while performing TTE's, including to the maximum possible extent, the capture and containment of any drilling mud/fluids that may escape the TTE holes.

3.9. Measurement of Quantities

3.9.1. The quantities of Work performed will be computed by the CONTRACTOR on the basis of measurements taken by the CONTRACTOR and approved by RPR. (See Specification 01290 Measurement and Payment)

3.10. Coordination of Specifications and Drawings:

3.10.1. This Specification, the Project Drawings, Special Provisions, and all supplemental documents are essential parts of the Contract, and a requirement

appearing in one is as binding as though appearing in all. In case of discrepancy, figured or field verified dimensions shall govern over scaled dimensions. In all cases the most stringent specification shall govern. (See Specification 00514 Article 1.)

3.11. Drawing Material Lists:

3.11.1. The material lists on Project Drawings are not intended to be binding for the quantities of materials to be furnished and installed by the CONTRACTOR. The material lists are not necessarily complete and are intended to be used as a guide and a method of clarifying details on the drawings by means of item numbers. CONTRACTOR shall check all quantities by making its own material take-offs; and should bear in mind that it is to perform and complete all Work represented on the Project Drawings, and supplemented by material lists and Specifications, in accordance with accepted practices of the construction industry. See Specifications 00330 and 01270)

3.12. Rules and Permits:

3.12.1. If additional Permits and licenses are required of a temporary nature necessary for the prosecution of the Work shall be secured by the CONTRACTOR. The CONTRACTOR shall give all notices and comply with all laws, ordinances, rules, and regulations bearing on the conduct of the Work as drawn and specified. Where the Specifications or the Project Drawings conflict with local conditions, or city, county, or state ordinances, the CONTRACTOR shall notify the RPR in writing, who shall then notify the CONTRACTOR in writing of the approved changes to resolve the issue.

3.13. Contractor Furnished Materials (See Specification 00700 6.17 for further information regarding Submittals and submittal procedures)

3.13.1. CONTRACTOR shall furnish and provide at the site the following materials and supplies, exclusive of other materials named, and all other items not specifically listed as furnished by OWNER. RPR reserves the right to approve the source of supply and manufacturer of all materials furnished by CONTRACTOR that will enter into the permanent construction. CONTRACTOR shall not place orders for any materials of this type until RPR has had the opportunity of exercising this option. All materials furnished by CONTRACTOR and entering into the permanent construction shall be new and of the Specifications prescribed by OWNER. CONTRACTOR shall make all arrangements for ordering, receiving and storing materials.

3.13.2. Welding equipment and all miscellaneous welding materials including welding rod and gases.

3.13.3. Fittings necessary for the completion of the project as stated in the scope of work and project drawings with the exception of the fittings to be supplied by OWNER as specified in Section 2.2. CONTRACTOR to provide all required Mill Test Reports of fittings to RPR prior to use to validate fittings comply with project specifications.

3.13.4. Equipment, coating, primer, and wrapping materials for coating of the pipeline installed below grade not furnished coated by OWNER. This includes field joints, valves, fittings and repairing damaged coatings of underground facilities not identified in the Project Drawings. Epoxy and Powercrete coating for coating weld joints, fittings, valves, etc., as required by Section 15600.

3.13.5. For all welds that are within the HDD drill string, CONTRACTOR shall supply and install Scar-Guard abrasion resistant sacrificial outer laminate produced by NRI, or approved equal, for added protection of welds in addition to the required field applied joint coating. Scar-Guard, or approved equal, must be applied to HDD welds prior to pulling the pipeline in the bore hole. Refer to manufacturer's installation instruction.

3.13.6. Equipment and materials used for sand blasting and painting all aboveground facilities.

3.13.7. Suitable, clean fill as specified in Section 3.4.3 for backfilling the trench.

3.13.8. River sand as specified in Section 3.4.1 to construct a 12-inch envelope of sand around the pipeline.

3.13.9. Compressed air or nitrogen to operate all cleaning, dewater, and drying pigs.

3.13.10. Water, fill pipe, spill pipe, valves, fittings and other necessary materials for hydrostatic testing of the pipeline. Water for all hydrostatic tests will be available from OWNER. CONTRACTOR shall follow the typical process to utilize hydrants to obtain water, which includes, but is not limited to, contact KUB's New Service Department, and pay the deposit to obtain a temporary water meter with backflow preventer. All costs associated with the hydrostatic test shall be included in the line item for the price of hydrostatic test in bid.

3.13.11. All tools and equipment necessary or required to complete the Project and all timbers or other materials required to store, move or erect pipe, piping, structures, and other facilities and equipment.

3.13.12. All expendable materials and supplies required for construction of Project.

3.13.13. Weld caps, valves, blind flanges, and materials for test manifolds required to facilitate pressure tests of fabricated pipeline sections. Fittings and material for non-pressurized service necessary for the completion of the Project. CONTRACTOR shall provide verification that all materials used in testing meet the standards necessary for test pressure requirements.

3.13.14. All pigs for cleaning, dewatering, and testing the pipeline.

3.13.15. Cable, ground rods, and all other materials used to ground pipe.

3.13.16. All tools, equipment, and machinery necessary for construction. This includes equipment necessary to test welders, hydrostatic testing equipment, and holiday detectors.

3.13.17. Non-detectable direct buried marking tape that meets the following standards:

3.13.17.1. Inert polyethylene, impervious to known alkalis, acids, chemical reagents, and solvents likely to be encountered in soil.

3.13.17.2. Thickness: 5 mils minimum.

3.13.17.3. Width: 4-inch minimum.

3.13.17.4. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.

3.13.17.5. Manufactured by: Mutual Industries, Presco or approved equal.

3.13.17.6. Color: In accordance with APWA Uniform Color Code for Temporary Marking of Underground Facilities

Color*	Facility
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communicating alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Green	Sewers and drain lines
Blue	Potable water
Purple	Reclaimed water, irrigation, and slurry lines
*As specified in NEMA Z535.1, Safety Color Code.	

4. SURVEY:

4.1. The OWNER will stake the location of the centerline of the open cut portion of the proposed pipeline with stakes at approximately 100 foot intervals or other intervals as required by the specific project. Each stake will be marked with a station number and/or survey information for progress reporting and installation purposes. CONTRACTOR shall be responsible, at his expense, for maintaining the centerline and workspace limit stakes. CONTRACTOR shall lay the pipe along the route as surveyed and marked by OWNER.

4.2. Where the pipeline is to be installed parallel to an existing pipeline or pipelines, CONTRACTOR shall stake the centerline of the closest existing pipeline at intervals not in excess of 100 ft or as required by paralleling utility company or ROW conditions.

4.3. CONTRACTOR shall not place spoil over existing pipelines without written approval from Owner.

4.4. The OWNER will stake, as necessary, the limits of the construction right-of-way limits, any temporary extra work spaces, staging areas, corners of sites for valve settings, meter stations, compressor/pump stations, scraper traps, other above ground piping and environmental concerns. These stakes shall not be removed until the commencement of respective "Clean up and Restoration" activities. CONTRACTOR shall be responsible, at his expense, for maintaining the workspace limit stakes.

4.5. OWNER staked property corners will establish dimensional control points for CONTRACTOR's installation of fabricated assemblies. CONTRACTOR shall perform all other field survey work necessary for the installation of valve settings, meter stations, compressor/pump stations, scraper traps and associated piping. The CONTRACTOR shall verify all grades, lines, levels and dimensions as shown on the drawings, and shall report any errors or inconsistencies to the OWNER.

4.6. The OWNER requires that all construction as-built surveys be conducted after the pipe is lowered into the ditch. To assist in this as-built, CONTRACTOR shall remove centerline

stakes directly ahead of the trenching operation and relocate them, to survey quality, to the outside edge of the construction right-of-way for future reference. These stakes shall not be disturbed until the CONTRACTOR's cleanup operation removes them. CONTRACTOR shall provide adequate notification for survey needs and allow adequate time for as-built survey prior to backfilling.

5. FENCING

5.1. CONTRACTOR shall, before proceeding with the cutting of fences, installation of gates or gaps, or any other right-of-way work, familiarize itself with all special provisions included in the right-of-way stipulations, ascertain the staked location of the pipeline from OWNER's representative, and ensure that all affected property-owners have been notified by OWNER.

5.2. "H" frames, shall be constructed and installed according to an OWNER provided Drawing or as detailed in ROW Provisions. All fence posts across the right-of-way shall be painted and/or repaired.

5.3. The CONTRACTOR shall provide and maintain suitable temporary walks, passageways, fences, or other structures so as not to obstruct or interfere with traffic in public streets, highways, or private rights-of-way, livestock crossings, to the satisfaction of the RPR, and maintain from the beginning of twilight through the whole of each night, on or near the construction site, sufficient and proper light, to protect from injury all persons, horse drawn or automotive vehicles, or livestock. When work is suspended, the CONTRACTOR shall keep all roadways and walks in proper condition, and put and leave same in proper condition at the termination of the work.

6. CLEARING AND GRADING:

6.1. Definitions

6.1.1. For the purposes herein, the right-of-way (ROW) shall be a strip of land, width as detailed on the Project Drawings and the Special Work Provisions. All of the CONTRACTOR's operations shall be confined within such applicable widths on each respective tract as designated under the Special Work Provisions and shall be controlling and binding upon the CONTRACTOR.

6.2. Limitations

6.2.1. Before clearing operations are started, the CONTRACTOR shall be familiar and comply with all special provisions included in the OWNER provided Special Work Provisions and environmental construction requirements.

6.3. Brush and Timber

6.3.1. Brush and timber encountered on the right-of-way shall be cleared to a width not exceeding the construction right-of-way limits. Restrictions in right-of-way agreements prohibiting the cutting or damaging of certain trees shall be made known to CONTRACTOR, and CONTRACTOR shall conduct its work in such a manner as to avoid damaging these trees. CONTRACTOR will mark these trees in a manner that their own personnel will know to avoid removal or damage to the trees, and will install a safety fence around the circumference of the tree at the approximate location of the widest point of the limb line. Trees that will be ultimately left remaining on the right of way shall be trimmed, if required for construction activities, utilizing the proper tree trimming saws in the presence of an RPR. Excavating equipment shall not be utilized to break off limbs and branches, therefore causing excessive damage to trees. Costs incurred by OWNER due to the damage or removal of any trees marked to remain will be reimbursed by CONTRACTOR including any punitive damages which may be assessed as a result of the unauthorized damage or removal of the tree.

6.3.2. All brush, timber, stumps, overhanging limbs, and canopy shall be disposed of by the CONTRACTOR in accordance with all applicable permits, state and local regulations, and right-of-way Special Provisions. All remaining stumps shall be ground to 6 inches below finished grade and backfilled to finish grade.

6.4. Utility Poles and Related Facilities

6.4.1. Where municipality, telephone or utility company power or light poles interfere with the safe ingress and egress of vehicles and equipment during construction, the CONTRACTOR shall take appropriate action with the facility owner/operators and obtain written authorization for methods in order to commence Work.

6.4.2. The CONTRACTOR shall make all necessary arrangements for the relocation and preservation of such facilities during construction, if required, and obtain the written authorization of the utility company.

6.5. Grading

6.5.1. The CONTRACTOR shall grade, as necessary, to mitigate the necessity of abrupt over-bends or sag-bends. CONTRACTOR shall minimize the grading where practical to prevent unnecessary disturbance and minimize work required to return the right-of-way to its original elevations, slopes, and profile as closely as practical, but consistent with minimizing abrupt over-bends and sag-bends. Graded subsoil materials shall be stockpiled so it can be returned to its original depth and location as opposed to spread along the right-of-way. The CONTRACTOR shall grub, or otherwise remove and dispose of, all stumps, roots, and debris found to be in the way of construction within permanent right-of-way limits.

6.5.2. The requirements of OWNER's Storm Water Pollution Prevention Plan (SWPPP) will apply to all erosion control operations. Temporary erosion control devices will be installed on the right of way during grading operations that will minimize erosion of the right of way. Refer to TDEC Erosion Control Manual for requirements.

6.5.3. When the CONTRACTOR is cutting grade along or across existing pipelines, or utilities, spoil or mats shall be placed over the existing lines per the written requirements of the Operating Company of the foreign pipeline or utility.

6.5.4. CONTRACTOR shall segregate and store the topsoil and shall restore the topsoil over the disturbed area upon completion. No mixing of top soil with sub soil will be permitted.

6.6. Damages

6.6.1. CONTRACTOR shall notify RPR immediately of any damage to bridges, public roads, private roads, fences, buildings, or other property, and shall make authorized appropriate repairs immediately. CONTRACTOR is responsible for all costs and for all damages regardless of whether the work is performed in accordance with hourly rate and/or lump sum rates. (Reference Specification 01725 Utility Damage Prevention)

6.7. Dust Control

6.7.1. During dry weather, when directed by the OWNER’s Representative, CONTRACTOR shall sufficiently water the right-of-way to minimize dust as necessary for nearby neighborhoods, air quality, welding quality, coating application purposes, and wildfire prevention. CONTRACTOR shall be responsible for all costs for dust control regardless of whether the work is performed in accordance with hourly rate and/or lump sum rates.

7. TRENCHING

7.1. General

7.1.1. The CONTRACTOR shall employ Occupational Safety and Health Administration (OSHA) approved equipment and methods required to keep the ditch in compliance with the line established by the OWNER regardless of the type of soil or rock encountered and regardless of the depth of excavation necessary. CONTRACTOR shall have a trained and certified "Competent Person" at each site that excavation activities are in progress. Daily excavation inspection reports will be prepared and maintained on site, and located at each

excavation bell-hole by CONTRACTOR's "Competent Person" while Work is commencing, If Work ceases at the excavated location and commences at a later time in the day a new daily inspection checklist must be completed and placed at the excavation bell-hole.

7.2. Foreign Line and Utility Crossings

7.2.1. A minimum clearance of 24 in. between pipe and foreign underground structure shall be maintain or as required by RPR.

7.3. Trench Specifications

7.3.1. Trench Width and Depth

7.3.1.1. Unless otherwise stated on the project drawings or Special Work Provisions, the trench shall maintain a minimum of 12-inches of clearance from the trench walls and the trench floor around the circumference of the pipe to be installed, and accommodate the River-sand Envelope. Minimum cover shall be maintained at 48-inches from top of pipe to sub-grade, unless otherwise specified on the Project Drawings. Cover shall be measured from the top of pipe to the average level of the original or restored sub-grade on the two sides of the ditch whichever is lower. Any installation less than the minimum required clearances shall be approved in writing by the RPR prior to installation. *Refer to Project Drawings for specific trench depth requirements.*

7.3.1.2. CONTRACTOR shall be required to remove separately and conserve the topsoil (Double Ditch). Topsoil shall be removed to the depth specified in the Special Work Provisions. Topsoil stripping will include the ditch line and backfill area. After the trench has been backfilled, CONTRACTOR shall replace the topsoil to the satisfaction of the RPR.

7.3.2. Waterways, Wetlands, Conveyances

7.3.2.1. Trench shall be excavated to maintain the minimum depth of cover of the pipeline but when installed in the natural bottoms of all waterways, cover shall be 6-feet below the bottom of waterway, stream, tributary, or wet weather conveyance to the top of the pipe unless otherwise specified in the project drawings or special provisions.

7.3.3. Trench Grading

7.3.3.1. The bottom of the trench shall be cut to a uniform grade so that the full width of the ditch shall be available for providing slack in the line when installed.

7.3.4. Bend Excavations

7.3.4.1. At over-bends, sags, and side-bends, the CONTRACTOR shall excavate the ditch to allow proper clearance between the inside bend of the pipe and the bottom or side of the ditch to maintain the minimum cover and clearance requirements.

7.3.5. Drainage Tile

7.3.5.1. Drain lines across the working site shall be cleaned out to ensure the tile has not been crushed or damaged by construction equipment. The CONTRACTOR shall construct the pipeline to maintain clearance of a minimum of 24-inches at the point directly under crossing all drain tiles that no interference shall occur between the repaired section of tile and the pipeline. If drainage tile is damaged during the trenching operations, the RPR shall be immediately notified, and the locations shall be immediately flagged for repair. The flags shall not be removed until permanent repairs have been inspected and accepted by both the RPR and the landowner. Unless otherwise authorized in the line lists or by the RPR, temporary repairs shall be made and temporary supports installed to maintain serviceability of the drain tiles until the permanent repairs can be made and the tiles properly supported by compacted backfill. Repairs shall be made by cutting tiles back into undamaged sections and replacing damaged sections with tile of equal size and quality, using care to maintain previous gradient.

7.4. Spoil Bank

7.4.1. General

7.4.1.1. The spoil bank from the trenching operations shall not be placed on any loose debris or foreign matter which might become mixed during padding and backfilling operations. Mixing of sub-soil and top-soil is strictly prohibited.

7.4.2. Drainage

7.4.2.1. The CONTRACTOR shall provide and maintain gaps or openings in the spoil bank across cultivated fields, so that excessive rains do not cause water to back up and flood cultivated sections. Extreme care shall

be exercised to keep all drain ditches and water courses open and useful.

7.5. Temporary Bridges

7.5.1. When the ditch is excavated through lands where livestock/wildlife is confined or through agricultural fields where the RPR determines, or has been notified it is desirable for the landowner or tenant to have a passageway across the trench, the CONTRACTOR shall plug the ditch or provide safe, temporary bridges for crossing the trench and leave an opening in the spoil bank.

7.6. Excavating near In-Service Pipelines

7.6.1. When trenching parallel to an existing pipeline, care should be taken to leave sufficient distance and support to ensure said line does not slough off into new excavation. Excavation within a minimum distance of 15-feet from a In-Service Pipeline is strictly prohibited, unless approved by RPR. CONTRACTOR shall obtain a safe excavation procedure from the owner/operator of the pipeline. In all instances, the work should be planned such that the excavation is not delayed and is open a minimum amount of time.

8. TRENCHLESS TECHNOLOGY EXCAVATION (TTE):

8.1. Scope

8.1.1. The pipeline may be installed by the means of Trenchless Technology Excavation (TTE) when installation by open cut is not feasible, and/or where OWNER specifies by the Scope of Work or Project Drawings.

8.2. Protection of Underground Facilities

8.2.1. **A:** CONTRACTOR shall undertake the following steps prior to commencing TTE operations in a location that might contain underground Utilities.

8.2.2. Positively determine the location and depth of and stake all existing lines, cables, or other underground utilities including exposing any utilities that are located within 15 feet of the designed drilled path.

8.2.3. Modify practices and down-hole assemblies to prevent damage to existing utilities.

8.2.4. CONTRACTOR shall be responsible for locating all underground utilities regardless of OWNER previous efforts in this regard. Whether Work is preformed on time and material basis or lump sum contract, CONTRACTOR is

responsible for all cost to repair damages to underground utilities resulting from TTE operations. (Reference Specification 01725 Utility Damage Prevention)

8.3. Plans and Procedures

8.3.1. Prior to Commencement of TTE Work:

8.3.1.1. CONTRACTOR shall supply, to OWNER, a design submittal (TTE Plan) sealed by a Professional Engineer licensed in Tennessee for any TTE. The TTE Plan shall describe the proposed alignment, profile and installation conditions that the pipe will be subject to including but not limited to TTE mud specification, pilot hole size and reamed hole size. The TTE Plan shall include a project specific Geotechnical Report. The project specific geotechnical report shall be used by the CONTRACTOR's TTE Plan DESIGN ENGINEER as input to the DESIGN ENGINEER's TTE Plan. The Geotechnical Report shall include the results from a CONTRACTOR completed geotechnical analysis that, based on the stamping engineers guidance, is sufficient to complete the TTE design. The TTE Plan shall include a TTE profile, TTE alignment, pipe stress calculations, drawings, and the method for monitoring the borehole profile.

8.3.1.2. The sealed TTE Plan shall also include the number and diameter of each hole opening pass, manufacturer and type of down-hole tools, supports/rollers and spacing along the stringing area, guidelines for the bentonite properties (i.e., viscosity, etc.), drilling fluid down-hole pressures, and drilling fluid flow rate. Technical criteria for bentonite shall be as given in API Spec. 13A, Specification for Oil Well Drilling Fluids Material. TTE fluids shall comply with all applicable permit requirements and environmental regulations. The following specifications and capacities of the drilling equipment must be provided:

- Maximum Capacities
- Intended Capacities
- Maximum Drilling RPM
- Intended Drilling RPM
- Maximum Drilling Pressure (PSIG)
- Intended Drilling Pressure (PSIG)

- Maximum GPM
- Intended GPM
- TTE rig type, size, manufacturer, noise ratings, sound proofing, torque, and pullback/thrust capacities (include appropriate drawings and photographs)
- Type and size of rollers and other support equipment
- Mud plume discharge control during excavation and TTE activities
- Buoyancy control
- Thrust block details including maximum thrust/pullback capability
- Diameter, type and grade of TTE pipe
- Downhole tooling including bits, reamers/hole openers, and mud motors (including manufacturer, size and type)
- Number, type, manufacturer and flow capabilities of mud pumps
- Pilot bore survey equipment type, accuracies and specifications (include sketch of surface coil layout for proposed tracking system)
- TTE fluid management plan detailing procedures, equipment, personnel and materials to be used to prevent, contain and cleanup a drilling fluid release at any location along the TTE alignment

  The above listed information will be used by the RPR during the inspection process to ensure the work is being carried out per the TTE Plan.

8.3.1.3. The TTE Plan will be completed during the preconstruction phase for review by RPR and subject to review and comment by any jurisdictional authority. The TTE Plan must be reviewed by RPR prior to construction. All TTE operations shall be performed by experienced supervisors and personnel. CONTRACTOR shall provide with his TTE Plan the resumes for all key personnel. Company names and personnel for Technical support, tool suppliers and required support systems used during this operation shall be provided to OWNER by the CONTRACTOR as part of the TTE Plan and updated as needed while the work is in progress.

8.3.1.4. CONTRACTOR shall include in the TTE plan methods and procedures descriptions of approach to the Work and individual procedures required to affect the overall method. As part of this requirement, CONTRACTOR shall show the plan of the drill site equipment layout, including location of erosion and sediment control devices, water, TTE mud treatment equipment, design profile drawings, etc., and a site specific safety program to protect CONTRACTOR, RPR personnel, the public and the environment.

8.3.1.5. All procedures or material descriptions requiring RPR review must be submitted by the CONTRACTOR a minimum of ten days prior to commencing any TTE activities at the proposed crossing locations. The work shall not commence until said documentation has been reviewed by RPR and lack of CONTRACTOR-obtained review shall not constitute grounds for extra work claims by CONTRACTOR.

8.4. TTE CONTRACTOR Responsibilities:

8.4.1. CONTRACTOR shall provide all necessary labor, supervision, professional and technical services, installation plans and procedures, plants and equipment, materials (except where stated otherwise in the "OWNER-supplied Materials" list), consumables, surveying, testing, mobilization/demobilization transportation, and shall perform the Work described in the Scope of Work including, but not limited to the following (Reference Specification Section 00514 Article 10)

8.4.1.1. Clearing, grading, and general site/access preparation necessary for construction operations, including installation of all turbidity mitigation structures (if required) and excavation of entry and exit holes.

8.4.1.2. Transportation of all equipment, labor, consumables, and OWNER supplied materials, including pipe and appurtenances, to and from the jobsite.

8.4.1.3. Erection of TTE equipment at the rig sites defined on the CONTRACTOR supplied TTE Plan.

8.4.1.4. Drilling of a small diameter pilot hole along the path defined on the CONTRACTOR designed Profile Drawings contained in the CONTRACTOR supplied TTE Plan.

8.4.1.5. Reaming the pilot hole to a diameter suitable for installation of the prefabricated pull section.

8.4.1.6. Prefabrication of the pull section and coating of welds.

8.4.1.7. Hydrostatically pre-testing the fabricated pipe pull section before pullback.

8.4.1.8. Installation of the prefabricated pull section in the reamed hole.

8.4.1.9. Perform Kaliper tool run and sizing plate run immediately after completion of TTE.

8.4.1.10. Clean up and restoration of all work areas, including removal of installation aids and backfilling of entry and exit holes and backfilling / grouting along the OD of the installed pipe as specified in the TTE Plan.

8.4.1.11. As-built plan and profile drawings

8.4.2. CONTRACTOR shall for the duration of the Work, assign the necessary qualified and experienced personnel, equipment, work areas, craftsmen, supervision, tools, and all other materials and supplies sufficient to meet Project milestones. Key personnel shall be identified in CONTRACTOR's TTE design submittal. A qualified TTE Superintendent shall directly supervise construction at all times. At no time shall other work pre-empt Work being performed for OWNER, without OWNER written consent. CONTRACTOR shall not reassign key project personnel and/or equipment from Work being performed for OWNER, without OWNER written consent.

8.4.3. CONTRACTOR shall work such hours, including extra shifts and overtime, necessary to meet the Contract Schedule specifically including the field coordination necessary to accommodate pull-back of the pipeline drill section. CONTRACTOR and its SUBCONTRACTORs shall accept the presence of RPRs on its premises and facilities for the purpose of coordination, inspection, monitoring, and review of any aspect of the Work. (Refer to Specification 00700 part 1.01, #27 Definition of Normal work Hours and the requirements to obtain approval to work outside those hours.)

8.5. Environmental

8.5.1. General

8.5.1.1. Environmental concerns addressed within this section include those actions necessary to execute the Work, including reduction of impacts to the surrounding water and land, regulatory impacts, and general public impacts.

8.5.2. Work Space

8.5.2.1. All trash, removed vegetation, and waste shall be removed from the site and disposed of in a manner acceptable to the OWNER.

8.5.3. Water Supply

8.5.3.1. CONTRACTOR shall procure and transport water for TTE operations and hydrostatic testing from sources approved by the OWNER. (Refer to section 8.15.1)

8.5.4. Hydrostatic Test Water Discharge:

8.5.4.1. All hydrostatic test water shall be treated, as required by permitting agencies, by CONTRACTOR to satisfy the SWPPP and all applicable permit requirements and discharged in accordance with regulations at an OWNER approved site. At no time shall discharge cause soil erosion, bottom sediment disturbance, nor affect wetlands nor project or public safety.

8.5.4.2. Dewatering, including storm water, shall be completed per the Storm Water Pollution Prevention Plan (SWPPP) and TDEC Erosion Control Handbook.

8.5.5. Bentonite:

8.5.5.1. Technical criteria for bentonite shall be as given in API Spec. 13A. The composition of all TTE fluids proposed for use shall be submitted to RPR for review. TTE fluids shall comply with all applicable permit requirements and environmental regulations.

8.6. TTE Fluids and Cuttings Disposal

8.6.1. Waste cuttings and TTE fluids shall be disposed of by CONTRACTOR at an OWNER approved disposal site. The construction areas will be checked multiple times daily by a RPR for signs of unplanned leaks or seeps. A written record shall be maintained by the CONTRACTOR of all inspections and submitted with his daily report to the RPR.

8.7. Refueling and Equipment Maintenance

8.7.1. CONTRACTOR shall provide all appropriate means to suppress the sound level at residential and business areas to a level that will not disturb the occupants of those areas. These noise suppression means shall include but shall not be limited to sound -reducing engine exhaust systems, enclosing the engines and equipment in tents, and temporary acoustic walls between the occupied

buildings and the work site. The City of Knoxville and Knox County zoning regulations define the dB limits for construction activities

8.8. Environmental Response Team

8.8.1. CONTRACTOR shall comply with all the environmental and erosion and sediment control requirements. An Environmental Response Team shall be formed to respond to changing environmental conditions and emergencies. CONTRACTOR shall provide all RPRs with a list of Environmental Response Team member and their contact information. Examples where an Environmental Response Team would be required include but are not limited to the following:

8.8.1.1. Potential sedimentation or watercourses, wetlands, or water-bodies as a result of rainfall

8.8.1.2. Earthen berm failure

8.8.1.3. Inadvertent discharges from Equipment

8.8.1.4. Frac-Outs, discharges from TTE methods

8.8.1.5. Zero Discharge at return pit locations

8.8.2. The Environmental Response Team shall be available on a 24 hour basis and be responsible for responding to and implementing the necessary remedial action.

8.9. Safety

8.9.1. Refer to Specification 00700 Section 6.13.

8.9.2. The safety of the general public, CONTRACTOR personnel, and OWNER personnel is of paramount importance. No construction activity shall occur which in any way compromises a safe operation. The CONTRACTOR shall at all times provide for the safety of all pipeline construction personnel and the general public during TTE operations by doing the following:

8.9.3. Restricting access to the immediate area involving the TTE operation to only those personnel engaged in the actual operation of the TTE equipment, RPRs and Inspectors, and OWNER visitors that have been notified of onsite safety hazards.

8.9.4. Prohibiting pipeline work in or around the TTE site not directly associated with the TTE operation.

8.9.5. Providing and installing construction warning signs as necessary in the vicinity of the work site.

8.10. Setup Entry and Exit Sides

8.10.1. Entry Side: The CONTRACTOR shall remove fences, trees, shrubs, trash, and debris, and set up workspace shown on site plan and profile drawing. CONTRACTOR shall, at an OWNER approved offsite location, dispose of all timber, stumps, and rock as required to not impede construction activity. CONTRACTOR shall not damage those trees marked and/or fenced by OWNER on and/or adjacent to the workspace. The area shall be graded and a 24-inch high containment berm built around the mud pit or as required by permits, whichever is greater. The site shall contain the TTE rig, pipe storage racks, mud pumps, primary pickup pits, mud tank, shaker/desander/desilter, disposal pits, water cleaning equipment, dry storage area for TTE fluid additives (etc.), offices, a crane area, and parking facilities, as needed.

8.10.2. Exit Side, Including Drag Section Staging Area**:** The CONTRACTOR shall remove fences, trees, shrubs, trash, and debris, and set up a temporary work area as shown on project drawings. CONTRACTOR shall, at an OWNER approved offsite location, dispose of all timber, stumps, and rock as required to not impede construction activity. CONTRACTOR shall not damage those trees marked and/or fenced by OWNER on and/or adjacent to the workspace. The area shall be graded and a 24-inch high containment berm built around the mud pit or as required by permits, whichever is greater.

8.11. TTE PROCESS and OPERATION Requirements

8.11.1. General

8.11.1.1. CONTRACTOR shall ensure that all TTE operations are performed utilizing supervisors and construction personnel thoroughly experienced in TTE. All required support, including TTE tool suppliers, survey systems, mud cleaning and disposal, and other required support systems to be used during the TTE operation shall be provided by the CONTRACTOR.

8.11.1.2. The CONTRACTOR shall take precautions, if applicable, to maintain all benchmarks, survey monuments, and other stationing positions in and around the TTE site. The CONTRACTOR shall be responsible for all damages, and whether Work is preformed on time and material basis or lump sum contract, CONTRACTOR is responsible for all cost to repair or replace damaged items.

8.12. Preliminary Trenching Requirements

8.12.1. CONTRACTOR shall be responsible for preparing all entry and exit holes prior to commencement of TTE operations. The holes shall be contoured to

attain the design radius of curvature of the CONTRACTOR stamped design profile. All spoil resulting from the formation of the holes shall be returned to the hole after completion of the Work. The longitudinal and transverse profiles of the holes shall be proven to the satisfaction of the RPR with appropriate survey methods.

8.13. TTE Fluids

8.13.1. The composition of all TTE fluids proposed for use shall be submitted to OWNER for approval. No fluid may be used that does not comply with permit requirements and environmental regulations.

8.13.2. Any polymers used to enhance the TTE fluid shall be environmentally safe and be approved for use by the OWNER. The polymers that are to be used shall be submitted with the CONTRACTOR design package. All fluids and materials used shall have the corresponding Material Safety Data Sheet (MSDS) information available on site. CONTRACTOR shall provide RPR with copies of all MSDS sheets prior to work commencing.

8.13.3. The CONTRACTOR shall maximize the re-circulation of TTE fluid surface returns. CONTRACTOR shall provide solids control and fluid cleaning equipment at all TTE site(s). The equipment used shall be capable of processing the surface returns and produce a fluid that is suitable for reuse. The OWNER shall have the option of specifying standards for the equipment performance and the treatment of excess TTE fluids and spoil.

8.13.4. Disposal of excess TTE fluids is the responsibility of CONTRACTOR and shall be conducted in compliance with all environmental regulations, right-of-way and workspace agreements, and permit requirements. TTE fluid disposal procedures proposed for use shall be submitted to OWNER for approval. No procedure may be used which has not been pre-approved by OWNER.

8.14. Inadvertent Returns

8.14.1. The TTE operation will be a closed system to eliminate the discharge of water, TTE fluids, and cuttings to areas involved in the construction process other than the entry and exit pits. CONTRACTOR shall employ their best efforts to maintain full annular circulation of TTE fluids. TTE fluid returns at locations other than the entry and exit points shall be minimized. CONTRACTOR shall provide equipment and procedures to maximize the recirculation of TTE fluid to minimize waste. In the event annular circulation is lost, CONTRACTOR shall take steps to restore circulation. If inadvertent returns of TTE fluids occur, they shall be immediately contained with barriers (i.e., silt fences, etc.) and/or a containment pit as necessary. TTE fluids shall be collected using pumps, vacuum trucks or if the amount of inadvertent returns is not enough to practically pump, the affected area shall be, with OWNER

approval, diluted with fresh water and the TTE fluid will be allowed to dry and dissipate naturally in upland areas. If surface returns exceed what can be contained as described, TTE operations shall cease until inadvertent returns are under control.

8.14.2. CONTRACTOR shall provide equipment (graders, shovel, etc.) and materials (such as ground sheets and/or silt fences, booms, absorbent pads, etc.). Equipment shall be maintained on site and materials stockpiled and readily available for use during clean-up, erosion control, and contingencies, as necessary. CONTRACTOR shall see that all ECD materials that can be affected by weather and deemed unfit for use, are stored in a dry controlled environment.

8.15. TTE Water

8.15.1. CONTRACTOR shall be responsible for obtaining, transporting, and storing any water required for TTE fluids and, as applicable, for the containment and the disposal of all TTE water in accordance with the governing permits and requirements. OWNER is not responsible to secure a water source for CONTRACTOR.

8.16. Instrumentation and Survey

8.16.1. CONTRACTOR shall at all times provide and maintain instrumentation which will accurately locate the pilot hole, measure drill string axial and torsional loads, and measure TTE fluid discharge rate and pressure. OWNER shall have access to these instruments and their readings at all times. A log of all recorded readings shall be kept and become a part of the "As-Built" information to be supplied by CONTRACTOR.

8.16.2. The path of the pilot hole shall be monitored during TTE by taking down-hole survey readings at intervals not to exceed 25-feet. These readings shall be used to calculate the horizontal and vertical coordinates of the downhole probe as it progresses along the pilot hole. Recorded data and calculations from downhole surveys shall include, but not be limited to, the following items:

8.16.2.1. Course Length; The distance between two downhole surveys as measured along the drilled path.

8.16.2.2. Measured Distance; The total distance of a downhole survey from the entry point as measured along the drilled path; also the summation of the course lengths

8.16.2.3. Inclination; The angle at which the downhole probe is projecting from the vertical axis at a particular downhole survey point; vertically downward corresponds to zero degrees.

8.16.2.4. Azimuth; The angle at which the downhole probe is projecting in the horizontal plane at a particular downhole survey point; magnetic north corresponds to zero degrees.

8.16.2.5. Station; The horizontal position of a downhole survey measured from an established horizontal control system.

8.16.2.6. Elevation; The vertical position of a downhole survey measured from an established vertical control system.

8.16.2.7. Right; the distance of a downhole survey form the design path reference line; positive values indicate right of the reference line while negative values indicate left of the reference line.

8.16.2.8. Bit of Probe; The distance from the TTE bit (leading edge) to the downhole probe.

8.16.2.9. Heading; The magnetic line azimuth to which the drilled path reference line corresponds.

8.16.2.10. Rig Setback; The distance from the drill bit when first placed on the TTE rig as measured from the staked entry point.

8.16.2.11. BHA Length; The length of the Bottom-Hole Assembly

8.16.3. CONTRACTOR shall monitor the position of the drill string with precise downhole survey instruments and verified with surface location equipment, i.e., tru-tracker or equal. At the beginning of the drill, the course azimuth shall be verified and adjusted as needed. CONTRACTOR shall compute the position in the X, Y, and Z axis relative to ground surface from down-hole survey data at an interval not to exceed 25 feet. Deviations between the recorded position of the drill string and the plan and profile drawing shall be documented and immediately brought to the attention of the RPR. At all times the surface coil position shall be within 6 inches, measured horizontally, of the pilot hole.

8.17. Pilot Hole Drill Tolerances

8.17.1. CONTRACTOR shall provide and maintain instrumentation that will accurately measure TTE fluid discharge rate and pressure. RPR shall have access to instruments and their readings at all times.

8.17.2. The Pilot hole shall be drilled along the path shown on the CONTRACTOR stamped design within OWNER and/or permitting agencies tolerances. However, right-of-way restrictions, foreign lines, utility crossings and/or structures shall take precedence over OWNER tolerances. Regardless of the tolerance achieved, no pilot hole will be accepted if it will result in any, or all, of

the pipeline being installed in violation of right-of-way restrictions. The entry and exit points as shown on CONTRACTOR stamped design shall be located using traditional survey methods.

8.17.3. Allowance of tolerances does not relieve CONTRACTOR from responsibility for safe operations or damage to adjacent utilities and structures.

8.17.3.1. The elevation along the profile shall be within plus 0 feet and minus 10 feet.

8.17.3.2. The horizontal alignment shall be within plus or minus 10 feet as long as the pilot hole does not come to within 10 feet of the permanent right of way.

8.17.3.3. The pilot hole shall penetrate the ground at the Entry Point at the exact location shown on the CONTRACTOR stamped design.

8.17.3.4. The pilot hole shall exit the ground surface at the Exit Point within plus or minus 7-feet of the alignment and plus 40 feet minus 0 feet of the length as shown on the CONTRACTOR stamped design.

8.17.4. If the pilot hole fails to meet with the above tolerances, the deviations will be subject to approval by the OWNER. If the OWNER does not approve the deviations, the CONTRACTOR shall drill another pilot hole, and shall be responsible for all cost for re-drill of pilot hole.

8.18. Pilot Hole Final Location

8.18.1. The CONTRACTOR shall, upon completion of the pilot hole, provide a tabulation of the coordinates. This tabulation shall be in addition to the log of recorded readings required under "Instrumentation". The coordinates shall be referenced to the drilled entry point and shall accurately describe the location of the following:

8.18.1.1. Entry and exit points

8.18.1.2. Drilled profile

8.18.1.3. Actual entry and exit angles

8.18.1.4. Actual entry and exit radius of curvature

8.18.2. Four Pilot Hole attempts. CONTRACTOR’s lump sum line item bid for the TTE portion of the work shall include provisions for up to 4 separate attempts to establish a pilot hole for any given borepath. Each attempt must have a corresponding change in the TTE Plan approved by CONTRACTOR’s Design Engineer prior to proceeding. If 4 attempts do not yield a borepath that is

useable then CONTRACTOR may consult with OWNER regarding a changed condition.

8.19. Reaming

8.19.1. Once the pilot hole has been completed, the hole must be enlarged to a suitable diameter for the pipeline. The reaming is accomplished by enlarging the hole by pulling back the reamers in successively larger diameters. The CONTRACTOR shall determine the number and sizes of the reaming passes. The final ream pass size must be at a minimum of 150% percent the Outside Diameter of the pull section to be installed. Any damage to the pipe resulting from inadequate pre-reaming shall be the responsibility of CONTRACTOR.

8.20. Lost or Stuck Tools

8.20.1. Any tools or other metal objects lost downhole shall be reported to the RPR immediately. Metal objects shall be fully recovered prior to pipe pullback unless specifically approved otherwise by the OWNER. Failure to recover metal objects lost downhole shall constitute just cause for rejection of the hole. OWNER is not responsible for the cost of lost tools downhole, or damage to pipe and materials due to lost items downhole.

8.21. Minimum Curve Radius

8.21.1. Curves shall be drilled according to CONTRACTOR-provided stamped design. Curves shall be drilled at a radius equal to or greater than that shown on the CONTRACTOR design drawing. CONTRACTOR shall calculate the drilled radius over any three joint (range 2 drill pipe) segments using the following formula:

Rdrilled = (Ldrilled/Aavg)*57.32		
Where:		
Rdrilled	=	Drilled radius (degrees) over Ldrilled
Ldrilled	=	Length drilled, no less than 75 feet and no greater than 100 feet
Aavg	=	Total change in angle over Ldrilled (degrees)

8.21.2. The horizontal deflection shall not exceed the limits of the permanent ROW as shown on the CONTRACTOR stamped design plan and profile drawing; however, in all cases, right-of-way restrictions, foreign lines, and utility crossings shall take precedence over horizontal deflection tolerance. CONTRACTOR shall provide to the OWNER, on demand, the data generated by the down-hole survey tools in a form suitable for independent calculation of the pilot hole profile.

8.21.3. CONTRACTOR shall conduct field measurements and shall provide to OWNER those as-built sketches and supporting documentation required to satisfy OWNER that the final overbend of the pipe string will meet the tolerances of the designed overbend.

8.22. Hole Rejection and Abandonment

8.22.1. In the event the drilled profile fails to meet these specifications, or metal objects are lost downhole, the OWNER may reject the TTE attempt. Upon notice of rejection, the CONTRACTOR shall abandon the hole. The CONTRACTOR shall submit a new stamped design for the additional drill attempt to the OWNER for review. No additional compensation shall be paid for failed attempts. (See 8.18.2 above)

8.23. Pipe Fabrication

8.23.1. The pipe string shall be fabricated in the workspace in one continuous section unless otherwise specified on a site-specific basis. CONTRACTOR shall notify RPR if a mid-weld is needed in order to safely setup string section for completion of TTE pull. OWNER must approve all mid-welds prior to Work commencing. Pipe fabrication shall be conducted in accordance with OWNER specified requirements.

8.24. Pipe Installation

8.24.1. **Welding**

8.24.1.1. The CONTRACTOR shall provide qualified welders to perform the work. Every welder shall be tested by OWNER approved testing company in accordance with API 1104 and OWNER specifications and welding procedures. *Refer to KUB Welding Manual 15260*.

8.24.1.2. All girth welds will have 100 percent radiographic inspection and be in accordance with API 1104 and OWNER Specifications. *Refer to KUB Welding Manual 15260.*

8.24.2. **Girth Weld Coating and Coating Repairs**

8.24.2.1. The CONTRACTOR shall repair all pipe coating damaged after receipt from the OWNER. Coating repair shall be inspected with a OWNER-approved electronic holiday detector. Surface preparation, pipe coating repairs, and inspection of coating repairs shall be in accordance with the OWNER Specification 15600 *Coating Specifications for External Surface of Steel Pipeline-Below Grade Services-Field Applied*. CONTRACTOR shall coat all field joints in

accordance with Specifcation.15600 to the thickness specified in the Scope of Work.

8.24.2.2. For all welds that are within the TTE section, CONTRACTOR shall supply and install Scar-Guard abrasion resistant sacrificial outer laminate produced by NRI, or approved equal, for added protection of welds in addition to the required field applied joint coating. Scar-Guard, or approved equal, must be applied to TTE welds prior to pulling the pipeline in the bore hole. Refer to manufacturers installation instructions.

8.25. Pullback

8.25.1. Prior to pull back, the TTE CONTRACTOR shall submit the actual drilled profile to the OWNER for approval. CONTRACTOR shall conduct field measurements and shall provide to OWNER those as built sketches and supporting documentation required to satisfy OWNER that the final overbend of the pipe string will meet design tolerances.

8.25.2. The pull back section shall be installed in one continuous string with no tie-in welds unless stated otherwise in the OWNER approved TTE plan. Once pullback operations have begun, the CONTRACTOR shall work continuously until the pipeline has been successfully installed. OWNER will not permit a pulling to cease and set overnight, and resume the following day.

8.25.3. A minimum of a 3, 10 foot joints of pipe including 3 welds shall be pulled beyond the exit point for inspection. OWNER acceptance of the TTE pull string shall be based on acceptance of all the following criteria:

8.25.3.1. OWNER analysis of exposed pipeline. If any metal loss occurs, the TTE pipeline section shall be rejected and CONTRACTOR shall be responsible for all costs necessary to install a new TTE pipeline section.

8.25.3.2. OWNER cathodic protection consultant or RPR to complete analysis of the pipeline to determine the extent of pipeline coating damage. If the damage to the pipeline coating cannot be protected by cathodic means, the TTE pipeline section shall be rejected and CONTRACTOR shall be responsible for all costs necessary to install a new TTE pipeline section.

8.26. Pulling Loads

8.26.1. CONTRACTOR shall provide and maintain instrumentation, which will accurately (+/- 5%) measure drill string axial and torsional loads. OWNER shall have access to instruments and their readings at all times.

8.26.2. The maximum allowable tensile load imposed on the pull section shall be equal to 80 percent of the product of the specified minimum yield tensile strength of the pipe and the area of the pipe section. If more than one value is

involved for a given pull section, the lesser shall govern. Maximum possible tensile strength loads shall be calculated using the following formula:

Max Pull Load = (SMYS * A_{steel}) * 0.8 * A_{steel}		
Where:		
SMYS	=	specified minimum yield strength of pipe (psi)
A_{steel}	=	cross-sectional area of pipe section(s) (in^2)

8.27. Pull Section Support

8.27.1. The pull section shall be supported as it proceeds during pull back so that it moves freely and the pipe and coating are not damaged. During the pullback operation, CONTRACTOR shall monitor roller operation and use side-booms if required to assist movement of the pipe. Situations that cause coating damage shall be corrected immediately. CONTRACTOR shall repair coating damage to OWNER Coating Specification 15600 before pulling operations resume.

8.28. Torsional Stress

8.28.1. A swivel shall be used to connect the pull section to the reaming assembly to minimize torsional stress imposed on the section. The swivel shall be load tested and recorded prior to mobilization to site and load test records shall not be expired. The load test records may be reviewed by RPR.

8.29. External Collapse Pressure

8.29.1. CONTRACTOR shall verify that the pull section is installed in the reamed hole in such a manner that external pressures are minimized and an appropriate counter balancing internal pressure is maintained. Any damage to the pipe resulting from external pressure during installation is the responsibility of the CONTRACTOR.

8.30. Buoyancy Modification

8.30.1. A buoyancy control system may be required during pull back, and if so, the installation plan shall be submitted to the OWNER for approval a minimum of 10-days prior to start of work. The CONTRACTOR is responsible for supply of all appurtenances necessary to add either weight or buoyancy to the pipe string. Any damage to the pull section resulting from the buoyancy modification is the responsibility of the CONTRACTOR.

8.31. Hydrostatic Testing

8.31.1. The completed prefabricated pipe section will be subject to a 4-hr preliminary hydrostatic test with 2, 15-minute holds; 1-pre-hold, 1-post-hold,

per OWNER approved test design. Test shall be conducted prior to completion of final ream in accordance with OWNER specifications for Hydrostatic Testing.

8.31.2. This preliminary hydrostatic test is a pretest and shall not preclude the requirement for an 8 hour test of the entire in-place crossing after installation.

8.32. Caliper Pig

8.32.1. OWNER requires that the completed crossing will be inspected, prior to mainline tie in and within 5 working days from the completed installation, with a caliper pig to determine if dents, buckles or ovalities are present. Any non conforming anomalies, dents, buckles, or ovalities found, must be rectified to the satisfaction of the OWNER, up to and including replacement of the pipe section or string at the CONTRACTORS expense.

8.33. Construction Final Report

8.33.1. CONTRACTOR shall maintain a separate set of plans and profile construction drawings on site during construction. Details will be neatly marked on these drawings on a daily basis. If changes are required which cannot be marked on the drawings, the CONTRACTOR shall prepare a neat sketch complete with dimensions and notes. At the end of the job the Record As-Built Drawing for the TTE will be signed by the CONTRACTOR and turned over to the OWNER.

8.33.2. Within ten days of completion of all Work, CONTRACTOR shall submit five hard copies and one reproducible electronic file of the as-built drawing, accurately depicting the location of the TTE crossing entry and exit points, a plan and profile of the pipeline in grid coordinates, calculation of forces and loads used, and the TTE mud and water disposal records. Additional items in the as-built shall include the following:

- Erosion control measures
- Pipe used: Information to include, Joint #, Heat #, Length, Weld ID, Survey ID for ea. (in order)
- Coating used for girth welds, and repairs

8.34. Backfill and Site Restoration

8.34.1. The CONTRACTOR shall ensure that all trenched and excavated areas at the entry and exit sites have been restored to the approximate original contours as required by OWNER and/or regulatory agencies.

8.34.2. CONTRACTOR shall remove all equipment, material (fencing, pit liners, etc.), and waste from all work areas. The general work area and all other construction areas used during construction shall be restored and graded by CONTRACTOR to their original contours.

8.34.3. Fences, gates, and utilities, which were removed or altered during construction, shall be restored or replaced by CONTRACTOR to their original or better conditions.

8.34.4. Land restoration shall satisfy OWNER General Conditions, landowner conditions, standards and specifications, agency approved permits, and Environmental Construction Plan (ECP).

9. PIPELINE CONSTRUCTION NEAR POWERLINES

9.1. Overview Guidelines

9.1.1. Piping parallel to, crossing, or in proximity of electric power transmission lines are subject to electrostatic and electromagnetic induced voltages and currents. The CONTRACTOR is required to provide trained electrical safety inspectors to supervise the necessary mitigating procedures associated with electrical safety on the pipeline. The CONTRACTOR and their personnel should be aware of safety requirements when construction crosses or parallels electrical power lines.

9.1.2. The principal limiting factors of construction are the minimum sag of the wires and the distance from the conductors that must be maintained by equipment operators to ensure against electrical shock resulting from induced voltage.

9.2. Electrical Safety Inspector

9.2.1. Guidelines: (if required)

9.2.1.1. The electrical safety inspector is the responsible person in charge of electrical safety during construction of the pipeline.

9.2.1.2. The CONTRACTOR with approval of the OWNER shall supply this inspector, A CONTRACTOR supplied competent person will meet the following requirements for Electrical Safety Inspector:

9.2.2. Requirements

9.2.2.1. The Electrical Safety Inspector shall:

- Have extensive knowledge of National and State codes for electrical safety.

- Be fully aware of proper grounding procedures and the dangers associated with inductive and conductive coupling, lightning, fault current, power arc, etc., on above and below ground structures.

- Know the intrinsic hazards of the construction equipment being used and the safe distances from overhead conductors required.

- Furnish the instrumentation required to monitor voltage levels, and ascertain vehicle instrumentation, equipment, and authority required to ensure safe working conditions.

- If required, communicate at least daily with the power company dispatcher controlling the involved electric lines.

- Have stop work authority.

- Obtain weather information daily from the local weather office.

- Have the authority to inspect all pipeline and construction equipment grounding Procedures.

- Have a strong background in electrical distribution and grounding so that these duties can be fully understood.

9.3. Work Stoppages

9.3.1. Introduction

9.3.1.1. Further reduction of the possibility of electrical hazards can be achieved if work on the pipeline is suspended during periods of severe weather, or when adjacent power lines are being energized or de-energized.

9.3.2. Guidelines

9.3.2.1. Since temporary grounding is not intended to safely mitigate voltages arising from lightning or power line faults, it may be necessary to halt all pipeline construction during inclement weather conditions.

9.3.2.2. The Electrical Safety Inspector, after discussions with the CONTRACTOR and RPR, shall decide when work is to be stopped.

9.3.3. **Conditions**

9.3.3.1. Work may be stopped if one or more of the following conditions exist:

- Any thunderstorm activity in the area of overhead high voltage power lines.
- Local electrical storms denoted by visible lightning or sound of thunder.
- High winds and rain.
- Scheduled switching on the electric power transmission system.
- Repeated contravention by CONTRACTOR of any grounding procedure.

9.4. Potential Measurements of Metallic Foreign Structures

9.4.1. **Introduction**

9.4.1.1. A foreign structure is any metallic structure in the right-of-way of the pipeline construction. Exposure of any metallic structure during trenching operations can represent a potential hazard.

9.5. Equipment Required

9.5.1. Measure voltage between the pipe and the exposed metallic foreign structure.

9.5.1.1. Record the voltage measurement on a CONTRACTOR data sheet.

9.5.2. AC Voltmeter (Comparable to the Fluke 87 Series II Analog/Digital Multimeter)

9.5.3. Insulated Rubber Sheet

9.6.Procedure:

9.6.1. **A:** If any metallic structures are exposed, check to see if they are coated. In the event that the structure is coated, the coating should prevent contact with any voltages that exist between the pipe and the foreign structure, although (if

deemed necessary by the Electrical Safety Inspector) the structure should regardless be tested for high voltages. If the structure is not coated, then follow these steps:

9.6.1.1. Measure AC voltage(s) on the foreign structure

9.6.1.2. Record value(s) on a CONSTRACTOR data sheet.

9.6.1.3. Pipe to foreign structure voltage > 15 volts?

9.6.1.3.1. YES – Wrap the structure with an insulated rubber sheet, similar to what electrical linesmen use when working on live conductors. If this does not prevent the voltage hazard, Grounding or Bonding procedures may be required. *See 9.11* for Grounding procedures, or Figure B-1: Procedure – Potential Measurements of Pipe for Bonding procedures.

9.6.1.3.2. NO – No special procedures are required. The pipe shall not be grounded or bonded to a foreign structure without permission of the owner of the foreign structure. If the owner will not allow direct bonding or grounding, other provisions shall be made.

9.7. Potential Measurements of Pipe

9.7.1. Introduction:

9.7.1.1. The pipeline to ground voltage of any string of pipe, exposed to contact by personnel, shall be measured periodically using a calibrated voltmeter of suitable range and high impedance (approved by Electrical Safety Inspector).

9.7.2. Equipment Required:

9.7.2.1. AC Voltmeter (Comparable to the Fluke 87 Series II Analog/Digital Multimeter)

9.7.2.2. Pipe End Clamp

9.7.3. Guidelines

9.7.3.1. The pipe to ground voltage must be measured on all welded pipe strings each day

9.7.3.2. Determine voltage between the pipe and a steel pin at least 10-inches in the ground and 3-feet from the section of pipe

9.7.3.3. Record each voltage measurement on a CONTRACTOR data sheet

9.7.4. Procedure (Figure B-1):

9.7.4.1. Connect a pipe end clamp to the uncoated edge of the pipe joint.

9.7.4.2. Install a ground rod at least 10-inches in the ground and at least 3-feet from the pipe.

9.7.4.3. In the event ground rods cannot be driven to this depth due to solid rock in the area, a large metal plate or mesh with bonding cables attached shall be used. The plate should be approximately 20-foot. X 6-foot. in size, and should be dragged onto the site and covered with soil to make a grounding connection.

NOTE: This step may be omitted if a ground rod or adequate ground system, meeting this criteria, is already in place.

- Connect voltmeter to both pipe clamp and ground cable.
- Set meter for AC volts.
- Read AC volts from meter.
- Record value on a data sheet at pipe - ground voltage.
- Remove meter connections.
- Measure pipe string length. Record value on a CONTRACTOR data sheet.
- Pipe to ground voltage > or = 15 volts?

9.7.4.3.1.1. YES – Grounding procedures required. *See 9.11* for grounding procedures.

9.7.4.3.1.2. NO – Grounding not required.

9.7.4.3.2. In the event that measured AC voltage above ground exceeds 30 volts, the electrical safety inspector shall issue appropriate warnings, and all work on the pipe string shall be suspended until potential is reduced to less than 15 volts with the driven ground rods.

9.7.4.3.3. Once the work on the pipe is complete and potential measurements are no longer required, remove the clamp.

9.8. Grounding of Pipe to Construction Equipment

9.8.1. Introduction

9.8.1.1. Each piece of equipment used to handle pipe in any way, such as for unloading, picking up, transporting, bending, or bonding, in the event current measurements show it is necessary, shall be equipped with a cable assembly capable of grounding the individual joints of pipe to the equipment handling that piece before the piece is moved. "Setting-in" booms shall be equipped with a ground cable, and the ground must be maintained at least until the stringer bead is completed. Rubber tired equipment should be grounded prior to grounding pipe to equipment.

9.8.2. Equipment Required

9.8.2.1. Grounding Cable Assembly

9.8.3. Procedure

9.8.3.1. Connect grounding cable assembly from construction equipment to the pipe joint.

9.8.3.2. Install supporting straps or slings as required.

9.8.3.3. Move pipe with construction equipment to desired location.

9.8.3.4. When pipe is set in place, remove all supporting straps.

9.8.3.5. Remove grounding cable assembly from the pipe joint.

9.9. Grounding of Pipe during Stacking and Stringing

9.9.1. Introduction

9.9.1.1. When handling pipe near, or parallel to, power lines, the following procedure as stated herein shall be followed.

9.9.2. Equipment Required

9.9.2.1. Ground Rod(s)

9.9.2.2. Grounding Cable Assembly

9.9.3. Procedure

9.9.3.1. Stack pipe joints per applicable stacking specs, or stack in a 10 (or less) joint stack.

9.9.3.2. Install a ½-inch (minimum diameter) ground rod at least 10-inch in the ground and at least 3-foot from the stack.

9.9.3.3. Install a grounding cable between the ground rod and the stack.

9.9.3.4. Using grounding cables, daisy-chain each pipe joint in the stack to assure the entire stack of pipe is grounded.

9.9.3.5. Maintain the ground connection until each individual joint is removed from the stack.

9.9.3.6. Stringing of pipe is permitted as long as each joint is connected to a ground.

9.9.3.7. A single ground rod can be used for multiple joints of pipe welded or strung together up to 400-foot in total length.

9.10. Operation of Construction Equipment

9.10.1. Introduction

9.10.1.1. Rubber tired vehicles operating on the right-of-way are also subjected to induced voltages from the proximity to power lines.

9.10.2. Equipment Required

9.10.2.1. Grounding Chain

9.10.2.2. Grounding Cable Assembly

9.10.2.3. Ground Rod

9.10.3. Procedure

9.10.3.1. Upon entering and operating on an electric power transmission right-of-way, attach a chain to the vehicle's frame of suitable length to maintain contact with the ground.

9.10.3.2. Park vehicles no closer than 200-foot from the right-of-way unless the vehicle is grounded.

9.10.3.3. Each fuel truck shall be equipped with a cable assembly capable of completing an electrical bond between the truck and any piece of equipment to be fueled. Fuel trucks and equipment must be grounded with a ground rod prior to grounding between them. It is required that this bond be made each and every time, prior to any part of refueling operations are completed. Care shall be taken where the cable attachments are made so that good electrical continuity is established.

9.10.3.4. Rubber tired vehicles shall not be refueled on the electric power right-of-way unless the vehicle is electrically bonded to the fueling facility/vehicle prior to commencement of the refueling operation, and the refueling vehicle is grounded to earth.

9.10.3.5. Rubber tired equipment parked for any appreciable time on a power line right-of-way may collect a considerable charge of static electricity. Efforts should be made to park such vehicles away from overhead lines. Vehicles should be parked no closer than 100-foot from the base of electric line towers. All tired vehicles, if parked on the right-of-way for over five hours, must be grounded with at least a 1/2- inch diameter ground rod that is driven or screwed to a depth of at least 4-foot. All vehicles which might be parked on the right-of-way for five hours or more at a time shall be equipped with a ½-inch copper ground rod and connecting cable assembly. Cable shall be at least No. 8 AWG and have insulated clips capable of completing an electrical bond between the ground rod and the automobile. Each time an automobile is parked on the power line right-of-way, the ground rod shall be pushed as far as possible into the ground, and an electrical connection made between the rod and the automobile. This bond shall remain as long as the car is parked on the power line right-of-way. Signs shall be posted for "authorized vehicles only." If rubber tired equipment is required to move about, then a short chain can be dragged behind the equipment for grounding in lieu of using a ground rod as stated above. The chain shall be heavy duty with at least 11/2-inch links. The CONTRACTOR is to provide the OWNER vehicles with the equipment for grounding.

9.10.3.6. At all times during construction, care must be exercised to assure that booms and cables are no closer than 10-foot from overhead power lines. Minimum midspan height between power line towers can range anywhere between 20 and 25-feet. Usually this height is greater, but in some cases the power lines may sag to this low, or even lower. Height should never be taken for granted, but should be investigated in each case. Check with the local power company for vehicle clearance. Consideration must also be given to the possibilities of broken cables

whiplashing close to power lines. Each piece of equipment shall be positioned so that should this occur, the cable would not come closer than 25-foot from a power line.

9.11. Connecting and Disconnecting Grounding Facilities

9.11.1. Introduction

9.11.1.1. Pipeline grounding is accomplished using ground rods and clamps as shown below. To avoid personal injury or arc damage on the pipe, the following steps are required.

9.11.2. Guidelines

9.11.2.1. Ground pipe using single No. 2 AWG welding cable or equivalent.

9.11.3. Equipment Required

9.11.3.1. Ground Rod

9.11.3.2. Grounding Cable Assembly

9.11.3.3. Pipe End Grounding Clamp

9.11.4. Procedure (Figure B-2):

9.11.4.1. **A** ground rod at least 10-inches in the ground and at least 3-foot from the pipe.

9.11.4.2. Connect pipe end grounding clamp to the pipe.

WARNING: There is a possibility that a voltage will occur on the pipe that may be a safety problem even while the operator is connecting the pipe end grounding clamp to the pipe.

9.11.4.3. Due to this risk, the operator should use insulating tools and gloves, and should avoid standing in wet ground. Any other special precautions deemed necessary should also be followed.

9.11.4.4. Connect grounding cable to the grounding facility/rod.

9.11.4.5. Connect grounding cable to the pipe end grounding clamp.

9.11.4.6. Cables used for temporary grounding attachments shall have good mechanical strength as well as high conductivity. The cable shall be

single conductor AWG No. 2, welding cable or equivalent. Cable attachments to temporary grounding systems shall be made using a method that assures good electrical contact with the pipe metal, and which applies firm pressure. The method of attachment should have a current carrying capacity of at least 200 amperes. Connections may also be made by the Thermite weld process, but under no circumstances should there ever be any arc welding of temporary clamps.

9.11.4.7. When grounding joints or strings of pipe, the ground rod shall be driven, and the connection between the rod and the ground cable made first. The connection between pipe and ground cable may then be made. Removal of all cables shall be in reverse order, that is, the cable should be disconnected from the pipe first. All grounding attachments or removals will be made by or under the direct supervision of the electrical safety inspector.

9.11.4.8. Each string of welded pipe that is between loose ends shall temporarily be grounded to a ground rod at least ½-inch in diameter, and which is driven to a depth of at least 4-foot. Any string of continuously welded pipe in excess of 2,000-foot shall be grounded at least twice, and strings of pipe should be limited to 3,000-foot long. These temporary grounds shall be maintained until the sections are tied into portions of line that have permanently been grounded with zinc wire or magnesium anodes and backfilled.

9.11.4.9. It is acceptable to use bare road casing for additional grounding during construction. This may be done by attaching a bond cable between any exposed metallic surface of the pipeline and the bare casing. Any bonds made for this purpose must be removed before the backfilling operation.

9.11.4.10. It is not acceptable to use straight polarity welding for stringer bead should the electromagnetic field produced by the power lines cause magnetization of the pipe.

9.11.4.11. When the pipeline no longer requires grounding, the grounding system may be disconnected.

9.11.4.12. Disconnect the grounding cable from the pipe end grounding clamp.

9.11.4.13. Disconnect the pipe end grounding clamp to the pipe joint.

9.11.4.14. Disconnect the grounding cable from the ground rod.

9.11.4.15. Remove the ground rod.

9.11.4.16. To avoid injury, follow the connecting and disconnecting procedures in the order shown.

9.12. Bonding of Piping and Tie-Ins and Cut-Outs

9.12.1. Introduction

9.12.1.1. Coordination is essential when conducting tie-ins and bonding across these pipes.

9.12.1.2. Bonding of a tie-in can transmit a voltage hazard remote from this tie-in.

9.12.2. Guidelines

9.12.2.1. Bond all piping at tie-ins and cut-outs regardless of pipe-ground voltage, prior to piping work (tie-in, cut-out).

9.12.2.2. Bond piping with single No. 2 AWG welding cable or equivalent.

9.12.3. Equipment Required

9.12.3.1. Grounding Cable Assembly

9.12.3.2. Grounding Clamps

9.12.4. Procedure (Figure B-3)

9.12.4.1. **C**onnect pipe grounding clamps to each side of the tie-in.

9.12.4.2. Connect the grounding cable between the pipe grounding clamps.

9.12.4.3. When bond is installed, a pipe-ground voltage measurement should be taken and recorded. (*See 9.5*) If the pipe-ground potential exceeds 15 volts, the Electrical Safety Inspector shall mandate special precautions.

9.12.4.4. Coordinate and schedule all tie-in bonding with the Electrical Safety Inspector and the CONTRACTOR.

9.12.4.5. Begin piping work (tie-in or cut-out).

9.12.4.6. Maintain all temporary grounds until section is tied-in to the line and permanent grounding is installed.

9.12.4.7. Final Coating of all tie-in welds and Thermite weld points must be performed using insulated gloves and boots, and under the supervision of the Electrical Safety Inspector.

9.13. Temporary Gradient Control Mats

9.13.1. Introduction

9.13.1.1. Temporary Gradient Control Mats are required during construction for personnel safety when working on exposed portions of the pipeline. The mats are also used after construction on aboveground portions of the pipe, in areas where a permanent gradient control mat is not present and there is a possibility of touch and step voltages greater than 15 volts.

9.13.2. Guidelines

9.13.2.1. All attachments for temporary grounding systems shall be made by a method that assures good electrical contact and applies firm pressure. Cable for temporary pipeline grounding shall have good mechanical strength as well as high conductivity.

9.13.2.2. The grounding cable shall be single conductor No.6 AWG welding cable or equivalent.

9.13.2.3. The method of attachment must have a current carrying capacity of at least 200A.

9.13.2.4. Connections may also be made by Thermite weld process, but absolutely no arc welding of temporary clamps will be permitted.

9.13.2.5. Construct temporary mats of 50mm chain linked galvanized steel fencing.

9.13.3. Equipment Required

9.13.3.1. Gradient Control Mat (chain linked galvanized steel fencing).

9.13.3.2. Grounding Cables.

9.13.4. Procedure (Figure B-4)

9.13.4.1. Stretch fencing in the "Y" direction.

9.13.4.2. Tighten tension bars.

9.13.4.3. Extend ground mat a minimum of 3 ft outside work area in all directions.

9.13.4.4. Connect grounding mat to the pipeline at two separate connections with grounding cables.

9.14. Gradient Control Mats

9.14.1. Introduction

9.14.1.1. A part of the permanent pipeline mitigation system is the gradient control mats at above ground structures. These mats should be constructed and installed following pipeline installation, but prior to making a tie-in

9.14.2. Guidelines (Figure B-5)

9.14.2.1. A gradient control mat consisting of zinc ribbon (or approved six gauge zinc coated steel mesh) covered with a washed crushed stone shall be installed at valve sites or appurtenances, where required.

9.14.2.2. Permanent zinc ribbon grounding facilities shall be installed by grounding personnel in accordance with the specifications of the pipeline project.

9.14.2.3. These facilities shall be installed at each grounding location following pipeline installation.

9.14.2.4. Grounding cable between zinc ribbon and the pipe shall be No.6 AWG.

9.14.2.5. Crushed stone shall extend a minimum of one foot beyond zinc ribbon and at least 3 ft beyond the fencing.

Appendix B Figures:

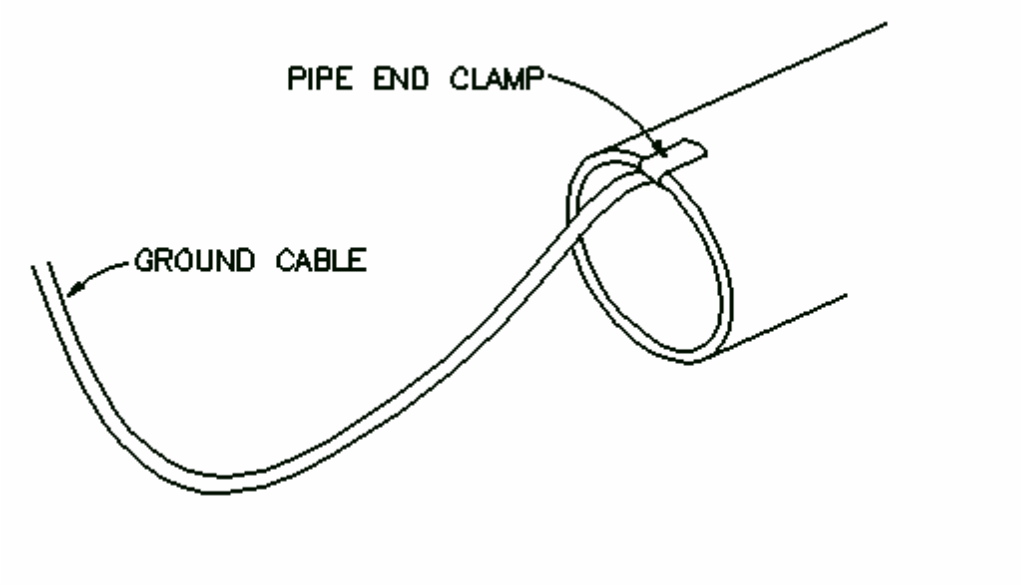


Figure B-1: Procedure – Potential Measurements of Pipe

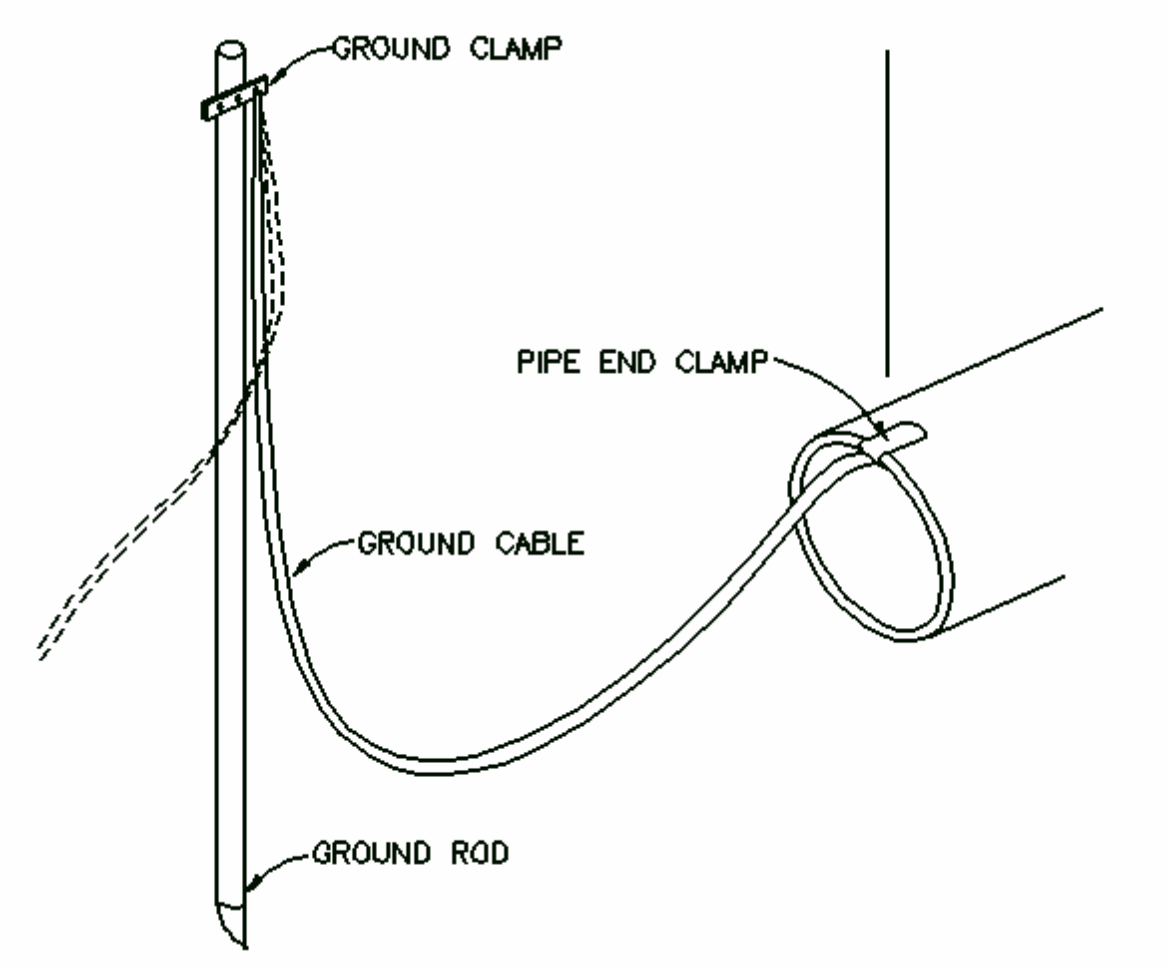


Figure B-2: Procedure – Bonding and Piping at Tie-Ins and Cutouts

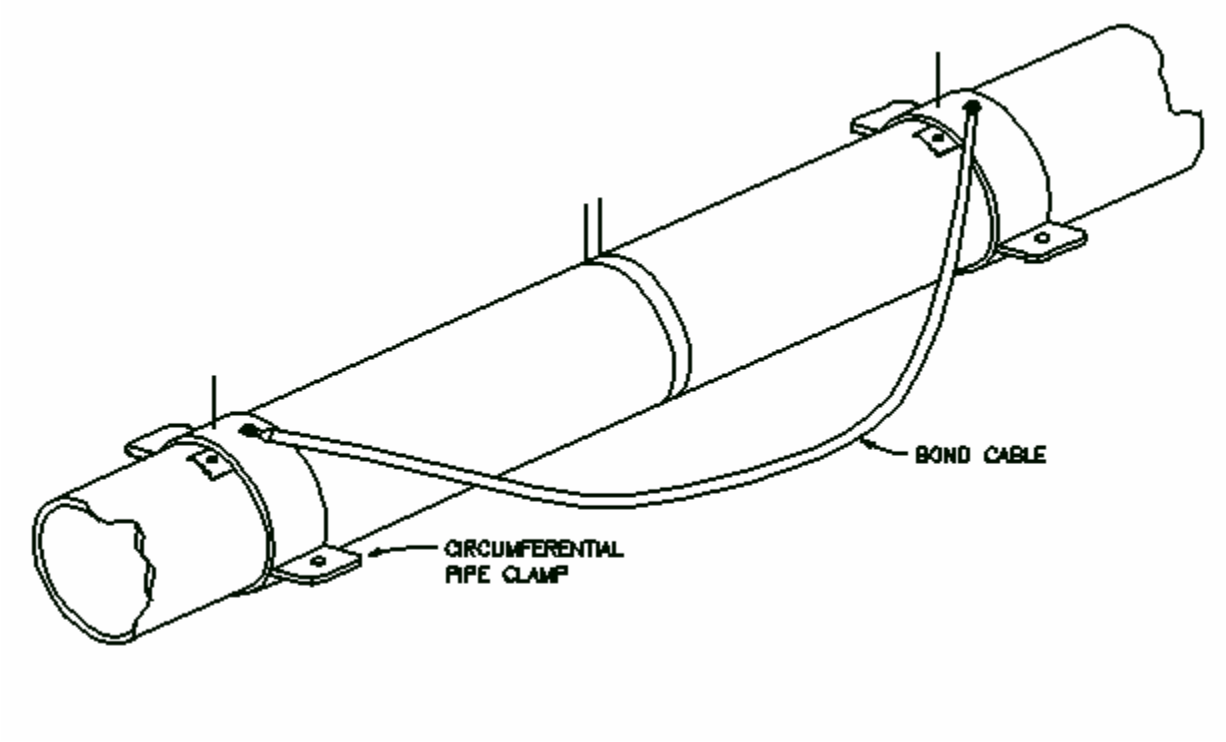


Figure B-3: Procedure – Bonding and Piping at Tie-Ins and Cutouts

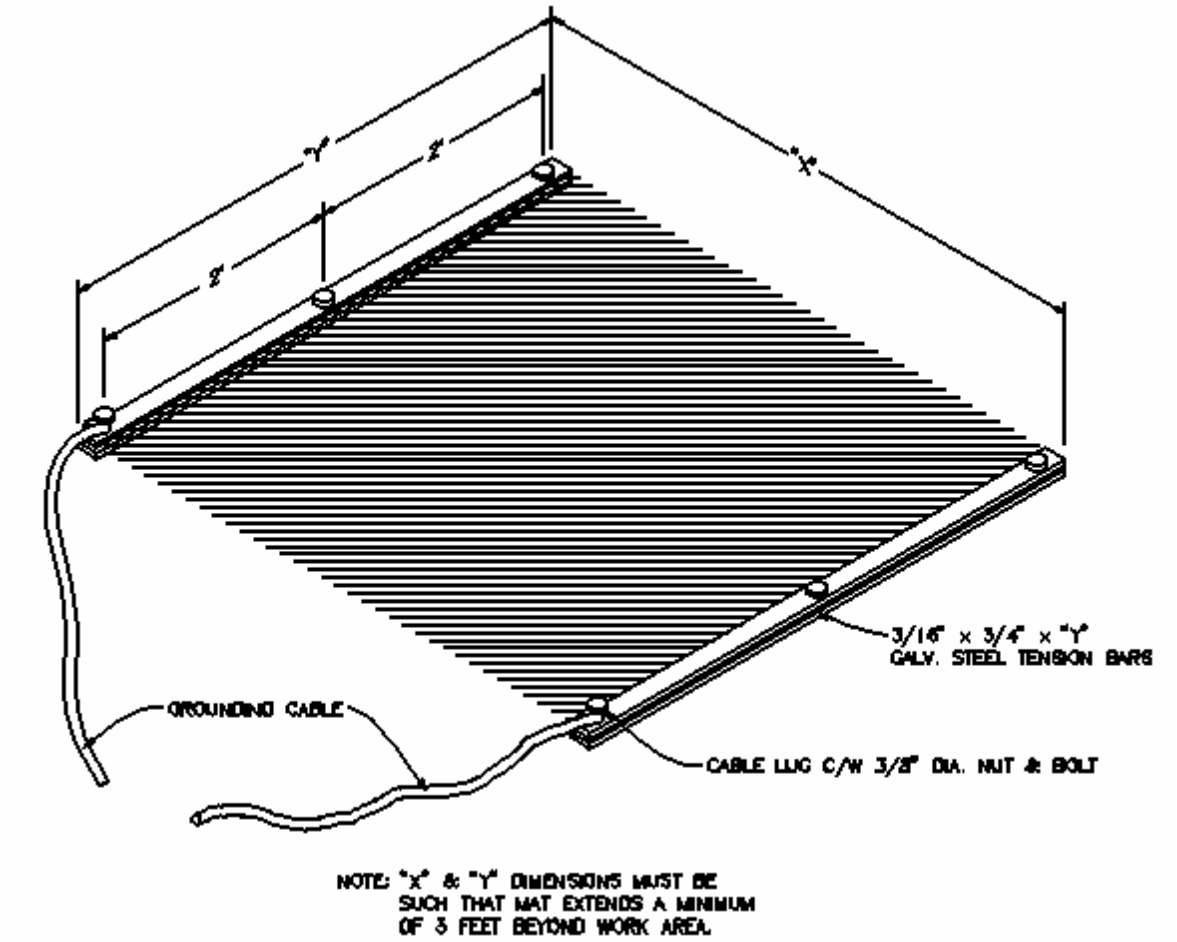


Figure B-4: Procedure – Temporary Gradient Control Mats

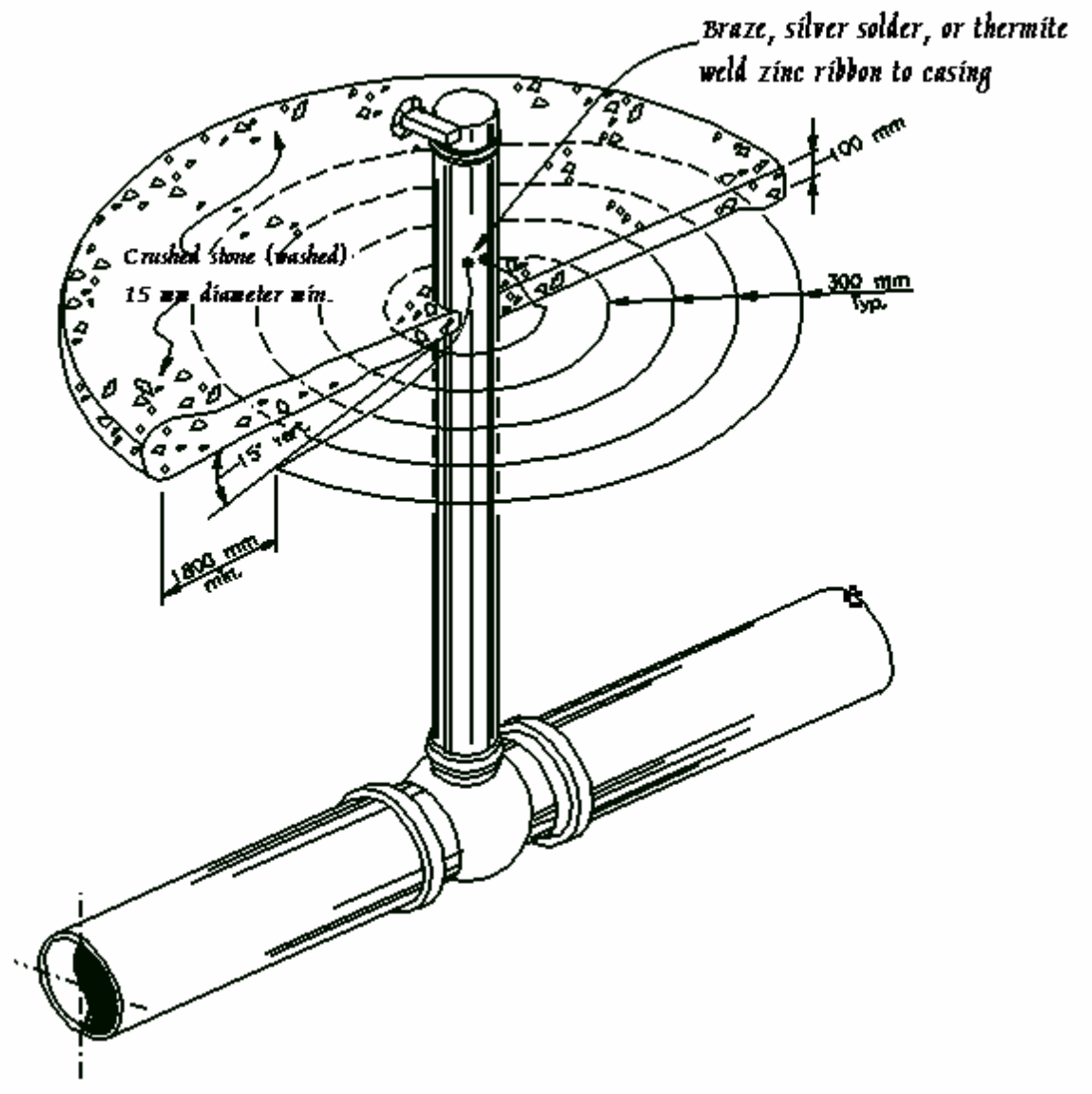


Figure B-5: Procedure – Temporary Gradient Control Mat at Valve

10. PIPE STRINGING:

10.1. Stringing, Unloading and Racking (Pipe and Casing)

10.1.1. General Locations

The CONTRACTOR shall be responsible for picking up materials at the OWNER's facility.

OWNER supplied pipe, fittings, and valves are located at:

4505 Middlebrook Pike
Knoxville, TN
37921

CONTRACTOR shall be responsible for providing equipment necessary to load and transport the pipe, fittings, and valves for this project.

All other OWNER supplied materials are located at:

1015 E Jackson Ave.
Knoxville, TN
37915

4505 Middlebrook Pike
Knoxville, TN
37921

OWNER will load materials from storeroom onto CONTRACTOR's vehicle for CONTRACTOR's transportation.

Unless otherwise stated in the Scope of Work, the CONTRACTOR shall unload and rack pipe and casing. The CONTRACTOR shall furnish any and all permits for unloading and hauling.

10.1.2. Pipe Yards

The CONTRACTOR will provide storage yards, if needed. The CONTRACTOR shall be responsible to haul pipe to yards, which are not adjacent to unloading areas in accordance with this section. The CONTRACTOR shall comply with all agreements or special provisions with the yard owner. A RPR shall be present during tally. The CONTRACTOR shall cooperate and assist in obtaining a complete and accurate tally of pipe.

10.1.3. **Handling or Unloading**

The CONTRACTOR shall handle all pipes with a vacuum hoe, or brass, aluminum, or neoprene lined hooks to avoid damage to beveled ends and shall handle all coated pipe with padded hooks, slings, forks, etc. Padding may be rubber, Teflon, neoprene, or equal to eliminate any pipe contact with truck bolsters or other hard surfaces. All hooks, padding, slings, tie-down lines, etc., shall meet with approval of the OWNER. Vehicles hauling coated pipe (excluding concrete coated) shall have fenders or other protection to prevent mud and rocks from being thrown upon the pipe, damaging the coating.

10.1.4. Racking

Pipe shall be racked on padded (rubber tires, Celotex board or equal) timber skids or earth berms covered to keep joint ends clear of the ground and out of water. Earth berms shall be covered with 10 mil polyethylene or geotech. Pipe shall not be racked more than six joints or a maximum of ten feet (ft) in height. Bare pipe racked for longer than six months duration shall not be nested but shall have divider strips and 2 inch x 6 inch hardwood between tiers. Coated pipe shall be transported with a minimum of three full encirclement padding strips (rubber tires, paper board. Nylon ropes, or equal). These strips shall be left in place on the rack and during hauling or be replaced by the CONTRACTOR.

10.1.5. Clean-Up

The CONTRACTOR shall dispose of all banding material and dunnage from rail cars or other carriers in a manner acceptable to the OWNER and completely clean-up the unloading area immediately after Unloading, stringing, handling has been completed.

10.2. Hauling and Stringing

10.2.1. General

The CONTRACTOR shall haul and string pipe, casing, and other materials to the right-of-way or work area. The CONTRACTOR shall provide all necessary trucks and equipment for the hauling and unloading of all materials

10.2.2. Stringing

The CONTRACTOR shall place pipe on skids on the right-of-way in a manner which keeps both ends free of dirt and debris, and to prevent pipe roll off. Coated pipe shall require a padding strip to keep coated pipe from coming in contact with skids. The CONTRACTOR shall furnish skids. The

CONTRACTOR shall furnish padding material (rubber tires, Celotex board, sand filled sacks, neoprene, 3/8”inch carpet padding, or equal). Earth berms in place of skids shall meet with approval of the OWNER. Gaps shall be left between adjacent lengths of pipe at suitable intervals and at well defined trails to permit the free passage of livestock or vehicles during the time interval between stringing and other construction activities

10.2.3. Line Pipe Pups

CONTRACTOR shall utilize pipe pups in pipeline construction with a minimum of 10-foot for pipe less than 24 in. OD. (*all line pups shall have heat#, Joint#, Length stenciled on both ends of pup*)

10.2.4. Surplus Pipe

The CONTRACTOR shall tally and haul all surplus pipe and casing to an OWNER designated yard and rack it as directed by the RPR.

10.3. Unloading and Storage of Materials, Excluding Pipe, Furnished by the OWNER:

Principal materials that are furnished by the OWNER shall be hauled by the CONTRACTOR to delivery points or storage lots and warehouses along the route as may be determined by the CONTRACTOR and shown on a schedule of material deliveries to be furnished by the CONTRACTOR to the OWNER. The CONTRACTOR shall keep the OWNER informed of the locations of its unloading gangs so that the OWNER may place RPR at points where the CONTRACTOR is unloading materials furnished by the OWNER. If material is received at delivery points in a damaged condition, an inspection must be made by an agent of the carrier before unloading or removal of material and a report of the inspection prepared and forwarded to the RPR. RPR shall determine if damaged material shall be unloaded for use or if material shall be rejected for use and transported back to specified material cull location. The CONTRACTOR shall unload all materials furnished by the OWNER promptly upon the arrival of materials at the designated stations along the route of said pipeline.

11. BENDING AND ALIGNMENT

11.1. Field Bending

11.1.1. General

The intent of this specification is to require that field bends shall be made in a manner that minimize the distortion of the pipe and in no way impair its strength. Where it is necessary to bend pipe, only cold bends shall be employed. The bends shall be free from buckling, flattening, cracks, or other evidence of mechanical damage. Particular care shall be taken so that egging of the pipe through the area of bend is such that the difference between the maximum and minimum diameters does not exceed 2.5 percent of the nominal diameter. All bends shall meet the criteria set forth in 49 CFR Part 192 or 195, whichever is applicable.

11.1.2. Slack and Longitudinal Welds

All over-bends, sags, and side-bends shall be made to provide an adequate amount of slack in the pipeline. On pipe containing a longitudinal weld, the longitudinal seam must be as near as practical to neutral axis of the bend.

11.1.3. Bending Machine

Each bend shall be made using a OWNER approved bending machine having a full circle bending shoe with a neoprene or urethane lining to produce a smooth, symmetrical bend, unless specified otherwise by the OWNER. If the pipe is internally coated, the bearing surfaces of the mandrel shall be constructed to avoid permanently marking or damaging the internal coating. No stretching or thinning of the pipe wall thickness shall be permitted.

11.1.4. Bending Limitation

Deflection shall be limited to a maximum of one and one-half degrees per pipe diameter measured longitudinally along the pipe. A OWNER accepted method of measurement shall be used by the CONTRACTOR when marking the pipe in preparation for making field bends.

11.1.5. Tangents

Bending shall not be allowed in a circumferential weld and not closer than six feet to an open end.

12. WELDING:

NOTE: *Also see separate "15260 Welding Manual for Knoxville Utilities Board Distribution Systems"*

12.1. Qualified Welding Procedures:

NOTE: *Also see separate "15230 Qualified Welding Procedures/Test Reports for Knoxville Utilities Board"*

13. BOLT TORQUING

13.1. Applicability

13.1.1. This standard is applicable for both critical and non-critical service as defined below, for both new and existing facilities. This standard is effective as of the date of its issuance and is not intended to be applied retroactively.

13.2. Critical Service

13.2.1. Critical service is defined as a service that satisfies **one or more** of the following conditions:

13.2.1.1. Flammable liquid (any liquid having a flashpoint below 100 °F)
13.2.1.2. Flammable gas (a gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of ≤13 volume %)
13.2.1.3. Combustible liquid (any liquid having a flashpoint at or above 100 °F but below 200 °F)
13.2.1.4. Toxic
13.2.1.5. Corrosive
13.2.1.6. Category M Fluid Service as defined by ASME B31.3
13.2.1.7. Class 300 and higher
13.2.1.8. Bolt size diameter of ≥ 11/8"
13.2.1.9. Operating temperatures < -20°F or > 500°F

13.2.2. Bolted flanged joints in critical service shall be tightened with manual or auxiliary powered torquing tools. Impact wrenches shall not be used. A written record of the assembly shall be prepared using the forms provided by OWNER, as applicable.

13.3. Non-critical Service

13.3.1. Non-critical service is defined as a service that satisfies **all** of the following conditions:

- Nonflammable
- Nontoxic
- Not damaging to human tissues
- Class 150

13.3.2. Bolted flanged joints in non-critical service can be tightened manually or with auxiliary powered tools including impact wrenches. A written record of the assembly is not required; however, Appendix B of this standard can be used to determine the applicable cross pattern bolt tightening sequence.

NOTE: Consult Material Safety Data Sheets (MSDS) for additional information regarding physical/chemical properties and hazard warnings for use in determining critical vs. non-critical service.

13.4. Codes and Standards

American Society of Mechanical Engineers (ASME)

ASME PCC-1-2010	Guidelines for Pressure Boundary Bolted Flange Joint Assembly

American Petroleum Institute (API)

API RP 686	Recommended Practice for Machinery Installation

American Society of Testing and Materials (ASTM)

ASTM Specifications A193 Grade B7 and Grade B8	Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM Specifications A194 Grade 2H and rade 8	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

13.5. Definitions and terms

- ***BFJA*** – Bolted Flanged Joint Assembly

- ***Bolts – New, Coated*** – Per PCC-1-2010, these are new bolts with factory applied lubricant of polyimide/amide. **No further lubrication is recommended.**

- ***Bolts – Uncoated*** – Bolts that have been previously tightened by torquing methods. For second and subsequent tightening, **the use of a 0.16 static coefficient of friction** (*f*) **lubricant is recommended.**

- ***Bolts – Salvaged*** – Fasteners that have been previously used in a facility, unit, or piping configuration that is no longer in service.
- ***Bolts – Used*** – Fasteners that have been used more than once.

- ***Category M Fluid Service*** – A fluid service in which the potential for personnel exposure is judged to be significant and in which a single exposure to a very small quantity of a toxic fluid, caused by leakage, can produce serious irreversible harm to persons on breathing or bodily contact, even when prompt restorative measures are taken.

- ***Differential Thermal Expansion (DTE)*** – Expansion between bolts and flanges that is present in all joints operating at non-ambient temperatures.

- ***End Points*** - An end point of a stud bolt is defined as an unthreaded length or edge, such as a bevel, which extends beyond the thread.

- ***Free Running Nut Check*** – The process of turning the nut on the bolt by hand past where the nut will come to rest after tightening.

- ***Hand Tighten*** – The process of turning the nut on the bolt by hand until the nut face rests against the flange surface.

- ***Multibolt Tightening*** – A minimum of four bolts are tightened simultaneously.

- ***Static Coefficient of Friction*** (*f*) – A dimensionless value which describes the ratio of the force of friction between two bodies and the force pressing them together. When a lubricant is used between the bolt threads and nut threads, and between the nut face and the flange surface, the value of *f* is reduced.

- ***Torque*** - The length of moment arm multiplied by the force applied.

- ***Target Torque*** - The torque calculated to produce the final desired load or clamping force in the joint.

- ***Target Prestress*** - The bolt stress to be achieved by applying a given torque. This value is based on a percentage of the minimum yield strength of the bolt material, usually between 40% and 70%.

13.6. General

13.6.1. For all single bolt tightening applications, threaded fasteners shall be tightened in accordance with Table 1A, Table 1B, Table 1C, Table 2, Appendix A, and Appendix B unless otherwise specified by the Equipment Manufacturer.

13.6.2. For all multibolt tightening applications, threaded fasteners shall be tightened in accordance with Table 1A, Table 1B, Table 1C, Table 2, Appendix A, and Appendix C, unless otherwise specified by the Equipment Manufacturer. Refer to ASME PCC-1-2010, Appendix F, Para F-1.4 for additional information.

NOTE: A multibolt hydraulic torquing system is recommended for highly critical flanges, large NPS flanges, and flanges with a history of leakage, since a manual torque wrench does not provide precise, reliable preloads. For additional details regarding bolt torquing refer to ASME PCC-1-2010.

13.6.3. For *Bolting Up to Rotating Equipment* see Appendix D of this standard.

13.6.4. For *Flange Joint Alignment Guidelines* refer to ASME PCC-1-2010, Appendix E.

13.6.5. For *Use of CONTRACTORs Specializing in Bolting Services* refer to ASME PCC-1-2010, Appendix G.

13.6.6. For *Washer Usage Guidance* refer to ASME PCC-1-2010, Appendix M.

13.7. Material

13.7.1. Carbon Steel threaded fasteners shall be in accordance with ASTM Specifications A193 Grade B7, A194 Grade 2H, A320 Grade L7, and A194 Grade 4.

13.7.2. Stainless steel threaded fasteners shall be in accordance with ASTM Specifications A193 B8 and A194 Gr 8. All other stainless steel bolting shall follow the guidelines of ASME PCC-1-2010, Para P-4.3 “Bolting Material Considerations.”

13.7.3. Acceptable bolt lengths shall be determined according to the lengths provided in Appendix A of this standard. If washers are used, the bolt lengths must be adjusted accordingly. Stud bolt lengths shall be purchased per Appendix A, but are acceptable if +0.25”/-0.00”

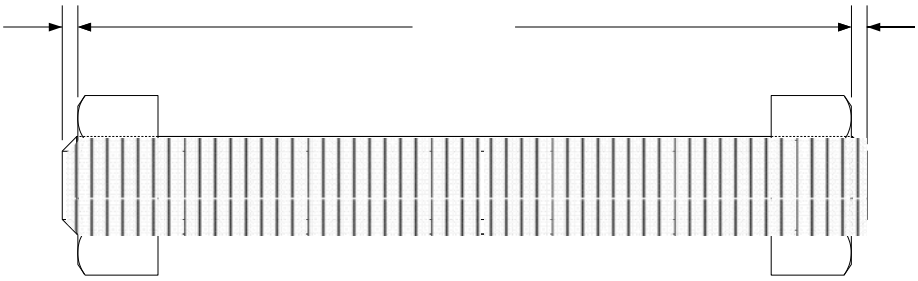
13.7.4. Acceptable and unacceptable bolt length figures:

NOTE: The following figures show position of nuts relative to length of bolt after initial tightening against flange surfaces.

ACCEPTABLE:
FIGURE 1:

The minimum acceptable length of bolt shall be full nut engagement after initial tightening

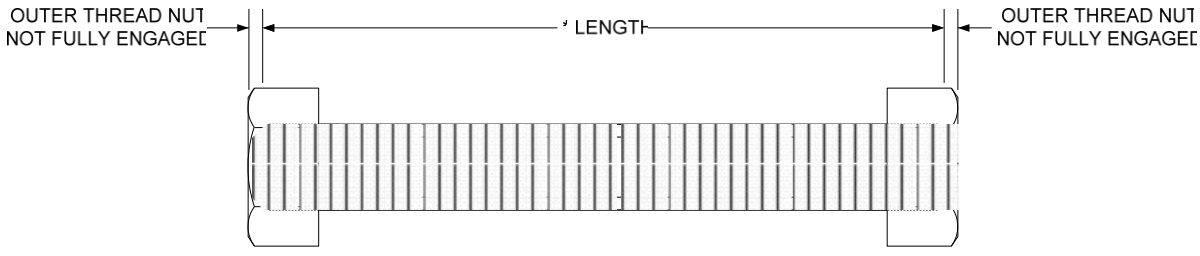
End Point Length End Point



The length of the stud bolt does not include the height of the points per ASME B16.5, Para 6.10.2

UNACCEPTABLE:
FIGURE 2:

Less than the minimum Acceptable length per SPECIFICATION.

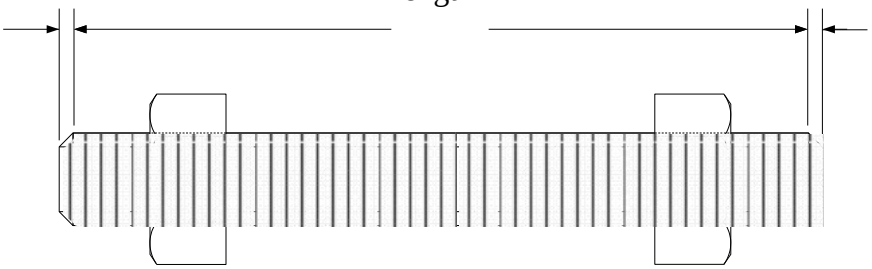


* The length of the stud bolt does not include the height of the points per ASME B 16.5 Para 6 10.2

UNACCEPTABLE:
FIGURE 3:

Example of excessive length bolt per specification.

End Point Length End Point



The length of the stud bolt does not include the height of the points per ASME B16.5, Para 6.10.2

Coated Bolts:

- Polyimide/amide is typically the factory applied coating or film used on new bolts and nuts.
- Cadmium coated bolts shall not be used in services with temperature exceeding 300°F.
- See individual piping material specifications for application specific bolt coating requirements.

Use of salvaged bolts and nuts is prohibited.

Threaded fasteners may be reused in certain applications if it is approved by the RPR. Reused threaded fasteners must meet all of the following requirements:

- Fasteners are clean, free of corrosion, paint, thread damage, teeth marks (such as caused by pipe wrenches), or other signs of damage.
- Fasteners have not been used underwater or coated with coal tar products.
- Fasteners have not been tightened to or beyond their yield strength.

(**NOTE: This condition can be determined by comparing the bolt threads of a used bolt to those of a new bolt. The nut should be capable of being finger tightened over the entire thread length.) For Guidelines on the Reuse of Bolts refer to ASME PCC-1-2010, App. N.**

13.8. Surface Preparation

13.8.1. Clean all working surfaces before assembly is to start.

13.8.2. Examine the gasket contact surfaces of both joint flanges for appropriate surface finish and for damage to surface finish such as scratches, nicks, gouges, and burrs. Indications running radially across the facing are of particular concern. Report any questionable imperfections to the RPR for appropriate disposition.

13.8.3. Check gasket contact surfaces of both joint flanges for flatness, both radially and circumferentially. Report any questionable results to the RPR.

13.8.4. Examine bolt and nut threads and washer faces of nuts for damage such as rust, corrosion, and burrs, and replace questionable parts. If separate washers are scored or cupped from previous use, replace with new through-hardened washers.

NOTE: Surface-hardened washers are not suitable.

13.8.5. Previously used bolts, in accordance with Section 4.0 of this standard, shall be thoroughly cleaned (such as wire brushing) before being reused.

13.8.6. Examine nut-bearing surfaces of flanges for scores, burrs, etc. Remove protrusions and spot-face if required.

13.9. Lubrication

13.9.1. Improper application of lubricants or the mixing of different lubricants could result in significant variability to the obtained bolt load, which could ultimately cause a leak in the joint. The mixing of different lubricants is prohibited.

13.9.2. With one exception, liberally coat all internal and external thread surfaces and nut/washer faces with appropriate lubricant. The one exception is as follows:

13.9.2.1. Lubricant is not to be applied to working surfaces for the initial tightening of new coated bolts/nuts. See Table 1A and/or 1B, Note (3).

13.9.2.2. The torque values for new, coated bolts/nuts shown in Table 1A and/or 1B, do not require lubrication other than that provided by the bolt/nut coating. See Table 1A and/or 1B, Note (2).

13.9.3. Do not apply lubricant to the gasket or gasket-contact surfaces.

13.9.4. Lubricant, if required, shall be selected and applied in accordance with the Equipment Manufacturer's recommendations. If no recommendations are available, the OWNER's Representative shall determine an approved lubricant, ensuring the following:

13.9.4.1. Lubricant is chemically compatible with the bolt/nut/washer materials and the process fluid. Particular care shall be taken to avoid lubricant chemistry that could result in stress corrosion cracking, galvanic corrosion, oxygen auto-ignition, etc.

13.9.4.2. Lubricant is suitable for the expected service temperature(s) and anti seize requirements.

13.9.4.3. Before lubricant is applied to the bolt and nut threads, nuts must run freely by hand past where they will come to rest after tightening. This is called the "free running nut check."

13.9.4.4. For noncoated bolts (see Notes to Table 1A and/or 1B), apply lubricant liberally and completely to the nut contact faces and to the threads on both ends of the bolts past where the nuts will come to rest after tightening.

13.9.4.5. For new, coated bolts and nuts (see Notes to Table 1A and/or 1B), free running nut checks as described above are required. Any lubricant application to new, coated bolts and nuts should be limited to the second and subsequent tightening operations since the coating provides sufficient lubrication for the first tightening.

13.9.4.6. Torque values in Table 1A and 1B for noncoated bolts are based on a static coefficient of friction (f) = 0.16. Examples of bolt/nut lubricants with a static coefficient of friction (f) = 0.16:

13.9.4.6.1. Machine oil

13.9.4.6.2. Berutex FH-34

13.9.4.6.3. DAG 580 (Dry Lubricant)

13.9.4.6.4. Fel-Pro C-102

13.9.4.6.5. Rocol 797

13.9.5. Torque values in Table 1A and 1B shall be recalculated if the static coefficient of friction of the lubricant used is **not** 0.16. (Contact OWNER Gas Systems Engineering for recalculation.)

13.10. Gaskets

13.10.1. Gaskets shall be specified per the appropriate piping specification according to OWNER requirements.

13.10.2. New gaskets shall be used on all new construction, and prior approved by RPR, and gaskets shall not be reused. All damaged gaskets shall be replaced.

13.10.3. Whenever existing bolted flange joint assemblies have been disassembled, new gaskets shall be used for reassembly.

13.10.4. Anti-seize compounds shall not be used on gasket surfaces unless approved by the OWNER's Representative.

13.10.5. When the installation of a Flange Insulating Set is required, CONTRACTOR must follow detail in Project Drawings and follow, *Material Selection and Installation of Flange Insulation Sets from manufacturer*.

13.11. Torque Wrenches

13.11.1. All torque wrenches shall be properly calibrated to two percent of the full scale reading. Torque wrenches shall be recalibrated at least annually or in accordance with the Torque Wrench Manufacturer's recommendations. CONTRACTOR shall provide a copy calibration certification to OWNER's Representative for record and review prior to commencement of torquing.

13.11.2. Torque wrench selection and application shall be in accordance with the Torque Wrench Manufacturer's recommendations and RPR's approval. Torque wrench selection shall have adequate capacity so that the working range is within the mid-quarters of the scale.

13.11.3. Automatic torque tools shall have the set limits verified with a calibrated manual torque wrench, and approved by OWNER'S Representative.

13.12. Torquing

13.12.1. All fasteners shall be hand tightened, ensuring the bolt has full thread engagement through the nut, plus the length of the end points. If nuts will not hand tighten, check for cause, and make the necessary corrections.

13.12.2. Torque values given in Tables 1A, 1B, and 1C are included in this standard for the convenience of the user, and should be used as a guideline only. The values are based on calculations that assume certain friction coefficients for the friction between the studs and nuts, and between the nuts and the flange face. It should be recognized that torque applied to a nut is only one of several ways to approximate the tension and stress in a fastener. Actual field results can be

monitored to establish more precise values for friction coefficients, tension in bolts, and required torque values.

13.12.3. The torque shall be applied in a method that allows the fasteners to be evenly and sequentially tightened using the torque increment passes specified in Table 2, and the cross-pattern tightening sequence diagrams shown in Appendixes B and C of this standard.

13.12.4. For the initial three tightening rounds, measurements of the gaps between the flanges around the circumference should be taken to verify that the flanges are being brought together evenly.

13.12.5. Due to differential thermal expansion (DTE), all external bolted flange joint assemblies may require retightening after the system has reached operating temperature. Generally, when the coefficients of expansion of flanges and bolting are closely matched, properly assembled joints with an operating fluid temperature less than about 500°F should withstand normal start-ups and shutdowns.

13.12.6. A written record of the entire process of the flange make-up shall be maintained by the CONTRACTOR. Appendixes B and C at the end of this specification shall be used for this purpose. Any difficulty in the initial flange alignment or fastener tightening process shall be recorded. The record shall include, but not necessarily be limited to, the following information:

13.12.6.1. Date of assembly

13.12.6.2. Location/identification of the assembly

13.12.6.3. Specifications of gaskets and bolts/nuts used

13.12.6.4. Lubrication used, if any

13.12.6.5. Assembly procedure used, including target torque settings at each pass

13.12.6.6. Names of joint assemblers

13.12.6.7. Printed name and signature of Supervisor

13.12.7. When the installation of a Flange Insulating Set is required, CONTRACTOR must follow detail in Project Drawings and follow, *Material Selection and Installation of Flange Insulation Sets from manufacturer*.

13.13. Tensioning

13.13.1. All flanges that are assembled using bolt tensioning equipment shall be installed employing the procedure recommended by the Manufacturer of the bolt tensioning equipment. CONTRACTOR shall ensure that all personnel involved in the use of the bolt tensioner equipment onsite are fully trained, experienced, and understand the proper implementation of the bolt tensioning equipment. Certificates signed by Manufacturer's Technical Representative and CONTRACTOR shall be presented to the OWNER for all flange assemblies installed using bolt tensioning equipment.

13.13.2. All tensioning equipment shall be properly calibrated to two percent of the full scale reading. Tensioning equipment shall be recalibrated annually or in accordance with the Manufacturer's recommendations. . CONTRACTOR shall provide a copy calibration certification to OWNER's Representative for record and review prior to commencement of torquing.

13.14. Leak Tightening

13.14.1. The following procedure shall be followed in the event that leaks are discovered after the recommended torque has been applied.

13.14.2. Blow down and lock out all associated pressure equipment in accordance to applicable lockout/tagout procedures.

13.14.3. Check equipment fasteners for proper tightness by first marking the position of the bolt head or nut and then by loosening it. Re-tighten the fasteners.

NOTE: If the bolt head or nut advances past its reference position, the fastener was loose and should be closely observed during future tightness checks. It is very important that the position of the bolt head or nut is marked before re-tightening.

13.14.4. Retighten flanges by first verifying the correct torque value at each fastener and then retightening in the specified sequence by increasing the specified torque value by 15 percent.

13.14.5. If the increased torque value does not resolve the leak when pressure is applied, disassemble and inspect the flange. The gasket seal area on the face of the flange shall be cleaned, inspected for damage, and then reassembled with a new gasket.

13.14.6. For *Guidance on Troubleshooting Flanged Joint Leakage Incidents* refer to ASME PCC-1-2010, Appendix P.

TORQUE TABLES

Table 1A: Recommended Target Torque Values Using ASTM A193 B7 or A320 L7 Bolts

Table 1A is taken from ASME PCC-1-2010, Table 1:

Nominal Bolt Size, in	Target Torque (ft-lb)	
	Noncoated Bolts(1)	New Coated Bolts(1),(2),(3)
1/2	60	45
5/8	120	90
3/4	210	160
7/8	350	250
1	500	400
1-1/8	750	550
1-1/4	1,050	800
1-3/8	1,400	1,050
1-1/2	1,800	1,400
1-5/8	2,350	1,800
1-3/4	2,950	2,300
1-7/8	3,650	2,800
2	4,500	3,400
2-1/4	6,500	4,900
2-1/2	9,000	6,800
2-3/4	12,000	9,100
3	15,700	11,900
3-1/4	20,100	15,300
3-1/2	25,300	19,100
3-3/4	31,200	23,600
4	38,000	28,800

TABLE 1A GUIDELINES:

- The values shown in Table 1A are based on a Target Prestress of 50 ksi (root area).This pre-stress level is generally considered suitable for joint systems designed using SA-193-B7 low-alloy steel bolts, except for joint systems using ring type joint (RTJ) gaskets. Target Torques for different Target Prestress levels may be obtained by reducing (or increasing) the values in this table by the following ratio:

$$\frac{\text{Target Pressure (ksi)}}{\textbf{50 (ksi)}}$$

- The root areas are based on coarse-thread series for sizes one inch and smaller and eight-pitch thread series for sizes 1⅛ in. and larger.

- Computed values are based on working surfaces that comply with Sections 6.0 and 7.0 of this standard, and the following static coefficients of friction: 0.16 for noncoated surfaces and 0.12 for new coated surfaces.

- The coating on new, coated bolts is polyimide/amide and is considered to be the sole source of working surface lubrication; the application of a lubricant to the coated surfaces can result in a considerable reduction in the assumed static coefficient of friction of 0.12.

- Coated torque values apply only for initial tightening of new, coated bolts using the torque increment passes shown in Table 2. For second and subsequent tightening by torquing methods, use of lubricants and torque values as specified for noncoated bolts is recommended.

- Static coefficient of friction (*f*) for coatings other than polyimide/amide:

Material	**Clean/Dry** (*f*)	**Lubricated** (*f*)
Cadmium to Cadmium	0.5	0.05
Zinc to Zinc	0.6	0.04
*Fluoropolymer to Fluoropolymer	0.07	0.04

- Torque values in Table 1A and 1B shall not be used if the bolt/nut coating is Cadmium or Zinc. (Contact OWNER Gas Systems Engineering for recalculation of target torque values)

- ***Use Table 1C if the bolt/nut coating is Fluoropolymer, such as PTFE.**

Table 1B: Recommended Target Torque Values Using ASTM A193 B8 Bolts:

Table is based on published bolt load data from HYTORC for ASTM A193 B8, Cl 2 bolts

Nominal Bolt Size, in	Target Torque (ft-lb)	
	Noncoated Bolts(1)	New Coated Bolts(1),(2),(3)
5/8	70	50
3/4	125	100
7/8	200	150
1	300	250
1-1/8	150	350
1-1/4	650	500
1-3/8	850	650
1-1/2	1,100	900
1-5/8	1,450	1,150
1-3/4	1,800	1,450
1-7/8	2,250	1,800
2	2,750	2,200
2-1/4	4,000	3,200
2-1/2	5,500	4,450

NOTE: THESE VALUES ARE ONLY A GUIDE AND MUST NOT BE RELIED UPON IN PLACE OF LOCAL ENGINEERING DATA.

TABLE 1B GUIDELINES:

- The values shown in Table 1B were calculated using the "Nut Factor Calculation of Target Torque", Appendix K, PCC-1-2010. A target bolt load of 60% of the minimum yield strength of A193 B8, Cl 2 bolts was used in the calculations.

- Target Torques for different target bolt loads may be obtained by reducing (or increasing) the values in this table by the following ratio:

$$\frac{\text{Desired \% Yield}}{\text{60\% Yield}}$$

- A common, acceptable range of per cent of yield strength is between 40% and 70%.

- Computed values are based on working surfaces that comply with Sections 6.0 and 7.0 of this standard, and the following static coefficients of friction: 0.16 for noncoated surfaces and 0.12 for new coated surfaces.

- The coating on new, coated bolts is polyimide/amide and is considered to be the sole source of working surface lubrication; the application of a lubricant to the coated surfaces can result in a considerable reduction in the assumed static coefficient of friction of 0.12.

- Coated torque values apply only for initial tightening of new, coated bolts using the torque increment passes shown in Table 2. For second and subsequent tightening by torquing methods, use of lubricants and torque values as specified for noncoated bolts is recommended.

- Static coefficient of friction (*f*) for coatings other than polyimide/amide:

Material	**Clean/Dry** (*f*)	**Lubricated** (*f*)
Cadmium to Cadmium	0.5	0.05
Zinc to Zinc	0.6	0.04
*Fluoropolymer to Fluoropolymer	0.07	0.04

- Torque values in Table 1A and 1B shall not be used if the bolt/nut coating is Cadmium or Zinc. (Contact OWNER Gas Systems Engineering for recalculation of target torque values)

  ***Use Table 1C if the bolt/nut coating is Fluoropolymer, such as PTFE.**

- To prevent imparting excess stress on precision rotating equipment flanges and cases, the following installation procedure shall be followed:

  - Installation of fabricated pipe assemblies shall proceed from equipment flange connections towards the valve or piping header.

  - After piping assembly is installed and completed between the pump and header, loosen flange bolts at pump, with flanges free and piping adequately supported.

  - Flange bolts shall be re-tightened using a new gasket.

  NOTE: Never reuse a gasket after it has been compressed.

- OWNER inspector shall carefully inspect flanges for signs of misalignment or strain due to pipe settlement or improper fit-up. If piping strain is present as evidenced by deflection of the loosened bolts within the flange holes, the piping

shall be excavated, if required, repositioned and supported at the CONTRACTOR's expense.

- CONTRACTOR shall exert special care when flanging up to pumps and meters since some have cast iron bodies and others are made with precision tolerances and cannot withstand excessive forces. A torque wrench is recommended for this operation

- OWNER inspector shall require that a dial indicator is set-up to ensure that rotating equipment flanges are not being strained (deflected) during the final bolt-up and torquing, if there is any question that excessive external forces or moments are being applied to the equipment. Measured strain at the flange shall be documented and transferred to the OWNER inspector. The bolt tightening sequence shall be in accordance with Appendix B for single tool applications or Appendix C for multiple tool applications.

Table 1C: Recommended Target Torque Values Using Teflon Coated ASTM A193 B7 or A320 L7 Bolts:

Table 1C torque values are taken from API Specification 6A, Table D.2

Nominal Bolt Size, inches	***Target Torque (ft-lb)** ***f* = 0.07**
	Non-lubricated Bolts Bolt stress equal to 52.5 ksi
1/2	35
5/8	68
3/4	118
7/8	188
1	279
1-1/8	401
1-1/4	553
1-3/8	739
1-1/2	962
1-5/8	1,226
1-3/4	1,534
1-7/8	1,890
2	2,297
2-1/4	3,276
2-1/2	4,500

TABLE 1C GUIDLINES:

- It should be recognized that torque applied to a nut is only one of several ways to approximate the tension and stress in a fastener. Table 1C is for the convenience of the user only, and is based on calculations that assume certain friction coefficients for the friction between the studs and nuts, and between the nuts and the flange face.

- Some factors that affect the relationship between nut torque and stud stress are

    - thread dimensions and form;
    - surface finish of studs, nuts, and flange face;
    - degree of parallelism between nut face and flange face;
    - type of lubrication and coatings of the threads and nut bearing surface areas.

- Any of these factors could change friction and thereby the expected outcome.

Table 1D: Torque Increment Passes:

This table is taken from ASME PCC-1-2010, Table 2. For additional information, refer to that document.

STEP	LOADING
Install	Hand tighten, and then snug up to 10 – 20 ft-lbs, without exceeding 20 percent of the Target Torque (see Table 1A). Check flange gap around circumference for uniformity. If the gap around the circumference is not reasonably uniform, make the appropriate adjustments by selective tightening before proceeding.
Round 1	Tighten to 20 percent – 30 percent of Target Torque (see Table 1A). Check flange gap around circumference for uniformity. If the gap around the circumference is not reasonably uniform, make the appropriate adjustments by selective tightening before proceeding.
Round 2	Tighten to 50 percent – 70 percent of Target Torque (see Table 1A). Check flange gap around circumference for uniformity. If the gap around the circumference is not reasonably uniform, make the appropriate adjustments by selective tightening before proceeding.
Round 3	Tighten to 100 percent of Target Torque (see Table 1A). Check flange gap around circumference for uniformity. If the gap around the circumference is not reasonably uniform, make the appropriate adjustments by selective tightening before proceeding.
Round 4	Continue tightening the bolts but on a rotational clockwise pattern

	until no further nut rotation occurs at the Round 3 Target Torque value. For indicator bolting, tighten bolts until the indicator rod retraction readings for all bolts are within the specified range.
Round 5	Time permitting, wait a minimum of four hours, and repeat Round 4; this step will restore the short-term creep relaxation/embedment losses. If the flange is subjected to a subsequent test pressure higher than its rating, it may be desirable to repeat this round after the test is completed.

Appendix A Bolt Length Tables:

BOLT LENGTHS per ASME B16.5-2009 (inches)					
Class	**NPS**	**No.**	**Bolt Dia.**	**Length (RF)**	**Length (RTJ)**
150	½	4	1/2	2-1/4	---
150	¾	4	1/2	2-1/2	---
150	1	4	1/2	2-1/2	3
150	1-1/4	4	1/2	2-3/4	3-1/4
150	1-1/2	4	1/2	2-3/4	3-1/4
150	2	4	5/8	3-1/4	3-1/4
150	2-1/2	4	5/8	3-1/2	4
150	3	4	5/8	3-1/2	4
150	4	8	5/8	3-1/2	4
150	6	8	3/4	4	4-1/2
150	8	8	3/4	4-1/4	4-3/4
150	10	12	7/8	4-1/2	5
150	12	12	7/8	4-3/4	5-1/4
150	14	12	1	5-1/4	5-3/4
150	16	16	1	5-1/4	5-3/4
150	18	16	1-1/8	5-3/4	6-1/4
150	20	20	1-1/8	6-1/4	6-3/4
150	24	20	1-1/4	6-3/4	7-1/4
BOLT LENGTHS per ASME B16.5-2009 (inches)					
Class	**NPS**	**No.**	**Bolt Dia.**	**Length (RF)**	**Length (RTJ)**
300	½	4	1/2	2-1/2	3
300	¾	4	5/8	3	3-1/2
300	1	4	5/8	3	3-1/2
300	1-1/4	4	5/8	3-1/4	3-3/4
300	1-1/2	4	5/8	3-1/2	4
300	2	8	5/8	3-1/2	4
300	2-1/2	8	3/4	4	4-1/2
300	3	8	3/4	4-1/4	4-3/4
300	4	8	3/4	4-1/2	5

300	6	12	3/4	4-3/4	5-1/2
300	8	12	7/8	5-1/2	6
300	10	16	1	6-1/4	6-3/4
300	12	16	1-1/8	6-3/4	7-1/4
300	14	20	1-1/8	7	7-1/2
300	16	20	1-1/4	7-1/2	8
300	18	24	1-1/4	7-3/4	8-1/4
300	20	24	1-1/4	8	8-3/4
300	24	24	1-1/2	9	10
BOLT LENGTHS per ASME B16.5-2009 (inches)					
Class	**NPS**	**No.**	**Bolt Dia.**	**Length (RF)**	**Length (RTJ)**
600	½	4	1/2	3	3
600	¾	4	5/8	3-1/2	3-1/2
600	1	4	5/8	3-1/2	3-1/2
600	1-1/4	4	5/8	3-3/4	3-3/4
600	1-1/2	4	5/8	4-1/4	4-1/4
600	2	8	5/8	4-1/4	4-1/4
600	2-1/2	8	3/4	4-3/4	4-3/4
600	3	8	3/4	5	5
600	4	8	7/8	5-3/4	5-3/4
600	6	12	1	6-3/4	6-3/4
600	8	12	1-1/8	7-1/2	7-3/4
600	10	16	1-1/4	8-1/2	8-1/2
600	12	20	1-1/4	8-3/4	8-3/4
600	14	20	1-3/8	9-1/4	9-1/4
600	16	20	1-1/2	10	10
600	18	20	1-5/8	10-3/4	10-3/4
600	20	24	1-5/8	11-1/4	11-1/2
600	24	24	1-5/8	13	13-1/4

NOTE: For additional details regarding flange alignment and equipment see API RP 686 *Recommended Practice for Machinery Installation*, Chapter 6 *Piping*.

14. COATINGS

14.1. Surface preparation and protective coatings for above and below ground Steel Surfaces: *Refer to Specification 15600*

15. PIPE LOWERING AND BACKFILLING:

15.1. Lowering-In Pipe General

15.1.1. Holiday detection (jeeping) shall be performed immediately prior to lowering in operation and coating shall be closely inspected for possible damage resulting from the lowering in operation. Any anomalies found by jeeping must be repaired at the CONTRACTOR expense prior to lowering in. While lowering in, if the coating is struck against any object, CONTRACTOR shall re-jeep the section. Any anomalies found by jeeping must be repaired at the CONTRACTOR expense prior to lowering in.

15.1.2. Lowering in operations shall only be performed in the presence of and with the approval of the RPR. Should lowering in be performed in the absence of or without the approval of the RPR, CONTRACTOR may be required to raise the section of line for inspection at CONTRACTOR's expense.

15.1.3. Before backfilling, the pipeline shall be inspected to ensure that it lies evenly on the river sand bed.

15.1.4. Sections of the coated pipe shall not be dragged or pulled into position, unless approved by RPR. The length of sections shall be regulated to allow handling without damaging the protective coating at stream crossings or at any other location where it may be necessary to pull or drag sections of pipe into place. The coated pipe shall be properly protected and handled in a manner to prevent damage to the pipe.

15.2. Over-Bends, Side-Bends, and Sag-Bends

15.2.1. All over-bends shall be made and installed to clear the high point of the bottom of the ditch by at least 12 inch at the point of bend. At side bends, the pipe shall be bent and lowered to lie against the outside wall at the bottom of the ditch. All sag-bends shall continuously lie on the river sand envelope or on sand bags where required.

15.3. Pipe Slings and Cradles

15.3.1. The CONTRACTOR shall provide padded slings for handling coated and wrapped pipe. The use of belting reinforced with wire cable shall not be

permitted. Any method of lowering-in which prevents damage to the coating shall be acceptable; however, the use of cradles is preferred.

15.4. Condition of Ditch

15.4.1. Prior to lowering-in the CONTRACTOR shall provide, to the satisfaction of the RPR, a ditch which is free from excess debris, large rocks and roots, welding rods, skids or other such objects which can cause damage to the pipe and its protective coating during lowering-in operations.

15.5. Water in Ditch

15.5.1. The CONTRACTOR shall pump water all from the ditch, bell holes, or other tie-in excavations prior to lowering-in.

15.6. Temporary Negative Buoyancy (Wetlands)

15.6.1. If warranted by the condition of the ditch, and if acceptable to the OWNER, the CONTRACTOR may fill sections of the pipeline with silt-free water to achieve temporary negative buoyancy during lowering-in operations.

15.7. Pipeline Supports

15.7.1. This specification defines the general requirements necessary for the supporting of pipelines and related facilities to provide installations which remain stress-free subsequent to the backfilling operation and the consolidation of the backfill material.

15.7.2. The CONTRACTOR shall construct the pipeline to lie on the bottom of the pipe trench or sand envelope, whichever dictates. Additional excavation shall be made as necessary around valves and fittings to provide for continuous support of the mainline by the bottom of the trench. All bends shall be made to fit the pipe ditch.

15.7.3. Where pipe cannot be directly and sufficiently supported by the sand envelope, support shall be provided by sandbags or other OWNER approved materials. Sandbags shall be placed at points to provide stress-free support for the pipeline subsequent to backfilling. Spacing intervals for sandbag supports shall be 15 ft. or less as required by the OWNER.

15.7.4. Supports comprised of materials other than sandbags shall be constructed in strict accordance with the manufacturer's instructions and at spacing intervals no greater than the appropriate maximum interval recommended by the

manufacturer. Support shall be placed at points to provide a stress-free installation subsequent to backfill.

15.7.5. The CONTRACTOR shall not use any support method without the prior approval of the OWNER and without providing the OWNER with the manufacturer's recommended installation directions for the specific method being used.

15.8. Cased Crossings

15.8.1. Special supports shall be provided to the pipeline for all cased crossings. These supports shall be located under the pipeline at a minimum of 5 ft and a maximum of 8 ft from the end of the casing and at intervals designated above throughout the boring bell hole area. The supports may be made of sandbags or other material approved by the OWNER.

15.8.2. CONTRACTOR shall supply all spacers between the carrier pipe and product pipe, link seals and wax filling of the voids, if required by project drawings.

15.9. Tie-Ins

15.9.1. Sections of the pipeline excavated for tie-ins shall be supported with sandbags or other approved materials at intervals indicated above. Supports shall be placed immediately after final tie-in to provide a stress-free installation subsequent to the backfilling operation.

15.10. Backfilling

15.10.1. After lowering-in has been completed but before backfilling, the ditch shall be pumped dry in upland areas and the line shall be inspected to ensure that no skids, brush, stumps, trees, boulders or debris are in the ditch. No such materials or debris are to be backfilled into the ditch.

15.10.2. After the pipe has been inspected and approved by the RPR, after all damage to the protective coating has been repaired and after the coating on the pipe has had sufficient time to cure, then the CONTRACTOR shall install the initial river-sand envelope around the piping per specification 15.12.

15.10.3. Remaining backfill shall be screened sub-soil not to exceed 1-inch in any dimension.

15.10.4. All backfill shall be placed evenly in the trench, lifts shall not exceed 12-inches, and all soil shall be packed down with backfill equipment to prevent any

voids and verified by an RPR. Any discrepancies shall immediately be corrected.

15.10.5. The CONTRACTOR shall complete the filling of the ditch to produce a trim backfill. Excavated material shall be placed in the ditch. Topsoil, where it has been segregated, shall be backfilled as close as possible to its original location.

15.10.6. Rock, 1-inches in diameter and larger, or like materials shall not be backfilled directly onto the pipe. Where such materials are encountered, the CONTRACTOR shall haul, if necessary, sufficient earth or sand to be backfilled around and over the pipe to form a protective padding or cushion as specified in Section 15.12 or, as otherwise specified in the Scope of Work. Large rock or boulders in excess of 12-inches in diameter, width or length, shall not be backfilled into the ditch. Such rock shall be disposed of properly.

15.10.7. The CONTRACTOR shall not use soil from the right-of-way except from the spoil bank. The CONTRACTOR shall keep the completed backfill to within one mile of the lowered in line unless otherwise approved by the OWNER.

15.11. Trench Breaker

15.11.1. The CONTRACTOR shall install erosion breakers in the ditch over, under, and around the pipe to provide full protection against backfill washing at various points along the pipeline. Breaker installations and spacing shall comply with the following specifications as well as OWNER, local, state, and Federal requirements.

15.11.2. Breaker materials shall include, but are not be limited to, decomposable bags, sand, and any other materials required to facilitate the proper placement of the breaker material in the ditch.

15.11.3. Breaker installations may be comprised of either a multiple sandbag configuration or by other approved methods. All breaker installations shall meet with the approval of the OWNER.

15.11.4. Breaker size is dependent on the extent and condition of the ditch in depth, width, slope, and grade. At a minimum, breakers shall extend the width and depth of the ditch.

15.11.5. Breakers shall be spaced along the ditch in accordance with the OWNER's environmental standards.

15.12. Pipeline Padding Envelope:

15.12.1. CONTRACTOR shall install a 12 inch (12”) envelope of River Sand around the pipe. River Sand must meet the gradation listed in Table 1. CONTRACTOR must submit River Sand gradation for OWNER’s approval. The 12 inches (12”) of sand required for the sand envelope is included in the specified minimum cover of the pipeline.

River Sand Gradation	
Sieve Size	**% Passing**
3/8’’ (9.5mm)	100.00
#4 (4.75mm)	100.00
#8 (2.36mm)	99.9
#10 (2mm)	99.7
#16 (1.18mm)	98.2
#30 (0.6mm)	85.6
#50 (0.3mm)	58.4
#100 (0.15mm)	28.8
#200 (0.075mm)	7.64
Pan	0.00

15.12.2. Rock shield shall be applied as designated on the construction drawings or upon the direction of OWNER. Rock shield material shall be TUFF-N-NUFF Protective Rock shield (11mm thick) or OWNER-approved equal. Rock shield shall not be used as a substitute for providing the required envelope of compacted sand for a minimum of 12 inches (12”) around the pipe.

15.12.3. Non-detectable Marking Tape: Place tape on the interface between the sand envelop and backfill material.

16. REINFORCED CONCRETE WORK

16.1. GENERAL REQUIREMENTS

16.1.1. All concrete, concrete reinforcing steel and concrete accessories shall be furnished and installed in accordance with ACI 301 and this specification.

16.2. QUALITY CONTROL

16.2.1. The CONTRACTOR shall have a written Quality Control Program and Inspection Procedures document that shall provide details of how compliance with the requirements of this specification and the shop and placement drawings shall be achieved.

16.2.2. The OWNER reserves the right to make inspections at any time at the source of supply of materials, at the place of preparation of materials, at the mixing plant if ready-mixed concrete is used, and during execution of all concrete work.

16.2.3. Four cylinders will be molded and cured in accordance with ASTM C31 and ACI 301. One cylinder will be tested at seven days for information and two cylinders at 28 days for acceptance in accordance with ASTM C39 and ACI 301. The fourth cylinder will be used as a spare and will be tested as specified by the OWNER. Testing frequency shall be as specified in ACI 301, unless otherwise specified by the RPR. CONTRACTOR to facilitate testing at OWNER approved testing laboratory. CONTRACTOR is responsible for all testing expenses.

16.2.4. Slump readings shall be taken in accordance with ACI 301 and the following guidelines:

16.2.4.1. At changes in moisture content of aggregate that may cause the water/cement ratio to be out of compliance with ACI 117

16.2.4.2. Whenever cylinders are made for testing

16.2.4.3. Every 100 cubic yards with consistent mix characteristics

16.2.4.4. After each batch delivered that has a slump above working slump shown in Table-1

16.3. SUBMITTALS

16.3.1. Prior to the start of work, the CONTRACTOR shall submit to the OWNER for review and acceptance, as a minimum, the following documentation in accordance with requirements of ACI 301. Additional documentation requirements of ACI 301 that are not listed below are to be provided by the CONTRACTOR to the OWNER for acceptance and review when required by the Contract Documents.

16.3.2. CONTRACTOR shall submit a mix design, for OWNER approval..

16.3.3. Quality control program of the CONTRACTOR's concrete supplier describing in detail how compliance with this specification will be ensured. The program shall include data and test documentation on materials and mixture proportions required by ACI 301.

16.3.4. Quality control program of the CONTRACTOR describing in detail how compliance with this specification will be ensured. The program shall include:

16.3.4.1. All fabrication, handling, placing, curing, and construction procedures

16.3.4.2. Testing and inspection procedures for all concrete work

16.3.5. Data on the formwork release agent proposed for use.

16.3.6. When re-shoring is required or permitted by the Contract Documents, submit for prior approval the plan of re-shoring procedures and operations. The re-shoring plans shall describe locations of re-shores and the load applied to the structural members during the re-shoring.

16.4. MATERIALS

16.4.1. CEMENT

16.4.1.1. Portland Cement shall conform to ASTM C150. Type I or II cement shall be used in all cases unless specified otherwise in the Contract Documents.

16.4.2. ADMIXTURES

16.4.2.1. When approved by the OWNER, chemical admixtures, conforming to ACI 301, may be used in concrete to improve its characteristics in one or more aspects including economy, strength, durability, workability, water tightness, drying shrinkage behavior, and increased resistance to damage from cyclic freezing and thawing.

16.4.2.2. When specified or approved for use, chemical admixtures shall conform to ASTM C494, shall be used in strict accordance with manufacturer's recommendations, and shall not reduce the strength of the concrete.

16.4.2.3. When approved by OWNER, super plasticizing admixtures may be added if concrete slump greater than the working slump values in Table 1 are required for proper concrete placement.

16.4.2.4. When super plasticizers are used, the aggregate ratio shall be adjusted to allow a flowable consistency without excessive bleeding or segregation. Use of admixtures containing soluble chlorides is not permitted.

16.4.2.5. When the OWNER approves use of fly ash, only Type F fly ash conforming to ASTM C618 may be used as a partial replacement of

cement. Fly ash may replace a maximum 25 percent of the cement by weight.

16.4.2.6. Concrete subject to cyclic freezing and thawing shall contain air-entraining admixtures conforming to ASTM C260 and capable of attaining the total air content specified in ACI 301.

16.4.3. AGGREGATES:

16.4.3.1. Fine and coarse aggregate shall be regarded as separate ingredients. Each size number of coarse aggregate, as well as the combination of size numbers when two or more are used, shall conform to the grading requirements of ASTM C33 size numbers 467 or 357.

16.4.3.2. The source of aggregate supply shall not be changed during the course of the job without approval of the OWNER.

16.4.4. REINFORCING STEEL

16.4.4.1. All reinforcing bars shall be of deformed billet steel conforming to the requirements of ASTM A615, Grade 60.

16.4.4.2. Plain welded wire fabric and cold-drawn wire for concrete reinforcement shall conform to the requirements of ASTM A185 and ASTM A82 respectively. Deformed wire shall conform to ASTM A496.

16.4.4.3. Epoxy coated reinforcing bars shall be in accordance with ASTM A775.

16.4.4.4. Zinc coated (galvanized) reinforcing bars shall be in accordance with ASTM A767.

16.4.5. CURING MATERIALS

16.4.5.1. Absorptive mat shall conform to ASTM C171, burlap-polyethylene, 8 ounces per square yard, bonded to prevent separation during use.

16.4.5.2. Curing compound shall conform to ASTM C309.

16.4.5.3. Plastic covering shall conform to ASTM D2103, and be 6 mils thick, clear polyethylene film.

16.4.5.4. All concrete used for underground duct envelopes shall have a specified compressive strength of 3000 psi at 28 days. Maximum aggregate size shall be 3/8-inch.

16.4.5.5. Concrete envelopes for underground electrical ducts shall be colored red by adding 20 pounds of red oxide powder per cubic yard of concrete.

16.4.6. ACCESSORIES

16.4.6.1. All accessories shall be specified in the Contract Documents.

16.5. EXECUTION

16.5.1. FORMWORK

16.5.1.1. Provide 3/4-inch chamfer strips at all comers on permanently exposed surfaces unless otherwise indicated in the Contract Documents.

16.5.1.2. Unless otherwise specified in the Contract Documents, formwork and shoring shall be left in place to support the weight of concrete until the concrete has attained at least 75 percent of its specified 28-day compressive strength; however, the concrete structure shall be evaluated for the effect of any superimposed loading applied before the concrete attains its design compressive strength.

16.5.2. JOINTS

16.5.2.1. Construction joints, control joints, expansion joints, and isolation joints shall be installed at the locations shown in the Contract Documents.

16.5.2.2. Dowels at expansion joints for pavements and slabs on grade shall be properly aligned to prevent any restraint on expansion movement at the joint.

16.5.3. WATERSTOPS

16.5.3.1. Waterstops shall be installed at the locations shown in the Contract Documents.

16.5.3.2. Waterstops shall be accurately cut, fitted, and fully and integrally joined at joints and junctions to provide a continuous, watertight diaphragm at all points.

16.5.3.3. Adequate provisions shall be made for the support and protection of waterstops during the progress of the work. Damaged stops shall be replaced and/or repaired before embedment in concrete.

16.5.4. EMBEDDED ITEMS

16.5.4.1. Aluminum items are not permitted.

16.5.4.2. All anchor bolts, anchors, inserts, sleeves, drains, curb and seat angles, nosing's, and other embedded items shall be installed before placing concrete.

16.5.4.3. All embedded items shall be free of grease, mud, excessive rust or coatings that can destroy or reduce bond with the concrete, unless debonding is desired and specifically shown in the Contract Documents.

16.5.5. PROPORTIONING, MIXING AND TRANSPORTING

16.5.5.1. Retempering or addition of water after concrete is first mixed shall not be allowed.

16.5.5.2. All concrete shall be normal weight concrete, unless specified otherwise in the Contract Documents.

16.5.5.3. Unless specified otherwise in the Contract Documents, all concrete shall develop 4000 psi compressive strength in 28 days.

16.5.6. REINFORCEMENT

16.5.6.1. Detailing of reinforcing steel shall be in accordance with ACI Detailing Manual SP-66.

16.5.7. PLACING CONCRETE

16.5.7.1. Concrete placed on soil shall be placed only on firm, undisturbed ground or engineered fill. Concrete shall not be placed in standing water.

16.5.7.2. Immediately prior to placing concrete, all form and sod surfaces shall be thoroughly wetted, but free from standing water.

16.5.8. SLUMP AND CONSISTENCY

16.5.8.1. Concrete shall be proportioned so as to comply with the requirements of Table 1. These values will be used to judge consistency prior to the addition of plasticizers.

16.5.8.2. The quantity of total mixing water shall be limited to an amount producing the lowest slump concrete that can be properly consolidated under existing placing conditions.

16.5.8.3. The concrete may exceed the working slump, however, it shall not exceed the maximum slump.

16.5.8.4. Concrete may be supplied with a slump less than the working slump provided it can be properly placed and consolidated.

16.5.8.5. Concrete that has been rejected for failure to meet slump limits shall not be salvaged for use in the concrete work. Increased mixing time, addition of dry materials, or similar modifications of a rejected batch for the purpose of conforming to slump limits shall not be permitted.

16.5.9. COLD AND HOT WEATHER CONCRETING

16.5.9.1. Cold weather concreting shall be in accordance with ACI 306.1.

16.5.9.2. Surfaces that will be in contact with the concrete shall be raised to a temperature above 35°F. Concrete shall not be placed on a frozen sub-grade or sub-grade that contains frozen materials.

16.5.9.3. Equipment for protecting concrete from freezing shall be available at the job site prior to placing concrete. Care shall be exercised to protect edges and exposed corners from freezing.

16.5.9.4. OWNER shall approve any use of accelerators. Only non-corrosive, non-chloride accelerators shall be used.

16.5.9.5. Unless otherwise specified, all concrete members 2-1/2 feet or more in thickness shall have a maximum placing temperature of not more than 70°F, and all other concrete shall have a maximum placing temperature of 90°F.

16.5.10. **CURING**

16.5.10.1. Length of moist curing shall be at least 7 days. Temperature of concrete shall be prevented from falling below 50°F during the curing period.

16.5.10.2. Liquid Membrane Method shall not be used on surfaces designed to receive special protective coatings, applied toppings, architectural plaster, paint finishes, or similar high bond coatings, except as specifically called for in the Contract Documents.

16.5.11. **SURFACE FINISHES**

16.5.11.1. Concrete surfaces to be protected by chemical resistant topping, surface, or coating shall be installed in accordance with the manufacturer's instructions.

TABLE 1 – SLUMP AND AGGREGATE SIZE

CONCRETE USE	MAXIMUM AGGREGATE SIZE	WORKING SLUMP-INCHES	MAXIMUM SLUMP-INCHES (REJECTION)
Foundations & Grade Slab	1-1/2	4	5
Slabs Less Than 8”	¾	4	5
Walls Less Than 8”	¾	4	5
Backfill	2	5	6
Tremmie	¾	4	6
All Other Normal Weight Concrete	1-1/2	4	5
All Lightweight Concrete	¾	2	5
Elevated Slab	¾	4	5
All Water Retaining Structures	3/4	3	4

17. PIPELINE HYDROSTATIC TESTING:

17.1. DEFINITIONS AND ABBREVIATIONS:

CONTRACTOR	Any entity contracted by OWNER to perform a pressure test or pressure test activities
ERW	Electric Resistance Weld (pipe)
°F	degree Fahrenheit (temperature)
MAOP	Maximum Allowable Operating Pressure
MOP	Maximum Operating Pressure
NDE	Non-destructive Examination
NIST	National Institute of Standards and Technology
PSIG	Pounds Per Square Inch Gauge
Shall	Indicates provisions that are mandatory.
Should	Indicates provisions that are recommended but not mandatory.
SMYS	Specified Minimum Yield Strength
Stabilization	A period of time after the pipeline is completely filled but before the pressure is increased to test pressure to allow the pressure and temperature in the test section to achieve steady-state. This is generally the time after the fill pumps are shut down and while the pressure pumps are readied for service and/or immediately after reaching test pressure.
Double Deviation	Yield for unidentified or used pipe is determined by using the pressure at the highest elevation within a test section, at which the number of pump strokes (measured volume) per increment of pressure rise becomes twice the number of pump strokes (measured volume) per increment of pressure rise that was required during the straight-line part of the pressure-volume plot before any deviation occurs.
Test Administer	Assigned by CONTRACTOR to administer all testing activities
Test Director	The Test Director is assigned by the OWNER, usually the RPR.

17.2. APPLICABILITY AND FREQUENCY

17.2.1. This standard is not intended to apply retroactively. Hydrostatic testing to be performed after the date on which this standard was adopted shall meet its requirements.

17.2.2. No OWNER facility may be placed in pressure service without first having been tested in accordance with this procedure except that pressure testing is not required for a single component (new) other than pipe that is added or replaced if the manufacturer certified either:

17.2.2.1. The component was hydrostatically tested to at least the minimum test pressure required below; or

17.2.2.2. The component was manufactured using a quality control system ensuring each item manufactured is at least equal in strength to a prototype that was tested to at least the minimum test pressure required below.

17.2.3. Pressure testing shall be performed:

17.2.3.1. Before placing in operation any new pipeline(s), pipeline facilities, replacement pipe, or fabrications used in pressurized service.

17.2.3.2. When qualifying a pipeline and associated facilities for a new or higher MAOP/MOP, and the pipeline's ability to withstand this pressure has not been verified or integrity verification is required.

17.2.3.3. As part of a conversion of service, prior to reinstating to service pipelines or facilities previously abandoned.

17.2.3.4. Prior to reinstating to service pipelines or facilities previously decommissioned, and the period of time decommissioned exceeds the recommended integrity reassessment date.

17.2.3.5. When the MAOP is to be requalified because of increases in class location in a gas pipeline and previous hydrotests were not sufficiently high for the new class location.

17.3. SAFETY

17.3.1. Personnel safety and environmental concerns shall be considered during the planning and during all phases of a pressure test.

17.3.2. No personnel shall be in the ditch during pressuring or within the testing area if the pressure is above 50 percent of SMYS.

17.3.3. There shall be no public/CONTRACTOR personnel or equipment working over a test section after the test pressure has exceeded the operating pressure.

17.3.4. Test equipment and personnel shall be positioned to minimize potential hazards. Typical positioning should include a barrier between the test equipment and test manifold and/or placement of test equipment a minimum distance of 100 feet from the test manifold. Personnel performing the test should approach the pressured line only in the performance of their duties.

17.3.5. Local authorities, governmental agencies, potential emergency response personnel, and landowners along the right-of-way should be notified as applicable prior to the test.

17.3.6. Provide and maintain reliable communication equipment during pressure testing so that all personnel directly involved may communicate.

17.3.7. All pressure must be reduced to static pressure prior to tightening of flanges or screwed fittings.

17.3.8. When filling, if high pressure hose is not used, adequate support and bracing shall be provided for the rigid piping used in connecting to the facility to be tested to avoid whipping.

17.3.9. After the test is complete, adequate support and bracing shall be provided for the dewatering line and extreme caution shall be taken when deflectors such as ells are used.

17.3.10. When required, an enclosed, lighted, heated, and/or air-conditioned shelter sized to house test recording equipment and test personnel at the data procurement site of each test section shall be provided. Adequate lighting shall be available for testing operations performed at night.

17.4. WRITTEN PLAN

- Before any OWNER facilities are pressure tested, a written hydrostatic testing plan shall be developed and approved by OWNER. The plan will, at minimum, cover the following topics as applicable:

17.4.1. Materials and Strengths

17.4.1.1. List the materials to be tested and their rated strengths

17.4.1.2. Provide a sketch, include stationing, of the facility to be tested.

17.4.2. Test Pressure and Duration

17.4.2.1. Determine the maximum and minimum test pressure and the duration.

17.4.2.2. Consider elevation changes.

17.4.3. Test Medium, Source, and Disposal Methods

17.4.3.1. Describe the test medium to be used.

17.4.3.2. Describe the source of the test medium

17.4.3.3. Describe line cleaning requirements.

17.4.3.4. Describe how the test medium will be disposed after testing is completed.

17.4.4. Safety

17.4.4.1. Describe the safety procedures to be used during filling, testing, and dewatering. Consider company employees, CONTRACTORs, and the general public as applicable.

17.4.5. Test Equipment

17.4.5.1. Describe the equipment required to acquire the data (fill volume, pressure, temperature, etc.)

17.4.6. Filling and Pressurizing

17.4.6.1. Describe how the facility to be tested will be filled and how the pressure will be increased from atmospheric to final test pressure.

17.4.6.2. Determine if a stroke-pressure plot is necessary.

17.4.7. Test Procedure

17.4.7.1. Describe how the test will be performed, including the necessity to perform stroke pressure graphs, the rate of pressure increases, stops for leak checks, etc.

17.4.8. Dewatering, Drying and Cleaning

17.4.8.1. Describe how the facility will be dewatered, dried, and cleaned after testing and what will be done to minimize contamination or corrosion if it will not be placed in service within one week of testing.

17.4.9. Permits

17.4.9.1. Describe any permits necessary to obtain fill water and dispose of the test water or medium.

17.5. PRESSURE TEST EQUIPMENT

17.5.1.1. The following is a comprehensive list of equipment and materials needed for a pressure test utilizing water as the test medium. Not all items will be required for each test.

17.5.2. Deadweight or Digital Pressure Gauges

17.5.2.1. The deadweight gauges shall be the prime source of monitoring pressure throughout the hydrostatic test. Accurate dead weight(s) or digital gauges (Gauge 2 or equal) shall be used to measure test pressures. Dead weights must have been certified for accuracy within the past 12 months, and digital gauges within the past six months, by an independent testing laboratory. The accuracy of the deadweight or digital gauges at the time of certification shall be at a minimum ±0.1 percent of the indicated pressure, traceable to NIST Standards. The serial number shall be clearly indicated on the deadweight gauges. The CONTRACTOR shall present certification documents to the RPR prior to testing.

17.5.3. Fill Pumps

17.5.3.1. CONTRACTOR shall provide fill pumps, when required, that shall be of sufficient size and capacity to fill the test section in an efficient and timely manner that prevents the inclusion of air into the test section.

17.5.4. Flow Meter

17.5.4.1. CONTRACTOR shall provide a flow meter of type and capacity capable of measuring the maximum water fill rate.

17.5.5. Water Filter

17.5.5.1. The fill pumps shall be equipped with a filter system, if required by the OWNER, rated at sufficient capacity to accommodate the output of the fill pump and capable of removing 99 percent of all particles 100 microns in diameter or larger in size.

17.5.5.2. The filter system shall be equipped with valves, gauges, and fittings sufficient to allow any necessary backwashing and to monitor the differential pressure across the filter and positive pressure on the discharge side of the filter.

17.5.5.3. Water suction lines shall also be equipped with a filter screen to ensure no solids or debris is introduced into the test section.

17.5.6. Pressure Pump and Stroke Counter

17.5.6.1. Pressure pumps shall be capable of attaining the desired test pressure and shall be capable of maintaining a pressure rise equivalent to 10 psig/minute or less. The pump unit driver shall have an efficient clutch, transmission, and throttle system capable of maintaining a constant volumetric injection.

17.5.6.2. Once the volumetric injection rate has been established, the pump shall be capable of maintaining this rate with only minor adjustments of the throttle.

17.5.6.3. The pressure pump shall be equipped with a suitable stroke counter with a manual reset switch and a tachometer. The stroke counter shall be located at the deadweight gauge location during the testing operation.

17.5.6.4. The pressure pump's serial number and capacity in terms of gallons/stroke shall be made provided to the Test Director prior to testing.

17.5.7. Pressure Recorder

17.5.7.1. A 24 hour pressure recorder with a ten inch (minimum) circular chart shall be used to maintain a continuous record of the pressure versus time during testing and must have been certified for accuracy within the past six months by an independent testing laboratory.

17.5.7.2. Certification documents shall be provided to the RPR by the CONTRACTOR prior to testing.

17.5.7.3. The serial number shall be clearly indicated on the pressure recorder.

17.5.7.4. Compare the pressure recorder reading with the pressure obtained from the deadweight or digital pressure gauge before recording test pressures.

17.5.7.5. The recorder is not to be used as the prime source of the pressure readings.

17.5.7.6. The range of the chart must be compatible to the spring range of the instrument on which it is used

17.5.8. Temperature Recorder

17.5.8.1. A temperature recorder shall be used to maintain a continuous record of the pipe temperature versus time during testing and must have been certified for accuracy within the past six months by an independent testing laboratory.

17.5.8.2. Certification documents shall be provided to the RPR by the CONTRACTOR prior to testing.

17.5.8.3. The temperature probe shall be taped to the pipe and connected to the temperature recorder. Consider burying the temperature probes where possible.

17.5.8.4. Compare the temperature readings against a certified thermometer immediately before beginning the test.

17.5.8.5. The serial number shall be clearly indicated on the temperature recorder.

17.5.8.6. Ambient temperature can be monitored using a test thermometer as long as it is of laboratory grade with a range from 0°F to 120°F, and have 1°F divisions. Keep the thermometer shaded.

17.5.9. Test Headers

17.5.9.1. Test manifolds used to pressure test OWNER pipeline facilities shall be fabricated by the CONTRACTOR in accordance to the following requirements:

17.5.9.2. Except as specified immediately below, the minimum wall thickness and yield strength of pipe and components used to fabricate test headers shall be designed such that the maximum test pressure experienced during facility testing does not exceed 80 percent of SMYS.

17.5.9.3. In instances where the proposed test pressure will exceed 80 percent of SMYS of the test headers, an initial pre-test shall be conducted on the entire test header to 100 percent of the test header's specified minimum yield strength (SMYS) for 30 minutes. Subsequent testing

shall be at the discretion of the RPR, dependent upon the condition of the test manifold and verification of qualification documentation (Test, NDE, Welding, and Material Records).

17.5.9.4. A qualified welder using a qualified welding procedure shall weld all pressure piping related to the pressure test.

17.5.9.5. All butt and fillet welds shall be nondestructively tested in accordance to all applicable OWNER NDE standards and procedures.

17.5.9.6. Test headers may also serve as fill and launching assemblies and must be designed to accommodate the size and number of pigs or squeegees specified in the test plan.

17.5.10. **Test Water**

17.5.10.1. The RPR will approve the source and disposal means of the test water with required permits

17.6. HYDROSTATIC TEST FIELD ACTIVITIES

17.6.1. Test information generally required includes the number of test sections, test section numbering, appropriate test pressure, tolerances, test duration, required acceptance criteria, outside diameter, wall thickness, grade, footage, engineering station numbers and/or mileposts for the entire pipe being tested and the written test plan.

17.6.2. Prior to pressure testing, ensure that the test section has been isolated from all other piping components, that all valves in the test section are open (half or full as applicable) and that check valves are pinned open or the clapper is removed; all flanged and screwed connections have been tightened; pressure and temperature recorders, deadweight gauge, and pressure pump are in proper working condition and functioning properly; the deadweight gauge is level, free spinning, and properly oiled; the spring range in each recorder is compatible with its chart; the pressure recorder is calibrated to the deadweight gauge and the temperature recorders are calibrated to the test thermometer.

17.6.3. For existing liquids facilities, purging shall be performed per applicable procedures in OWNER O&M Manual and/or OWNER Safety Policies Manual.

17.7. Filling:

17.7.1. Prior to filling the test section, ensure that valves, flanges, closures or bull plugs at the high point are set to an appropriate position (open, closed, or

partially open) to bleed all air out during filling, and that all instrument tubing has been disconnected.

17.7.2. Fill water shall be obtained only from approved sources.

17.7.3. As per environmental permit requirements, arrange with an approved contract laboratory to collect a sample of the fill water prior to filling the test section. Requested analysis will be dependent on the state the test is being conducted in and if the section is new or used as well as the final discharge water quality limitations.

17.7.4. Fill the pipeline section with water at a continuous rate. Should the fill stop at any time due to uncontrollable circumstances, the fill line shall be purged of air. Care shall be taken to ensure that no excess air is entrapped in the pipeline.

17.7.5. The pipeline and components shall be completely filled with clean water from a source approved by the OWNER, free of silt, trash or any substance that might be injurious to the system.

17.7.6. All fill pump filter apparatus back flushing operations and test media shall be properly disposed of without damage to land or contamination to the water source. Monitor the gauges on the filter for any differential pressure across the filter and positive pressure on the discharge side of the filter.

17.7.7. Measure the quantity of fill water pumped into the pipeline. Consider monitoring the pressure and temperature of the test medium during the filling operation.

17.7.8. During the filling process, construct dewatering piping (but do not connect) and water and sediment containment/filtration facilities as provided in the water discharge permit.

17.8. Pressuring

17.8.1. Prior to pressuring, ensure that the public, environment and OWNER personnel are secured. The test area should be secured with visible tape or fence materials and with visible signs indicating hazardous area.

17.8.2. The stabilization period shall begin after the fill operation is complete. A minimum of 12 hours shall be allowed for the temperature of the pipe, test medium and backfill (if any) to become relatively stable. Verify stabilization by comparing temperature readings taken from the temperature probes at the pipe and in the ground. Verify that all valves and components are in the proper orientation prior to pressurization.

17.8.3. After the stabilization period, the test section shall be pressurized to the test pressure with caution, recognizing the possibility of failure of the piping or equipment or the potential over-pressurization of the pipe. Meter and record the volume of water pumped into the test section during pressurization.

17.8.4. For pipeline test sections which are not 100 percent visible for tests pressures above 90% SMYS, the RPR will make a plot of the pressure versus volume of water being injected into the test section. Refer to the section, "Stroke – Pressure Plot."

17.8.5. Pressurize the pipeline at a uniform rate shall be 250 psi and hold overnight during stabilization process. Continue to pressure up in 250 psi increments with a minimum of 5 minute holds between each pressure rise, and at a reasonable rate which allows accurate pressure readings and proper collection of data. Any abrupt changes or breaks on the charts should be labeled as to the cause, at that point on the face of the chart. Pressure charts should have the dead weight pressures noted at the beginning and end of the test.

17.9. Pressure Test

17.9.1. Pressure shall be increased or decreased as necessary during the hold period in order to maintain the test pressure within the desired range as specified within the hydrostatic test package. The pressure range specified by the Test Director shall be in accordance to the specified range. Pressure, time, and volume of water shall be recorded for any "bleeding-off" or repressuring along with applicable comments.

17.9.2. The test period begins when stabilization to the required target test pressure has been reached.

17.9.3. Determine the quantity (gallons or strokes) of water used for each re-pressure. The volumes of water added or removed to control test pressures shall be metered and recorded.

17.9.4. Test pressures and ambient temperatures shall be recorded at 10 minute intervals for the first hour and at 15 minute intervals for the remaining test period. All information shall be recorded in ink in a neat and legible manner. The form shall incorporate all pertinent information relating to the particular test. During all phases of pressuring, repressuring, and bleeding, an accurate log of time, pressures, strokes, and temperatures shall also be recorded in a similar manner.

17.9.5. The pressure and temperature recorders shall be operated throughout the test period including the pressuring, the test duration, and the bleed down.

17.10. Hydrostatic Test Failures

17.10.1. The failure location shall be secured by RPR. No one shall be allowed into the immediate leak/rupture location until RPR determines that it is safe to do so. Contact Test Director in all instances.

17.10.2. An initial evaluation shall be conducted. The initial evaluation may consist of the following:

17.10.3. Visual inspection of the failure location to note general ROW condition, geographic characteristics of the location, and any unusual or possibly contributing factors such as water accumulation, other pipelines/utilities in the area, highway crossings, indications of land movement, third-party equipment/activity in the area, and obstacles to excavation safety.

17.10.4. Visual and NDE inspection of the pipe/component at the failure location to note steel condition (corrosion attack, gouges, dents, discoloration, etc.), external coating condition (disbonded, damaged, missing, etc.), appearance of the leak/rupture (small hole, longitudinal crack, circumferential crack, etc.), orientation of the leak/rupture (o'clock position), location of the leak/rupture (pipe body, longitudinal weld, girth weld, component body, etc.), any solids/liquids located around the pipe/component, and any solids/liquids inside the pipe/component.

17.10.5. Photographic evidence should be collected to document the failure site and other pertinent details regarding the failure. This should be made in place before the sample has been removed from the ditch. Mark each photograph with the Line Name, Line ID No. and the Asmt No., as well as the date and time the photograph was taken.

17.10.6. Subsequent to the initial location evaluation, activities can begin to repair or replace the failed pipe/component. Corrosion Prevention, Pipeline Integrity, and/or Operations Management personnel shall decide if a sample of the failure is required for additional analysis.

17.10.7. All repair activities should follow Standard 9006 *Pipeline Defect Evaluation and Repair Procedure*.

17.10.8. In the event that additional analysis is required, metallurgical analysis report shall be requested. The cutout pipe shall be preserved accordingly. Contact Pipeline Integrity for additional laboratory analysis requirements.

17.10.9. All repair activities shall be documented utilizing OWNER's Maintenance Report form.

17.11. Depressurizing and Dewatering

17.11.1. The test section shall be bled down slowly and carefully after successful completion of the test period.

17.11.2. After completion and acceptance of tests, completely dewater the pipeline by:

17.11.3. Connecting the discharge/dewatering pipe to the mainline and securing it to prevent whipping after the test pressure has been bled off

17.11.4. Where feasible, running a sufficient number of appropriate pipeline pigs;

17.11.5. Filtering the test water as required by permits and/or Right of Way special requirements;

17.11.6. Sampling the discharged water as required;

17.11.7. Draining all valves, sections of non piggable pipe, and other places where water may be trapped.

17.12. Cleaning and Drying

17.12.1. Air dry the pipeline by repeated passages of squeegees, running a train of drying pigs with dehumidified air from an air compressor, or as otherwise indicated in the scope of work. This process shall continue until there is no evidence of free water exiting from the test section and the exhausted air inside the pipeline should achieve a specified dew point of -45°F or at a humidity level as otherwise indicated in the scope of work.

17.12.2. The pipeline will be considered “clean and dry” when the required dew point has been achieved and dust penetration of 1/4 in. or less is visible in a foam pig.

17.12.3. Consider removing the air from the test section with a nitrogen purge. The air should be displaced with squeegees or pigs followed by the nitrogen with the nitrogen left in the system having a pressure of 50 psig or less. The nitrogen injected into the system should be at a temperature greater than 40°F but less than 90°F and a pressure less than the MOP or MAOP of the system.

17.12.4. After cleaning and drying, pipeline should be tied-in, purged, and loaded per the OWNER’s start up plan, as soon as practical.

17.13. STROKE-PRESSURE PLOT

17.13.1. The starting test pressure for preparing the stroke-pressure plot (if required per ASME B31.8 Appendix N) is at the discretion of the Testing Director; however, the starting test pressure for the plot shall begin prior or equal to 200 psig below the anticipated ending test pressure or after reaching 80% of the anticipated final test pressure. The test section is to be pressured with the pump operated continuously at the determined stroke rate. It is most important that full attention be given to maintaining a constant pump rate. Observation of a tachometer or counting strokes versus time and small throttle adjustments may be needed to achieve a constant rate. The constant rate shall be maintained throughout preparation of the stroke-pressure plot.

17.13.2. A continuous plot shall be made of pump stroke versus pressure during at least the last 200 psig of pressuring to the anticipated ending test pressure, after reaching 80% of the anticipated final test pressure, or if the pipe properties are unknown. The yield level is defined as that point along the stroke pressure plot at which the number of strokes per pound of pressure rise is equal to twice the number of strokes per pound of pressure rise experienced prior to initial deviation and the yield is determined by using the pressure at the highest elevation within the test section. Pump strokes in excess of that determined for a constant pressure rise could be indicative of a leak. Pump strokes versus pressure shall be indicated as a plot point at 10 psig intervals in whole multiples of 10. Stroke readings shall be indicated at each plot point. Time in hours, minutes, and seconds shall be indicated at the beginning and ending points as well as intermediate points at 50 psig intervals.

17.13.3. **:** Gear ratios and throttle setting for the pressure pump should be set so that speed changes will not be necessary during the plot. The recommended rate of pressure increase during pressuring is 10 psig/minute or less.

17.13.4. The pressure pump should be stopped when double stroking occurs or if a specified maximum test pressure is reached. If double stroking (yielding) occurs before the specified minimum test pressure is reached, the RPR and the Test Director shall determine whether to proceed with increasing the pressure, revising the specified minimum test pressure to the double stroke pressure, or other alternatives such as running a post-test deformation smart pig to detect pipe that has been expanded.

17.14. PRETEST AND ABOVEGROUND TEST

17.14.1. Some sections of the pipeline may require testing prior to installation. Required pre test segments will be specified in the contract documents. Roadway, waterway, and railroad crossings are examples of pipeline sections

that normally require pre-testing. The term pretest is used because the pipe segment, once installed, will be tested again with the connecting mainline or facility piping. An aboveground test has the same purpose of a pretest but differs in that it shall not be tested again with the interconnecting mainline or facility piping once installed. This type of test is used for pipe segments which will be installed in an existing pipeline or connection to an existing facility where the performance of a post installation hydrostatic test is not practical.

17.14.2. The Test Director shall determine the sections for pretest and aboveground test.

17.14.3. The pretest and aboveground test shall begin by filling the section of pipeline with water and, in doing so, making sure provision is made for the elimination of entrapped air by venting at the high elevation of the test section. Additionally, bleeding entrapped air out of hoses leading to instruments; i.e., deadweight gauge, recorders, prior to connecting hoses to said instruments shall be required.

17.14.4. The procedure for a pretest and the aboveground test, which follows, differs somewhat from that of a pipeline relocation or station and terminal test. However, the same care and precautions shall be exercised.

17.14.5. The pretest or the aboveground test shall begin by pressurizing the pipeline section with water to a pressure equal to 60 to 80 percent of the final test pressure, allowing 15 minutes for pressure equalization, then checking for leaks. If the leaks cannot be stopped, bleed off pressure to atmospheric or a safe pressure and change out or repair the source of the leak. Once any leaks have been eliminated, continue pressurizing a pretest section to the required test pressure. Valves, fittings, etc., may be limiting components of the test. Test pressures and ambient temperatures shall be recorded at 10 minute intervals for the first hour and at 15 minute intervals for the remaining test period. A record of bleeding off or pressuring up shall also be taken.

17.14.6. The minimum hold time shall be per applicable regulations (see Appendix A of this standard). The pressure variance shall be as specified in the hydrotest package. If the Test Director is satisfied that no leaks exist, and can equate pressure rise or fall to temperature, the test may be accepted.

17.14.7. Dewatering shall be done by first bleeding the pressure off at either manifold. Environmental protection and safety is important in releasing the pressure and draining the water. Written permission or permits, as required, from state environmental agencies will be secured by the OWNER per section 7.0 of this standard. In the event that the test medium must be discharged into vacuum trucks, provision must be maintained not to allow any of the test medium to flow into any watercourses, including ditches, or into

environmentally sensitive areas. Provision must also be maintained to prevent erosion in the area of the discharge.

17.14.8. The test section shall be pigged, if required, during the dewatering stage to assure that all test water is removed. Especially in the case of the aboveground test, the test section shall be completely dewatered as this section will be tied into an existing facility or pipeline and will not be tested again as would a pre-tested section.

17.15. Acceptable Test Requirements

17.15.1. An acceptable test will have been performed when the following conditions have been met:

17.15.2. The section has been maintained at the desired test pressure (in accordance with the hydrotest package) for the required hold period.

17.15.3. No visible leakage occurs where the entire test section has been visually monitored during the required test period and no unaccountable pressure loss when the test section is not under visual observation.

17.15.4. All hydrostatic test failures shall be documented on Form 4507.

17.16. RECORD KEEPING

17.16.1. A record of each pressure test performed, including records of unsuccessful attempts, shall be created and maintained for the useful life of the facility per OWNER requirements. Only OWNER approved forms shall be used. Forms shall be completely filled in and have the pressure and temperature recording charts attached. All forms must be properly signed and approved. The Project Name, Project Number, and Line Identification are to be included on ALL documentation. At minimum, the following reports shall be provided:

17.17. Final Test Report

17.17.1. A final test report shall be prepared and filed per OWNER required Project Records Management.. The test report shall be retained for the useful life of the pipeline and shall include the originals of all test forms, recorder charts, etc. The OWNER's Project Manager shall be responsible for documenting and filing the test reports and records.

17.17.2. The following information shall be included and clearly labeled with the test report:

17.17.2.1. Recorder serial number.

17.17.2.2. The original pressure chart shall be signed after successful completion of the test by the RPR present during the test.

17.17.2.3. AFE number and name of job.

17.17.2.4. Test reports on plants shall include a piping drawing showing what piping is included in each test.

17.17.2.5. A profile of the pipeline that shows the elevation and test sites over the entire length of the test station.

17.17.2.6. Calibration data and independent party certification of test equipment.

17.17.2.7. Start time and date of "on" test with initial pressure.

17.17.2.8. End time and date of "off" test with final pressure.

17.17.2.9. Description of test section, to include pipe data and test section number.

17.17.2.10. Pressuring, leak test, start of plot (if applicable), and bleed down.

17.17.2.11. Test Site Location and Stations.

17.17.2.12. Pressure of any anomalies on chart with comment.

17.17.2.13. The name of the operator, the name of the person responsible for making the test and the name of the test company used (CONTRACTOR – where applicable).

17.17.2.14. An explanation of any pressure discontinuities, including test failures.

17.17.2.15. In the case of a test failure, location, description, time and date of the failure, failure pressure, cause (if known), method of repair, any metallurgical analysis report and disposition of failed pipe.

17.17.2.16. Description of the test medium, source of the test medium and any additives used with it.

17.17.2.17. Other records as determined by the operator or required by regulation or law.

17.17.3. The following records should also be maintained with the test report following any pressure test:

17.17.3.1. Sketch and/or profile drawing of the pipe or pipeline being tested including equipment location and stationing.

17.17.3.2. ANSI rating for applicable pipeline components in the test segment.

17.17.3.3. Copies of pipe and fitting purchase orders, mill test records, or results of laboratory testing to confirm material composition

17.17.3.4. Straight-line plot of pump strokes per increment of pressure rise during pressurization.

17.17.3.5. Minimum and maximum test pressure and the locations of both in the test segment.

17.17.3.6. Physical description and location of the pressure-limiting component in the test segment.

17.17.3.7. Temperature log and continuous temperature chart showing pipe or test medium temperature versus time.

17.17.3.8. Temperature log and continuous temperature chart showing ambient temperature versus time.

17.17.3.9. Description of the weather during the test (including any changes).

17.17.4. Field Pressure Log

17.17.4.1. Forms shall be signed after successful completion of the test by the OWNER

17.17.4.2. Representative present during the test, thereby certifying that the hydrostatic test was conducted in accordance with this standard. The report must be filled out completely and shall include the disposition of any leaks or failures.

17.17.5. Fill Log

17.17.5.1. Record of water volume added to the pipeline during the filling process shall be maintained if required by the permitting process.

17.17.6. **Analytical Reports:**

17.17.6.1. All analytical laboratory reports and waste disposal records shall be maintained per OWNER requirements.

PRESSURE TEST SPECIFICATIONS FOR FACILITIES SUBJECT TO 49 CFR PART 195 REGULATIONS			
NEW CONSTRUCTION and EXISTING FACILITIES			
		PRESSURES	**PRESSURES**
FACILITY	**DURATION***	**MINIMUM**	**MAXIMUM**
Pipelines, Meter Stations, and Fabrications (notes)	8 hours	To be provided by OWNER	To be provided by OWNER
Above Ground and Pretest	4 hours	To be provided by OWNER	To be provided by OWNER
NOTE: A component other than pipe does not need to be hydrotested if it is the only item being replaced or added to the pipeline system and complete records have been provided to confirm that the component was hydrostatically tested at the mill.			

18. CLEAN-UP AND RESTORATION

18.1. Clean-Up

18.1.1. Right-of-Way, Temporary Access Roads, and Work Space:

18.1.1.1. The CONTRACTOR shall keep the right-of-way clear of litter, skids, defective materials, and all other construction debris to the satisfaction of the OWNER.

18.1.1.2. Upon completion of the backfill, the CONTRACTOR will clean and grade the right-of-way in a neat and acceptable condition, returning the right-of-way to pre-construction conditions. Topsoil, where it has been segregated, shall be backfilled as close as possible to its original location.

18.1.1.3. Private roads used by CONTRACTOR shall be restored to their former condition and to the satisfaction of the RPR and landowner or tenant.

18.1.1.4. Terraces, levees, and watercourses shall be restored to their former condition to the satisfaction of the RPR and landowner or tenant.

18.1.1.5. Unless directed otherwise by the RPR, temporary roadways or access pads along the right-of-way for construction equipment shall be removed and disposed of to the satisfaction of the RPR and landowner or tenant

18.1.1.6. Any rock greater than 3 inches, including loose rock encountered by the grading, trenching, or boring operations and not backfilled according to the specifications, shall be removed from the right-of-way and disposed of at locations and in a manner that is satisfactory to the RPR and the landowners or tenant. CONTRACTOR will acquire written permission if required, from the landowner or tenant to dispose of rock on the property from which it is to be removed by right-of-way agreement.

18.2. Surplus Materials

18.2.1.1. Surplus materials shall be assembled, inventoried, and delivered by CONTRACTOR to a location designated by the OWNER.

18.3. Fences and Gates

18.3.1.1. Fences disturbed by construction shall be restored to their original or better condition in accordance with the Drawings and to the satisfaction of the RPR and landowner or tenant. Gates shall be installed as indicated by the OWNER. The CONTRACTOR shall furnish gates, fencing, and posts.

18.4. Pipeline Markers

18.4.1. Pipeline markers shall be installed at points designated by the OWNER during clean-up operations. Adequate pipeline location markers for the protection of the pipeline, the public, and persons performing work in the area shall be placed over or near each pipeline in accordance with the following:

18.4.1.1. On buried pipelines, markers shall be located at any change in direction, on each side at public road crossings, at railroad crossings, at all navigable water crossings, and in sufficient number along the remainder of the buried line so that the pipeline location and route direction is easily discernable.

18.4.1.2. Markers shall be installed at locations where the pipeline is above ground in areas accessible to the public.

18.4.1.3. In rural operating areas, markers shall be located utilizing line-of-sight spacing, except in agricultural areas or large water crossings such as lakes where line-of-sight spacing is impractical. For liquid pipelines, additional markers must be placed along the pipeline in areas where the pipeline is buried less than 48 inches.

18.4.2. The placement and design of markers is dependent on the purpose, type and local conditions and must meet or exceed the requirements of 49 CFR 192 or 195, as applicable.

18.4.3. The OWNER shall furnish pipeline markers.

18.5. Restrictions

18.5.1. The CONTRACTOR shall at all times complete the clean-up within 10 days of final grade, including fence replacement, signs, test leads, drainage, and terraces.

19. CATHODIC PROTECTION:

19.1. Cathodic protection and test stations: *Refer to Specification 15500*

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