



## **NOTICE TO ALL BIDDERS**

### **TO REPORT BID RIGGING ACTIVITIES, CALL: 1-800-424-9071**

THE U.S. DEPARTMENT OF TRANSPORTATION (DOT) OPERATES THE ABOVE TOLL-FREE "HOTLINE" MONDAY THROUGH FRIDAY, 8:00 A.M. TO 5:00 P.M., EASTERN TIME. ANYONE WITH KNOWLEDGE OF POSSIBLE BID RIGGING, BIDDER COLLUSION, OR OTHER FRAUDULENT ACTIVITIES SHOULD USE THE "HOTLINE" TO REPORT SUCH ACTIVITIES.

THE "HOTLINE" IS PART OF THE DOT'S CONTINUING EFFORT TO IDENTIFY AND INVESTIGATE HIGHWAY CONSTRUCTION CONTRACT FRAUD AND ABUSE AND IS OPERATED UNDER THE DIRECTION OF THE DOT INSPECTOR GENERAL.

ALL INFORMATION WILL BE TREATED CONFIDENTIALLY AND CALLER ANONYMITY WILL BE RESPECTED.

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### **PLANS, PROPOSALS AND ADDENDA**

AFTER AWARD OF CONTRACT, THE LOW BIDDER WILL RECEIVE TEN (10) COMPLIMENTARY SETS OF PLANS, PROPOSALS, AND ADDENDA FOR FIELD AND OFFICE USE. AN ELECTRONIC COPY WILL ALSO BE PROVIDED. ANY ADDITIONAL COPIES REQUIRED WILL BE THE RESPONSIBILITY OF THE CONTRACTOR.

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## NOTICE TO CONTRACTORS

Electronic Bids for this project will be received by the South Dakota Department of Transportation (SDDOT) via the SDDOT secure bid submission site at <http://apps.sd.gov/hc65bidletting/bidsubmittallogin.aspx> until 10 A.M. Central time, on August 13, 2014, at which time the SDDOT will open bids. All bids will be checked for qualifications with results posted on the SDDOT website. The South Dakota Transportation Commission will consider all bids at a scheduled Commission meeting.

The work for which proposals are hereby requested is to be completed: **ON OR BEFORE MAY 27, 2016.**

Work Type for this project is: **Work Type 3.**

All proposals shall be prepared and submitted accordance with the Special Provision of Electronic Bidding Requirements. Any proposal otherwise submitted will be deemed informal, irregular and not subject to or worthy of consideration in the award of the contract.

Plans and the proposal package for the work may be obtained at:  
<http://apps.sd.gov/hc65bidletting/ebslettings1.aspx>

City specifications for the City Utility work are provided and referenced within the advertised contract documents. All work not covered under the City utility specifications shall be completed in accordance with the Standard Specifications for Roads and Bridges, most recent edition. An electronic version of the Standard Specifications for Roads and Bridges may be obtained at <http://www.sddot.com/business/contractors/specs/Default.aspx>

The electronic bid proposal must be submitted by a valid bidder as designated on the [Bidding Authorization Form](#). The Bidder ID and Password, coupled with a previously Department assigned Company ID, will serve as authentication that an individual is a valid bidder and will assure the secure electronic delivery of bid proposals to the Department. This authorization shall remain in full force and effect until written notice of termination of this authorization is sent by an Officer of the company and received by the Department.

No proposal will be considered unless a guaranty in amount of five percent of the total amount of the bid is secured by the Contractor and received by the Department with the bid or prior to opening of the bids. Satisfactory proposal guaranties include certified checks, cashier's checks, bank drafts issued upon a National or State Bank, or a bid bond issued in accordance with the laws of South Dakota. If electronic bid bonds are used, the Contractor is required to submit the bid bond identification number with the Contractor's bid. Unless otherwise specified in the proposal book, the proposal guaranty shall be made payable at sight to the Department of Transportation, State of South Dakota.

The South Dakota Transportation Commission reserves the right to reject any or all Proposals.



SOUTH DAKOTA DEPARTMENT OF TRANSPORTATION, STATE OF SOUTH DAKOTA:

Ladies / Gentlemen:

The following proposal is made on behalf of the undersigned and no others. It is in all respects fair and is made without collusion on the part of any other person, firm or corporation not appearing in the signature to this proposal.

The undersigned certifies that she / he has carefully examined the plans listed herein, the Specifications hereinbefore referred to, the Special Provisions and the form of contract, both of which are attached hereto. The undersigned further certifies that she / he has personally inspected the actual location of the work, together with the local sources of supply and that she / he understands the conditions under which the work is to be performed, or, that if she / he has not so inspected the actual location of the work, that she / he waives all right to plea any misunderstanding regarding the location of the work or the conditions peculiar to the same.

On the basis of the plans, Specifications, Special Provisions and form of contract proposed for use, the undersigned proposes to furnish all necessary machinery, tools, apparatus and other means of construction, to do all the work and furnish all the materials in the manner specified, to finish the entire project **ON OR BEFORE MAY 27, 2016** and to accept as full compensation therefore the amount of the summation of the products of the actual quantities, as finally determined, multiplied by the unit prices bid.

The undersigned understands that the quantities as shown in the Bid Schedule are subject to increase or decrease, and hereby proposes to perform all quantities of work, as increased or decreased, in accordance with the provisions of the specifications, and subject to any applicable special provisions, and at the unit prices bid.

The undersigned understands that the "Total or Gross Amount Bid" as immediately hereinbefore set forth is not the final amount which will be paid if this proposal is accepted and the work done, but that such amount is computed for the purpose of comparison of the bids submitted and the determination of the amount of the contract bond.

The undersigned further proposes to perform all extra work that may be required on the basis provided in the specifications, and to give such work personal attention in order to see that it is economically performed.

The undersigned further proposes to both execute the contract agreement and to furnish a satisfactory contract bond, in accordance with the terms of the specifications, within twenty (20) days after the receipt of notice from the South Dakota Department of Transportation that this proposal has been accepted.



REV. 12/19/13

SPECIAL PROVISIONS

PROJECT NUMBER(S): SSW11 1926( ) PCN: X02D

TYPE OF WORK: UTILITY RECONSTRUCTION AND LANDSCAPING

COUNTY: PENNINGTON

The following clauses have been prepared subsequent to the Standard Specifications for Roads and Bridges and refer only to the above described improvement, for which the following Proposal is made. In case of any discrepancy or conflict between said specifications and these Special Provisions, the latter are to govern.

The Contractor's attention is directed to the need for securing from the Department of Environment & Natural Resources, Foss Building, Pierre, South Dakota, permission to remove water from public sources (lakes, rivers, streams, etc.). The Contractor should make his request as early as possible after receiving his contract, and insofar as possible at least 30 days prior to the date that the water is to be used.

Penny Kutz is the official in charge of the Rapid City Career Center for Pennington County.

**THE FOLLOWING ITEMS ARE INCLUDED IN THIS PROPOSAL FORM:**

**Instruction for Bidders, dated 5/15/14.**

**Special Provision Regarding Combination Bids, dated 7/14/14.**

**Special Provision Regarding the City Portion for Subletting, dated 2/19/14.**

**Section 8B Corrosion Protection – Plastic Pipe Systems**

**Section 03 4100 – Precast Structural Concrete**

**Geotechnical Engineering Report**

Special Provision for Contractor Administered Preconstruction Meeting, dated 4/18/13.

Special Provision for Electronic Bidding Requirements, dated 12/18/13.

Special Provision for Differing Site Conditions, dated 12/19/13.

Special Provision for Suspension of Work, dated 2/13/04

Standard Title VI Assurance, dated 1/15/04.

Special Provision For Implementation of Clean Air Act & Federal Water Pollution Control Act, dated 9/1/97.

Supplemental Specification for Errata, dated 3/3/10.

Supplemental Specification to Standard Specifications for Roads and Bridges, dated 3/3/10.

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**SSW11 1926( ), PCN X02D  
CITY UTILITIES AND LANDSCAPING  
INSTRUCTIONS FOR BIDDERS**

May 15, 2014

- 1) This City Utilities and Landscaping Project will be let and awarded by the South Dakota Department of Transportation.
- 2) Department of Transportation procedures regarding letting and awarding of contracts shall be followed.
- 3) Bidders submitting a bid on this project shall also submit a bid on Project NH 0016(78)67 PCN 01TH, Pennington County. Award of these projects will be to the same bidder based on the total of the two projects.
- 4) A prospective bidder must request any explanation regarding the meaning or interpretation of the bidding package in adequate time to allow a Department reply to reach all prospective bidders before submission of final bid proposals. The bidder will contact the Department by submitting a request for explanation to the project Q&A forum.
- 5) The bid bond shall be made out to the Department of Transportation in accordance with Section 2.8 of the Special Provision for Electronic Bidding Requirements.
- 6) The contract completion date for this project will be the same as specified of Project NH 0016(78)67 PCN 01TH, Pennington County. Any delays in completing this contract will not be a basis for an extension of the contract completion time for PCN 01TH, Pennington County.
- 7) After award of contract, the Contractor shall furnish satisfactory proof of coverage of insurance required. Copies of Certificates of Insurance shall be furnished to the Department of Transportation AND City of Rapid City.
- 8) The contractor is required to schedule and conduct a preconstruction meeting that shall be held jointly with the preconstruction meeting for the state contract. Additionally the contractor is responsible for contacting the city for a list of required submittals upon receiving Notice of Award of the contract.
- 9) Construction engineering for this contract will be performed by the City of Rapid City.
- 10) Payment for this Utilities project will be made to the Contractor by the City of Rapid City.
- 11) The Contractor to whom the work is awarded will be required to give a Performance (Surety) Bond to the City, executed by a reliable and accredited Surety authorized to do business in the State of South Dakota, acceptable to the Council, signed by and "Attorney in Fact" of residence in South Dakota, and in an amount equal to the total of the utilities contract as a guarantee of the full performance and completion of the contract and payment of all labor and all material bills.

A Warranty Bond, or other equivalent surety, in an amount equivalent to ten percent (10) of the total cost of the utilities project shall be provided to the City. The Warranty Bond shall be for two (2) years from and immediately following the completion of said contract and the acceptance thereof by the said City.

Both the Performance (Surety) Bond, and the Warranty Bond shall be made out to the City.

12) Utility specifications to be followed under this contract are the City of Rapid City Standard Specifications for Public Works Construction (2007 Edition), as currently revised, and any Special Provisions, Special Conditions, and/or Detailed Specifications pertaining to this contract.

13) Method of payment under this contract will be as checked below:

- (1) Partial Payments Project **XXXXX**
- ~~(2) Single Payment Project~~

14) Consideration of partial or full payments of materials on site within this contract will be as indicated and checked below:

- (1) Yes - Payments will be considered **XXXXX**
- ~~(2) No - Payments will not be considered~~

a. No payment on stockpiled materials as specified herein shall be made on fuel, hardware(bolts, plates, etc.), supplies, form lumber, false work, perishable materials, or on temporary structures of any kind which will not become an integral part of the finished construction nor on items when unit bid prices are obviously unbalanced as compared to the Engineer's estimated unit prices prepared prior to the letting.

b. No payment shall be made on stockpiled material until it has been tested and approved for use. All material for which an allowance is requested shall be stored in an approved manner in areas where damage from floodwaters is not likely to occur. If, at any time, stored materials are lost or become damaged by floods or in any other manner, the Contractor will be responsible for repair and replacement of such damaged materials. If payment has been made prior to such damage, the amount so allowed, or a proportionate part thereof, shall be deducted from the next partial payment and withheld until satisfactory repairs or replacements have been made.

c. Progress payments for stockpiled materials will be made on the basis of the quantities determined by actual measurement as placed in storage in accordance with the stipulations in these specifications and percentages of Contract unit prices listed.

15) In compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the rehabilitation act of 1973, the age discrimination act of 1975, the Americans with disabilities act of 1990, and other nondiscrimination authorities it is the policy of

City of Rapid City  
300 Sixth Street  
Rapid City, SD 57701-5035

to provide benefits, services, and employment to all persons without regard to race, color, national origin, sex, disabilities/handicaps, age, or income status. No distinction is made among any persons in eligibility for the reception of benefits and services provided by or through the auspices of the City of Rapid City.

If you have any concerns regarding the provisions of services or employment on the basis of disability/handicap you may contact our ADA/Section 504 coordinator at telephone no. (605)394-4110.

- 16) The Contractor shall obtain all applicable permits associated with the project. Building Permit Fees, Drainage Basin Fees, and Inspection and Permit Fees (as covered under Section 13.04.100 for excavations, driveways and patching etc.) shall be borne by the owner. All other fees, taxes and costs shall be borne by the Contractor.

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**STATE OF SOUTH DAKOTA  
DEPARTMENT OF TRANSPORTATION**

**SPECIAL PROVISION REGARDING  
COMBINATION BIDS**

**SSW11 1926( ), PCN X02D  
UTILITY RECONSTRUCTION AND LANDSCAPING  
PENNINGTON COUNTY**

**JULY 14, 2014**

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Bidders submitting a bid on this project **MUST ALSO** submit a bid on project:

**NH 0016(78)67, PCN 01TH**

**URBAN GRADING, STORM SEWER, C&G, SIDEWALK, LIGHTING,  
SIGNALS, PCCP SURFACING, & BRIDGE REHABILITATION  
PENNINGTON COUNTY**

Award of both projects will be to the same bidder based on the total of the two projects.

Work on PCN (01TH) CANNOT be used to meet the DBE Goal established for this project.

After award, the contracts will be administered as entirely separate contracts.

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**STATE OF SOUTH DAKOTA  
DEPARTMENT OF TRANSPORTATION**

**SPECIAL PROVISION REGARDING  
THE CITY PORTION FOR SUBLETTING**

**SSW11 1926( ), PCN X02D  
PENNINGTON COUNTY**

**FEBRUARY 19, 2014**

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This project is being let in combination with State Project Number NH 0016(78)67, PCN 01TH. The provisions of section 8.1 of the Standard Specifications for Roads & Bridges, 2004 ed., requiring Contractor to perform work amounting to not less than 50% of the total contract cost with his own organization does not apply to the work to be performed on this contract.

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**SECTION 8B**  
**CORROSION PROTECTION – PLASTIC PIPE SYSTEMS**

**8B.1 GENERAL**

1.01 WORK INCLUDED

- A. This work consists of furnishing and installing cathodic protection for all water mains, service lines and appurtenances. This includes all equipment, tools, materials, labor and other incidentals to provide a complete system ready for immediate and continuous use. The work includes, but is not limited to the following:
1. Coatings on all ferrous metal (steel, ductile iron, cast iron) piping and fittings;
  2. Galvanic anodes, joint bonds, insulating joints, test stations, and tracer wire to form an electrically continuous piping network;
  3. Labeling, marking, and testing of cathodic protection system.

1.02 RELATED WORK

- A. Not all sections listed in Related Work may be applicable to this contract:
- B. Section 7 - General Conditions
  - C. Section 8A - Water Piping Systems
  - D. Section 9 - Sanitary Sewer
  - E. Section 11 - Utility Excavation and Backfill
  - F. Section 41 - Utility Trench Resurfacing
  - G. Section 56 - Concrete for Incidental Construction (Class M)
  - H. Section 90 - Traffic Control
  - I. Section 112 - Select Granular Backfill
  - J. Section 200 - Controlled Low Strength Material

1.03 REFERENCE STANDARDS

- A. The latest revision of the following minimum standards shall apply to the materials and installation included in this specification, except where more stringent standards are applicable. In case of conflict, the most stringent requirements shall apply.
1. American National Standards Institute (ANSI):
    - a) C80.1-90, Rigid Steel Conduit-Zinc Coated.
    - b) ANSI/NSF Standard 61 Drinking Water System Components – Health Effects
  2. American Society for Testing and Materials (ASTM):
    - a) ASTM -A380, Standard Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems

- b) ASTM A967 Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts
  - c) ASTM B418, Standard Specification for Cast and Wrought Galvanic Zinc Anodes.
  - d) ASTM B843, Standard Specification for Magnesium Alloy Anodes for Cathodic Protection
  - e) ASTM G97, Laboratory Evaluation of Magnesium Anode Test Specimens for Underground Application.
3. American Water Works Association (AWWA):
- a) AWWA C116, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
  - b) AWWA C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
  - c) AWWA C210, Liquid Epoxy Coating System for the Interior and Exterior of Steel Water Pipelines.
  - d) AWWA C213, Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
  - e) AWWA C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
  - f) AWWA C216, Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
  - g) AWWA C217, Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
  - h) AWWA C219, Bolted, Sleeve-Type Couplings for Plain-End Pipe
  - i) AWWA C550, Protective Epoxy Interior Coatings for Valves and Hydrants.
4. National Association of Corrosion Engineers International (NACE),
- a) Recommended Practice SP0169, Control of External Corrosion on Underground or Submerged Metallic Piping Systems.
5. National Electrical Manufacturers Association (NEMA):
- a) I-10, Type R and 4X Enclosures
  - b) TC 2-83, Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
  - c) WC 3-80, Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (R 1986).

- d) WC 5-73, Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (R 1985).
  - e) WC 7-88, Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- 6. National Fire Protection Association, National Electrical Code (NEC), NFPA 70.
  - 7. Occupational Safety and Health Administration (OSHA)
  - 8. Underwriters Laboratories (UL) ANSI/UL 467 "Grounding and Bonding Equipment".

#### 1.04 DEFINITIONS

- A. **Anode:** The electrode or metallic surface location where DC current is discharged into a surrounding electrolyte and corrosion (oxidation with a loss of electrons) occurs in a corrosion cell. The opposite of a cathode.
- B. **Appurtenances or Fittings:** Items including but not limited to valves, fittings, elbows, tees, glands, angles, bends, blow offs, restrained joints, flanges, couplings, spool pieces, miscellaneous piping, tapping saddles, or hydrants, including metallic glands, etc.
- C. **Cathode:** The electrode or metallic surface location where DC current is received or collected from a surrounding electrolyte and protection (reduction with a gain of electrons) occurs in a corrosion cell. The opposite of an anode.
- D. **Cathodic Protection, (Cathodic Protect, Cathodically Protected, etc.):** An electrical method of reducing or eliminating corrosion by making previous anodic areas on a structure surface, turn into a cathode by creating a DC current flow to the structure surface.
- E. **Cathodic Protection Criteria:** The NACE criteria for protected cathodic protection levels of a minimum of -0.85 volt to a copper/copper-sulfate reference electrode or a 100-millivolt polarization shift or more negative (instant off or IR accounted for) in accordance with NACE Standard SPO 0169. Selection of protective criteria per NACE Standard SPO 0169 to be at Engineer's discretion.
- F. **Cathodic Protection System:** Two common cathodic protection methods are galvanic anodes and impressed current cathodic protection systems. A galvanic anode system consists of galvanic anode materials (usually magnesium or zinc) that naturally corrodes or sacrifices itself and does not require an outside power source. An impressed current type system utilizes an outside power source usually a rectifier (that converts AC to DC current) and forces (impresses) current from a number of anodes (or groundbed) through the environment to the structure to be protected.
- G. **Cathodic Protection Station (CPS):** An impressed current cathodic protection installation location usually consisting of a rectifier and groundbed.

- H. **Drain Anode:** A galvanic anode that is installed at foreign pipeline crossing locations with the intent that any interference current be discharged or drained from the affected pipeline by the drain anode.
- I. **Electrically Continuous Pipeline:** A pipeline which has a linear electrical resistance equal to or less than the sum of the resistance (ohms) of the pipe plus the maximum allowable bond resistance for each joint as specified in this section.
- J. **Electrically Continuous Wire:** A wire that demonstrates the ability to conduct current and that has a linear resistance (ohms) equal to or less than printed literature values for the different wire gauges and wire types. Resistance of 1,000 feet of stranded copper wire at 77 degrees F for No. 12 AWG wire is 1.65 ohms and for No. 10 AWG wire is 1.04 ohms.
- K. **Electrical Isolation:** The condition of being electrically isolated from other metallic structures (including, but not limited to, piping, reinforcement, casings, etc.) and the environment as defined in NACE SPO286, The Electrical Isolation of Cathodically Protected Pipelines.
- L. **Exothermic (Thermite) Welds:** A metallurgical method of making electrical connections based on an exothermic reaction, which turns a mixture of copper oxide and aluminum into molten copper using specially designed graphite molds, steel or cast iron (ductile iron) charges, and wire sleeves.
- M. **Ferrous or Metallic Pipe:** Any pipe or fitting made of steel or iron, or pipe containing steel or iron as a principal structural material (such as steel, ductile iron, and cast iron), except reinforced concrete pipe or stainless steel.
- N. **Fasteners:** To include but not be limited to bolts, nuts, washers, T-bolts, tie-rods, restraining devices, etc.
- O. **Foreign Owned:** Any buried pipe or cable not specifically owned or operated by the Owner.
- P. **Functional and Performance Testing:** Tests necessary to demonstrate that installed equipment and systems function as specified and operate in the manner intended. Functional testing is a prerequisite to performance testing for equipment and systems specified to have a performance test.
- Q. **Joint Bonds:** A method of making the pipeline electrically continuous by connecting insulated copper wire(s) or strap(s) across each side of the pipe joint or fitting.
- R. **Lead, Lead Wire, Joint Bonds, Pipe Connecting Wires, Cable:** Insulated copper conductor; the same as wire.
- S. **Manufacturer's Representative:** Employee of manufacturer who is factory trained and knowledgeable in technical aspects of their products and systems.

- T. **Mils Dry Film Thickness (MDFT):** the thickness, expressed in mils, of an applied and cured coating or mastic. Mil is equivalent to 0.001 inch.
- U. **Petrolatum:** A purified mixture of semisolid hydrocarbons obtained from petroleum jelly.
- V. **Petroleum Wax:** A refined mixture of solid hydrocarbons, paraffin in nature, obtained from petroleum. Provided as a refined paraffin wax or microcrystalline wax forms.
- W. **Pin Brazing:** A metallurgical method of making electrical connections based on an electric-arc silver solder brazing method using a specially designed portable brazing unit and gun with a hollow brazing pin containing silver solder and flux.
- X. **Plastic Reference Pipe:** Plastic conduit or pipe placed in soil next to structure to allow a portable reference electrode to be inserted into for structure-to-reference electrode potential measurements.
- Y. **Potential, Structure-to-Reference Electrode Potential** (also structure-to-reference electrode voltage): Common method to determine corrosion protection levels by measuring the difference in voltage (potential) between the subject metallic structure and the electrolyte in which it is buried or submerged, as measured to the standard specified reference electrode (usually a copper/copper sulfate reference electrode) placed in contact with the electrolyte.
- Z. **Polyethylene Encasement:** A flat sheet or tube of polyethylene plastic that is typically 4 or 8-mils thick and meets the requirements of AWWA C105. The polyethylene encasement is a type of loose bonded coating that is wrapped around a ductile iron pipe, fitting, or valve box riser for corrosion protection.
- AA. **Raceways:** Conduit, sheath, plastic or metal pipe, or electrical metallic conduit (EMT) for casing of electrical or cathodic protection cables.
- BB. **Test Station:** Insulated lead wire connections to the structure, which are brought to a test station terminal board or box in order to allow an electrical connection to be made to the structure for location, and corrosion and cathodic protection testing.
- CC. **Tight Bonded Coatings:** A dielectric coating that is bonded or physically attached to the pipe surface.
  - 1. Ductile iron pipe bituminous asphaltic shop coating does not qualify as an approved factory or shop applied tight bonded coating.

#### 1.05 SUBMITTALS

- A. Provide catalog cuts and other information for all proposed products proposed for use that shows compliance of those materials with these Specifications. Contractor submittals shall be made in accordance with Section 7 - General Conditions. In addition the following specific information shall be provided.

- B. Submittal information shall clearly show manufacturer's name and model number of specified item to be provided, not just supplier name, if only supplier name is provided, then entire submittal shall be rejected and a new resubmittal will be required. Materials provided with only supplier's name shall be relabeled with original manufacturer's name, model number, etc., or be returned at Engineer's discretion at no additional cost to Owner.
- C. Contractor shall submit required information on a system-by-system basis with items clearly marked for specific products or models to be used. Indiscriminate submittal of manufacturer's literature only is not acceptable.
- D. Contractor shall submit installation, material, and safety requirements for thermite weld wire or pin brazing type connections.
- E. Contractor shall submit a list of test equipment (make and model) to be provided. Test equipment shall be approved and at project site prior to start of pipe installation.
- F. Contractor shall submit tracer wire continuity test equipment (make and model) and proposed tracer wire continuity test procedure.
- G. Quality Assurance Submittals:
  - 1. Manufacturer's Certificates of Compliance.
  - 2. Field Test Reports.
  - 3. Certificate of Compliance for galvanic anodes. Independent laboratory analysis required.
  - 4. Record Drawings
- H. Submit Certificate of Compliance from fitting and appurtenance manufacturer and supplier verifying that bolting, fasteners, nuts, and washers proposed for the project meet the specifications provided herein.
- I. Contract Closeout Submittals: Special guarantees as specified hereinafter.
  - 1. Submit record drawings and field test report information to Engineer at end of project.
  - 2. The cathodic protection system and corrosion control monitoring systems including but not limited to joint bonding, test stations, insulators, galvanic anodes, etc. shall be fully operational upon completion of pipe installation and a functional test performed prior to acceptance of the project.
  - 3. The tracer wire system including tracer wire access boxes and continuity testing shall be fully operational upon completion of pipe installation. A functional test shall be performed prior to acceptance of the project.

## 1.06 QUALITY ASSURANCE

- A. The Contractor shall provide at all times a thoroughly experienced and competent field foreman, who will be present to supervise this portion of construction at the site. This person shall be responsible for the field test reports and have the authority to represent the Contractor and shall be the point of contact with the Engineer for this section of the specifications.
- B. Functional testing shall be completed by the Contractor only in the Engineer representative's presence on the installed cathodic protection and corrosion protection items.
- C. The final testing shall be completed by the Engineer.

## 1.07 OBSERVATION OF WORK

- A. Provide access to the project site for Owner, Engineer, and manufacturer at all times during installation and to observe finished work.
- B. All materials and installations shall be subject to observation for suitability as the Engineer may elect, prior to, during, or after incorporation into the work. Observation or testing by the Engineer or the waiver of observation or testing of any particular portion of the work shall not be construed to relieve the Contractor of his responsibility to correctly perform the work and testing required in accordance with these specifications and the product manufacturer's recommendations.
- C. The Contractor is in charge of and solely responsible for all of the quality control and final inspections required. Observation of or spot testing by the Engineer or product manufacturer does not meet the quality control inspection requirement or relieve the Contractor from doing the quality control testing required by the product manufacturer, this specification, or the Contractor's quality control program.
- D. The Engineer reserves the right to reject all work that does not meet the minimum requirement of this specification. This may be done either during or after completion of the work, during subsequent observations or testing, warranty inspection testing, or at anytime when discovered during the warranty period.

## 1.08 RECORD DRAWINGS

- A. Contractor shall maintain an accurate record of the cathodic protection devices, tracer wire boxes, and field-coated and/or repair coated pipe segments in redline fashion on a project plan set. Items to include on redline plans includes, but is not limited to:
  - 1. Galvanic anode type, size and as-constructed location to each fitting, valve or other metallic pieces
  - 2. Test station and tracer wire box locations,

3. Tracer wire color coding for each wire segment within the project if different than that provided in this Specification.

#### 1.09 SPECIAL GUARANTEE

- A. The Contractor, corrosion subcontractor, and product manufacturer shall jointly and severally warrant to the Owner and guarantee the work under this section against defective workmanship and materials for a period of two (2) years or longer if required by the General Conditions commencing on the date of final acceptance of the work.
  1. Functional and final testing and warranty inspection(s) of the corrosion protection systems shall be made at the end of the project and within the warranty period, respectively. The Contractor, subcontractor, and/or product manufacturer's representatives at their option if desired may be present during the functional or final testing or warranty inspections by the Engineer and Owner.
  2. Any construction defects identified by the Engineer during energizing and testing or during warranty inspections shall be located and corrected by the Contractor at his sole expense including all additional Engineering time, full time inspection, and re-testing time.
  3. Any defects in the corrosion protection system discovered at or during the functional, final, and/or warranty inspection(s) shall immediately be repaired and retested in a timely manner (repairs starting within 30 days and completed, tested, and approved within 60 days of notice) by the Contractor. All repairs shall be in accordance with the written product manufacturer's instructions as reviewed and approved by the Engineer. Provide the Engineer with a minimum of 5 days advance notice before beginning repairs.
  4. For all repairs, the Contractor shall provide an extended warranty (equal to the original warranty period length) of two (2) years or longer if required by the General Conditions commencing on the date of final acceptance of the repair work.
  5. All repairs or any damage to other work caused by such defects or repairing of the defects including additional Engineering, full-time observation during repairs, and retesting or re-warranty inspections shall be at sole cost to Contractor.

## 8B.2 MATERIALS

### 2.01 GENERAL

- A. All materials specified within this specification shall meet the requirements of this specification section as well as Section 8.A. Materials referenced within specification 8.B do not necessarily imply that the stock material item is in compliance with Section 8.A. The supplier and contractor are responsible for complying with Specifications 8.A and 8.B collectively and in their entirety unless modified by project specific requirements.
- B. The use of a manufacturer's name and model or catalog number is solely for the purpose of establishing the standard of quality and general configuration desired. Products of other manufacturers of equal standard and quality will be considered in accordance with the General Conditions.

### 2.02 MATERIAL SUPPLIERS

- A. Suppliers listed below can usually supply the types of materials specified in this section. Alternate suppliers will be considered, subject to approval of the Engineer. Address given is that of offices in the Western United States; contact these offices for information regarding the location of their representative nearest the project site:
  - 1. Farwest Corrosion Control, Denver, CO (888-532-7937), [www.farwestcorrosion.com](http://www.farwestcorrosion.com)
  - 2. Goudy Engineering, Tucson, AZ (520-298-1104) [www.goudyengineering.com](http://www.goudyengineering.com)
  - 3. Hoff Company, Denver CO (800-736-4546) [www.pipelinesupplies.com](http://www.pipelinesupplies.com)
  - 4. MESA Products, Inc., Tulsa, OK (918-627-3188) [www.mesaproducts.com](http://www.mesaproducts.com)
  - 5. Northland Corrosion Services, Laurel, MT (406-628-2213)
  - 6. Total Corrosion Solutions, Inc., TCS, Billings, MT (406-248-6985).

### 2.03 WIRES

- A. All cathodic protection wires, joint bond wires, bonding cables, leads, and cables provided shall be insulated **STRANDED** copper wire. Wire size, type, and insulation type as specified in this section. Wire shall conform to applicable requirements of NEMA WC 3-80, WC 5-73, and WC 7-88.
  - 1. Tracer wire materials specification is included under TRACER WIRE.
- B. Joint Bonds:
  - 1. General: Type of joint bonds shall depend on pipe joint coating and shall be either:
    - a) Insulated copper joint bond wires for all pipe joint bond locations.

- b) Metallic Fitting Pigtail Bond Wires shall be No. 12 AWG single-conductor, stranded copper wire with 600-volt, TW, THWN, THHN or HMWPE insulation.
  - 1) Provide with a sleeve on each end of No. 12 AWG metallic fitting pigtail bonding wire used for bonding of metallic fittings including but not limited to fittings, valves, couplings, mega-lugs, metallic fitting glands or restraint rings, etc. for metallic and plastic pipe.
- 2. Insulated Joint Bond Wires: Provide joint bond wires consisting of single-conductor, stranded insulated copper wire. Supply all joint bonds complete with a formed copper sleeve on each end of the wire. Wire conductor for field-applied sleeves shall extend 1/4 inch beyond end of copper sleeve. End of factory formed copper sleeves shall be angled so as to allow end of wire to be exposed to thermite weld material.
  - a) Wires equal to or smaller than No. 10 AWG shall be provided with 600-volt, TW, THWN, THHN or HMWPE insulation.
  - b) All other joint bond wires larger than No. 10 AWG wire shall be provided with 600-volt high molecular weight polyethylene (HMWPE) insulation.
- 3. Bond Lengths: Length of bond strap and joint bond wire may have to be increased for different pipe size and joint type per pipe manufacturer's recommendations so as to provide sufficient slack (one (1)-inch minimum on each end or two (2)-inches total for pipe or joint movement between each thermite weld connection.
  - a) For Pipe Diameters larger than 16-inch:
    - 1) For Push-on, Mechanical, or Flanged Joints: No. 2 AWG wires, 18-inches long minimum.
    - 2) For Flexible Coupling Joints: No. 2 AWG wires, 24-inches long minimum, with two 12-inch long minimum insulated No. 12 AWG wire pigtails.
    - 3) Smaller couplings than 24-inch OD pipe may allow shorter lengths. Contractor shall confirm that bond wire length supplied provides a minimum of one inch slack on each end for a total of two inches of slack.
      - A) Bond wires with pigtail wires can be utilized at flexible couplings, fitting or valve locations. The pigtail wires shall be bonded to the fitting or valve body.

- B) For multiple piece fittings, No. 12 AWG pigtail wires shall be utilized to bond different pieces to pipe. Pigtail wire length shall be as required.
    - 4) For Insulated Flexible Coupling Joints: No. 2 AWG insulated copper wire, 18-inch long minimum, with one 12-inch long minimum No. 12 AWG wire pigtail.
  - b) For pipe smaller than 15-inch diameter, Contractor may utilize No. 4 AWG wire size instead of No. 2 AWG wire size.
  - c) Acceptable pre-made insulated copper joint bond wires are available from:
    - 1) J-Four Pipeline Products (Hoff Company), (800-331-3404), Broken Arrow, OK, [www.pipelinesupplies.com](http://www.pipelinesupplies.com);
    - 2) Erico Products Inc. (Cadweld - 800-753-9221) Solon, OH, [www.erico.com](http://www.erico.com);
    - 3) ThermOweld® (800-558-1373), Tulsa, OK, [www.thermoweld.com](http://www.thermoweld.com);
    - 4) Or approved equal.
- C. Pump Station, Vaults, Test Station, and Cross Bond Pipe Connecting Wires:
- 1. Single-conductor, No 2 AWG, No. 4 AWG, No. 6 AWG, and No. 8 AWG cathodic protection cables shall be single-conductor, stranded copper wire with 600-volt high molecular weight polyethylene (HMWPE) insulation.
    - a) Insulation shall be 7/64-inch (110 mils) minimum thickness in accordance with ASTM D 1248, Class C, Grade 5.
  - 2. Bonding of buried and abovegrade appurtenances may be required to minimize stray current, safety hazards, and corrosion effects (e.g., bonding through a vault).
- D. Test Wires:
- 1. No. 12 AWG wire for prepackaged galvanic anode and No. 12 AWG test leads and No. 12 AWG and No. 14 AWG reference electrode lead wires shall be single-conductor, stranded copper wire with 600-volt, TW, THWN, THHN or HMWPE insulation.
  - 2. No. 2, No. 4, No. 6, or No. 8 AWG leads shall be single-conductor, stranded copper wire with 600-volt, HMWPE insulation.
- E. Wire Identification:

1. Wire insulation color shall indicate the function of each wire and shall be as follows:
  - a) Pipeline test wires:
    - 1) Water Pipeline: Blue.
      - A) Test wires for water systems of different pressure zones shall be uniquely identified by the following color combinations on transmission mains and at zone separation valves only:
        - i. High Level: Blue with 1 strip of Blue tape
        - ii. Low Level: Blue with 1 strip of White tape.
    - 2) Foreign Pipeline: White or as requested by Foreign pipeline company.
    - 3) Unprotected Pipe (not cathodically protected): Black. (e.g., pump station side of metallic pipe).
  - b) Casings: Orange.
  - c) Anode lead wires: Black.
  - d) Reference electrode wires: Yellow.
  - e) Coupon wires: Green
    - 1) Pair of leads to protected coupon (one strip of white tape)
    - 2) Pair of leads to unprotected coupon (one strip of black tape)
  - f) Tracer wires on plastic, concrete, or non-metallic pipe:
    - 1) Blue with two strips of black tape.
    - 2) Color code tracer wire by project pressures and direction with tape strip(s) as noted below:
      - A) Project Pressures (for transmission main projects and at zone separation valves only):
        - a. Higher pressure – one strip of BLUE tape
        - b. Lower pressure – one strip of WHITE tape
        - c. Or as directed in the plans.
      - B) Direction:
        - a. North (1 Strip) and West (2 Strips) PURPLE tape.
        - b. South (1 Strip) and East (2 Strips) GRAY tape.

## 2.04 THERMITE WELD MATERIALS

- A. Electrical connection of copper wire or copper strap to metallic (steel, ductile iron, and cast iron) fittings, pipe, and structures shall be by the thermite weld method. The thermite weld materials shall be UL listed to ANSI/UL 467.

- B. The thermite weld metal shall consist of a mixture of copper oxide and aluminum material ignited by magnesium starting powder with a spark or by an electronic type ignition. Thermite weld materials shall be designed for connection of copper to steel or ductile iron and cast iron surfaces. The materials and exothermic process shall provide a completed permanent type connection that will not loosen or develop high resistant connection points and have a resistance equal to or lower than the strap or wire, be durable, be corrosion resistant, and have a high adhesion connection to both the surface and strap or wire.
- C. Supply the proper size and type of wire sleeves, cartridges, and welder molds as required for each type of connection and pipe material in accordance with the thermite weld manufacturer's written recommendations.
  - 1. Material and equipment shall be from the same manufacturer and utilized throughout the entire project.
  - 2. Weld materials from different manufacturers shall not be interchanged.
- D. The individual thermite weld metal charges shall be sealed in a moisture-resistant plastic container (tube or cartridge) with tight fitting caps with the separate steel disks in a prepackaged sealed container. The starting (ignition) material shall be packed in the bottom of the tube with the weld material on top or for the electrical ignition type intermixed as required. The individual plastic containers shall be packed in sealed boxes so as to protect the individual containers and keep their contents dry. The size (weight in grams) and type of the charge shall be clearly marked on the plastic package and individual sealed containers.
- E. Provide type of charges required for each pipe, fitting, or structure base material.
  - 1. Provide steel charges for steel materials. Charge (cartridge) size shall be minimum of 15 grams and maximum of 25-grams for steel materials.
    - a) Cadweld F-33 (Green Top) or Thermoweld P Standard Powder;
    - b) Electronic ignition materials:
      - 1) Cadweld Plus CA15PLUS33 with black top or CA25PLUS33 with red top, or
      - 2) ThermOweld EZ Lite Remote with suitably sized Thermoweld P Standard Powder Charges;
    - c) Or approved equal.
  - 2. Provide cast iron charges for all ductile iron and cast iron materials. Charge (cartridge) size shall be a minimum of 25 grams and maximum of 32-grams for ductile and cast iron materials.
    - a) Cadweld XF-19 (Orange top) or Thermoweld CI Cast Iron Powder;
    - b) Electronic ignition materials:

- 1) Cadweld Plus CA25PLUSXF19 with red top or CA32PLUSXF19 with white top, or
  - 2) ThermOweld EZ Lite Remote with suitably sized Thermoweld CI Cast Iron Powder Charges;
  - c) Or approved equal.
3. Minimum cartridge size for strap bonds shall be 25 grams for 1/2-inch and 5/8-inch diameter hole sizes to steel and 32-grams for 5/8-inch diameter holes for ductile iron pipe per manufacturer's recommendations.
- F. Welder molds shall be graphite molds sized for each type and size of charge and pipe size and type to be used as recommended by the cadweld manufacturer. Each mold shall have permanent identification showing manufacturer's name, mold part number, wire size, and weld metal type and size.
1. Ceramic "One-Shot" molds will not be acceptable.
  2. Special welders and materials are required for copper strap, formed joint bond wires, and flexible coupling bonds.
  3. Vertical type connections require special welders and materials as recommended by the weld manufacturer.
- G. For horizontal type connections to smaller pipe and fitting sizes, different molds to match the different pipe curvature are required according to the manufacturer's recommendations. These molds for small pipe sizes shall be identified by each pipe diameter.
1. For steel pipe and fittings, different molds are required for pipe up to 3-1/2-inch diameter. Different steel mold sizes are required for 4-inch and 6-inch to 8-inch pipe sizes. For steel pipe ten-inch (10") or larger, flat steel molds can be used.
  2. For ductile iron or cast iron pipe and fittings, different size of molds are required for different pipe diameters up to 24-inch. The molds must be obtained for each pipe size to be welded.
- H. Electronic Ignition Connections
1. Cadweld Plus Exothermic or ThermOweld's EZ Lite Remote:- Connections with prepackaged containers with electronic type ignition can be substituted for standard cadweld spark type ignition connections provided that equal or better low resistance, durability, adhesion, and performance characteristics are proven.
  2. Electronic type ignition materials shall be able to be used in standard graphite molds for wire and strap type connections for each structure type and size.

3. Manufacturer shall provide a reference table with corresponding molds and charge sizes and types.
  4. Spark type and electronic ignition type materials from different manufacturers shall not be intermixed.
- I. Weld mold sealer shall be heavy duty, clay-like, mold sealer putty material, specially designed for that use.
1. Acceptable sealer putty brands include:
    - a) Electrical Duct Seal manufactured by Ideal Industries;
    - b) Duct Seal Compound manufactured by Gardner Bender;
    - c) CADWELD® Mold Sealer by Erico® Products, Inc.;
    - d) Or approved equal.
- J. Cleaning wheels shall be self-cleaning and leave no resin or residue on surface to be bonded to *as recommended by the weld manufacturer*.
1. The use of resin, rubber, or shellac-impregnated type grinding wheels are not recommended by the weld material manufacturers and shall not be used.
- K. Mold cleaner shall be type and size recommended by weld manufacturer for each type of graphite weld mold being used.
- L. Adapter Sleeves:
1. Install adapter sleeves for all No. 10 AWG and No. 12 AWG wires. Provide sleeve type as recommended by thermite weld manufacturer and attach in the field.
  2. Install adapter sleeves for all No. 4 AWG and No. 2 AWG wires. Premade factory sleeved wires or wires with sleeves made in the field with the appropriate sized sleeves and hammer die are acceptable.
    - a) Factory formed sleeves shall be beveled to allow molten thermite weld material to directly contact wire.
    - b) Field formed sleeves shall be attached with the appropriate sized and type of hammer die with method as recommended by the thermite weld manufacturer. Wire conductor for field installed adapter sleeves shall extend 1/4 inch beyond end of the sleeve to allow molten thermite weld material to directly contact wire.
  3. Table 8B.1 presents sleeve and hammer die information for Erico® Cadweld® and ThermOweld® products.

**Table 8B.1. Sleeved Thermite Weld Materials – Horizontal Connections**

STRANDED TEST LEAD OR BOND WIRE SIZE	CADWELD®		thermOweld®	
	SLEEVE MODEL No.	HAMMER DIE MODEL No.	SLEEVE MODEL No.	HAMMER DIE MODEL No.
No. 12 AWG	CAB-133-1H	Crimped	38-0200-00	Crimped
No. 10 AWG	CAB-133-1H	Crimped	38-0201-00	Crimped
No. 4 AWG	CAS-20-F	CAD-11	38-0204-00	38-4859-00
No. 2 AWG	CAS-09-F	CAD-09	38-0203-00	38-0310-00

M. Thermite weld materials are available as specified from:

1. Erico® Products Inc. (CADWELD® - 800-248-9353) Cleveland, OH;
2. ThermOweld® – 800-558-1373, Tulsa, OK;
3. Or approved equal.

N. Thermite Weld Mold, Charge and Size for pipes LARGER than 8-inches in diameter are provided in Table 8B.2:

**Table 8B.2. Thermite Weld Mold, Maximum Charge Size and Type for Diameters Greater than 8 Inches**

CONDUCTOR SIZE	CADWELD®			thermOweld®		
	SLEEVE #	MOLD #	MAXIMUM CHARGE TYPE AND SIZE	SLEEVE #	MOLD #	MAXIMUM CHARGE TYPE AND SIZE
No. 12 AWG	CAB-133-1H	CAHBA-1G-PS	CA25XF-19	38-0200-00	M-156	25CI
NO. 10 AWG	CAB-133-1H	CAHBA-1G-PS	CA25XF-19	38-0201-00	M-7351-PS	25CI
NO. 8 AWG	N/A	CAHBA-1G-PS	CA25XF-19	38-0201-00	M-7351-PS	25CI
NO. 6 AWG	N/A	CAHBA-1G-PS	CA25XF-19	38-0202-00	M-7352-PS	25CI
NO. 4 AWG	CAS-20-F	CAFCA-1L-PS	CA32XF-19	38-0204-00	M-154-PS	32CI
NO.2 AWG	CAS-09-F	CAFCA-1V-PS	CA32XF-19	38-0203-00	M-175-PS	32CI

**2.05 THERMITE WELD REPAIR COATING**

A. One Hundred Percent (100%) Epoxy Repair Coating

1. Field repair material shall be fast cure, high build, low temperature (cure down to 0° F.), moisture tolerant (cure underwater), one-hundred (100)-

percent epoxy material that can be distributed in a two component repair cartridge tubes with a dispensing gun.

2. Repair coating shall be compatible with original pipe or fitting coating and exhibit minimum 2,000 psi adhesion values.
3. Acceptable field epoxy repair type coatings are:
  - a) Denso North America Protal 7125 Repair Cartridge;
  - b) CANUSA-CPS HBE-95 WG high build epoxy;
  - c) Or approved equal.

## 2.06 EASY BOND PIN BRAZING

- A. Pin Brazing for joint bond and test wire connection to dielectric lined pipe offers lower temperature, less weather restrictions, and greater versatility in connection locations.
  1. Only direct type pin brazing connections to pipe or fitting shall be utilized, no threaded bolt and nut type connections shall be allowed. Direct type pin brazing connection shall be sized as required to meet specified test wire or joint bond wire and strap size. Consult pin brazing manufacturer for recommended direct metal type connection sizes.
- B. Wire ring tongue terminal pin brazing connectors to bond or test lead wires shall be crimped and silver-soldered for all pin brazing type wire connections.
- C. Pin brazing connections can be made directly to suitable sized punched copper straps.
- D. Pin brazing system for cathodic protection connections shall consist of direct type pin brazing pins connected with a BAC pin brazing system are available from
  1. Farwest Corrosion Control Company;
  2. GMC Electrical, Inc.;
  3. Hoff Company, Inc.;
  4. Mesa Products;
  5. Or approved equal.

## 2.07 GROUND CLAMPS

- A. Heavy duty all bronze ground clamps for wire connections to copper service pipe shall be sized to fit the pipe and wire and UL 467 listed for direct burial in earth or concrete. All parts of the clamp shall be bronze including bolts and nuts, as manufactured by
  1. Burndy, LLC;

2. EMERSON Industrial Automation (formerly O. Z. Gedney);
3. Thomas and Betts;
4. Or approved equal.

2.08 GALVANIC ANODES

A. Magnesium Anode:

1. High-Potential Magnesium Composition for buried soil applications shall be cast of primary magnesium and meet or exceed ASTM B843 Grade with Alloy M1C chemical requirements as shown in Table 8B.3:

**Table 8B.3 High-Potential Magnesium Anode Composition**

ELEMENT	CONTENT
Aluminum (Al)	0.010% maximum
Manganese (Mn)	0.500% to 1.300%
Copper (Cu)	0.020% maximum
Silicon (Si)	0.050% maximum
Iron (Fe)	0.030% maximum
Nickel (Ni)	0.001% maximum
Total Others	0.050% each or 0.300% maximum total
Magnesium (Mg)	Remainder

2. Prepackaged Magnesium Anode Dimensions:
  - a) The anode size and weight may differ slightly because of variations in casting and mold shapes, but shall be the manufacturer's standard and should approximate the characteristics in Table 8B.4:

**Table 8B.4 High-Potential Magnesium Anode Dimension Characteristics**

BARE ANODE SIZE	17 POUND ANODE	32 POUND ANODE
Shape	17D3	32D5
Bare Anode Nominal Dimensions	3 inches by 25 inches long minimum	5 inches by 20 inches long minimum
Packaged Weight	42 pounds minimum	68 pounds minimum
Nominal Package Size	6 inch diameter by 29 inches long minimum	7 inches by 28 inches long minimum

3. Magnesium anodes shall be verified with a third party ASTM G97 tests for quality control and meet the following minimum requirements:
  - a) Minimum Open Circuit Potential shall be -1.7 volts or more negative to a copper/copper sulfate reference electrode.
  - b) Minimum current efficiency shall be 50-percent (50%) efficiency or higher or a minimum 500 amp hours or higher.
  - c) Anode suppliers (distributors) shall provide anode manufacturing certificates, manufacturing quality control testing results, and supplier's own third party ASTM G97 test results for each batch of anodes supplied for project.
  - d) The minimum current efficiency should be in the range of 48 to 52 percent. If any anodes provided for the project do not pass this or other minimum specified ASTM G97 requirements, then all anodes supplied in that batch or lot shall be rejected and replaced at no cost to the Owner.
  
4. Acceptable High Potential Magnesium Anodes are:
  - a) MAXMAG by Interprovincial Corrosion Control Company (ICCC), Lewiston, NY, 800-699-8771, [www.rustrol.com](http://www.rustrol.com);
  - b) MESA High Potential Magnesium Anodes, MESA Products, 888-800-6372, [www.mesaproducts.com](http://www.mesaproducts.com);
  - c) UltraMag High Potential Magnesium Anode, Farwest Corrosion Control Company, 888-532-7937, [www.farwestcorrosion.com](http://www.farwestcorrosion.com);
  - d) Or approved equal.

B. Zinc Anode:

1. Zinc anodes for buried soil conditions shall meet the requirements of ASTM B 418, Type II, as shown in Table 8B.5.

**Table 8B.5 Zinc Anode Composition**

<b>ELEMENT</b>	<b>CONTENT</b>
Aluminum (Al)	0.0050% maximum
Cadmium (Ca)	0.0030% maximum
Iron (Fe)	0.0014% maximum
Lead (Pb)	0.0030% maximum
Copper (Cu)	0.0020% maximum
Zinc (Zn)	Remainder

2. Prepackaged Zinc Anode Dimensions

- a) The anode size and weight may differ slightly because of variations in casting and mold shapes, but shall be the manufacturer's standard and should approximate the characteristics provided in Table 8B.6.

**Table 8B.6 Zinc Anode Dimension Characteristics**

<b>BARE ANODE SIZE</b>	<b>18 POUND ANODE</b>	<b>30 POUND ANODE</b>
Shape	ZUR-18	ZUR-30
Bare Anode Nominal Dimensions	1.4 inches by 36 inches long minimum	2 inches by 30 inches long minimum
Nominal Package Dimensions	5 inch diameter by 42 inches long minimum	5 inches by 38 inches long minimum
Packaged Weight	70 pounds minimum	70 pounds minimum

C. Prepackaged Galvanic Anode General Requirements:

1. Anode Wire: Supply each anode with No. 12 AWG stranded copper wire with TW, THWN, THHN or HMWPE TW, THWN, THHN or HMWPE insulation, 10 feet long minimum.
  - a) Provide longer anode leads as required for test stations to extend splice free from anode to test station location.
    - 1) Lead wire shall be coiled and bound.
2. Wire-to-Anode Connection: The anode connection shall be stronger than the wire. The galvanic anode material shall be cast around a galvanized steel wire, strap, or pipe core. The anode lead wire connection to the steel core shall be silver-soldered (45% silver) by the manufacturer's standard process and be stronger than the wire. Connection of lead wire to anode shall be electrically insulated with manufacturer's standard waterproof epoxy or electrical potting compound type insulation.
3. Prepackaged Anode Backfill: Backfill shall have a grain size so that 100 percent is capable of passing through a 20-mesh screen and 50-percent will be retained by a 100-mesh screen. The backfill mixture shall be thoroughly mixed and firmly packaged around the galvanic anode within the cloth bag or cardboard tube by means of adequate vibration. The complete packaged galvanic anode shall weigh a minimum of 2.0 times the bare anode weight. The quantity of backfill shall be sufficient to cover all surfaces of the anode to a depth of 1-inch.

4. Packaging and Shipping: Bare anodes shall be centered in cotton bag filled with specified backfill. Provide anode packaged in and shipped and stored in waterproof plastic or heavy multi-walled paper bag of sufficient thickness to protect the anode, wire, backfill, and cloth bag.
5. Compliance Statement: Furnish an independent laboratory analysis certifying that all anode and backfill material supplied meets the requirements of this Specification and specified laboratory testing.
6. Field Verification: At Engineer's option, a galvanic anode may be selected at random for Contractor to provide an independent laboratory analysis on to demonstrate that both anode and backfill material supplied meets the requirements of this Specification.
7. Prepackaged Galvanic Anode Backfill Composition is provided in Table 8B.7.

**Table 8B.7 Prepackaged Galvanic Anode Backfill Composition**

ELEMENT	CONTENT
Ground Hydrated Gypsum	75 Percent
Powdered Wyoming Bentonite	20 Percent
Anhydrous Sodium Sulfate	5 Percent

## 2.09 CATHODIC PROTECTION TEST STATIONS

### A. Flush Mounted Test Stations

1. Flush mounted test stations shall be standard unless specifically indicated on the plans.
2. Test Box: Traffic H-10 load rated concrete body cast with a cast iron ring, with a minimum weight of 55 pounds and minimum dimensions of 10-inch inside diameter and 12-inches long.
  - a) Furnish with locking metallic ring extensions as required to penetrate concrete or pavement surfaces by 4-inches minimum.
  - b) Furnish with a minimum 12-pound cast iron lid with the letters "TS" or words "CP Test", "Test Station" or similar words cast into the lid.
  - c) Test Boxes shall be:
    - 1) Model 3RT Traffic Valve Box by Brooks Products, [www.brooksproducts.com](http://www.brooksproducts.com);

- 2) Model G3 Traffic Valve Box by Christy Concrete Products, [www.oldcastleprecast.com](http://www.oldcastleprecast.com);
  - 3) Or approved equal.
3. Terminal Block: Plastic or glass-reinforced, 1/4-inch thick laminate terminal board with minimum dimensions of 3-inches by 4-inches.
- a) Furnish terminal block with a minimum of seven (7) terminals. Terminal nuts and studs shall be 1/4-inch with double nuts for securing the studs to the terminal board.
  - b) Terminal nuts, studs, flat and lock washers shall be nickel-plated brass, bronze, or Series 300 stainless steel.
  - c) Terminal board shall not be connected to flush test station cap or be constructed in a manner that will accidentally allow wires to be shorted together through terminal board.
  - d) Manufactured seven terminal test boards shall be:
    - 1) CP Test NM-7 by Bingham & Taylor ;
    - 2) Flush Fink 7 by COTT Manufacturing;
    - 3) Or approved equal.

B. Shunts:

1. Shunts for test stations shall be:
  - a) Holloway Type RS 0.01 ohm manganin wire shunt with 6 amp capacity by Holloway Shunts;
  - b) Yellow CP Shunt (0.01-ohm shunt with 8 amp capacity) by M.C. Miller Company;
  - c) Yellow CP Shunt (0.01-ohm shunt with 8 amp capacity) by COTT Manufacturing;
  - d) Or approved equal.

## 2.10 MISCELLANEOUS REFERENCE MONITORING EQUIPMENT AND MATERIALS

- A. Reference electrodes shall only be used at locations specifically indicated in the plans or as directed by the Engineer.
- B. Prepackaged Copper/Copper Sulfate (CU/CUSO<sub>4</sub>) Reference Electrodes:
  1. Permanent reference electrode for buried piping locations shall be a copper/copper sulfate reference electrode. Reference electrode dimensions shall be approximately 1.5-inches in diameter by 6-inches long. Reference electrode shall be suitable for permanent installation

and designed for a 15-year minimum life expectancy with an accuracy of plus or minus 5-millivolts.

2. Electrode manufacturer shall warrant electrode for 15-year design life and provide both labor and material replacement, if electrode becomes unstable by more than 20 millivolts during design life.
  3. Electrodes shall be supplied prepackaged in a permeable cloth bag containing manufacturer's special low-resistivity backfill mixture formulated to retain moisture and maintain electrode stability. Outside dimensions of electrode package shall be approximately 6-inches in diameter by 14-inches long.
  4. Supply electrode with a lead wire attached and electrically insulated with the manufacturer's standard connection. The connection shall be stronger than the wire. Lead wire shall be single conductor No. 14 AWG or larger stranded copper wire insulated as specified under WIRE, this section. Lead wire shall be of sufficient length (minimum 50') or longer as required to reach splice free from reference electrode to test station. Lead wire shall be coiled and bound.
  5. Package cloth bag with reference electrode in and shipped and stored in waterproof plastic or heavy paper bag of sufficient mil thickness to protect the electrode, wire, backfill, and cloth bag.
  6. Acceptable  $\text{CU/CUSO}_4$  reference electrodes can be obtained from:
    - a) FWCC Series SP-150 by Farwest Corrosion Control Company;
    - b) STAPERM Model CU-1-UGPC by GMC Electrical, Inc.;
    - c) Model UL CUG LongLife Reference Electrode by Electrochemical Devices, Inc.;
    - d) Or approved equal.
- C. Plastic Reference Monitoring Pipe shall be a three-inch (3") minimum diameter Schedule 40 PVC plastic pipe with a threaded pipe cap provided at test stations as shown on the Drawings or called out in the test station schedule. Plastic reference monitoring pipe at flush test stations shall not require a threaded cap.

## 2.11 CONDUIT, LOCKNUTS, AND STRAPS

- A. The minimum conduit size shall be 1-inch diameter unless otherwise indicated on Drawings or specified.
- B. Use intermediate metal conduit, including couplings, elbows, nipples, and other fittings, hot-dipped galvanized and meeting the requirements of UL and the NEC.
  1. Do not use setscrew type couplings, elbows, and nipples unless approved by the Engineer.

- C. Heavy wall rigid PVC conduit shall be Schedule 40, UL listed for concrete-encasement, underground direct burial, concealed and direct sunlight exposed use.
  - 1. Use conduits, couplings, elbows, nipples, and other fittings meeting the requirements of NEMA TC and TC 3, Federal Specification W-C-1094, UL, NEC, and ASTM specified tests for the intended use.
- D. Flexible metal conduit shall be UL listed, liquid-tight flexible metal conduit consisting of galvanized steel flexible conduit covered with an extruded PVC jacket and terminated with nylon bushings or bushings with steel or malleable iron body and insulated throat and sealing O-ring.
- E. Locknuts, two-hole straps, and other miscellaneous hardware shall be galvanized steel.
  - 1. Galvanized items shall be hot-dipped galvanized in accordance with ASTM A153.
  - 2. Galvanized hardware shall not be used underground or in immersion service.
- F. Conduit bushings shall be threaded plastic or plastic-throated galvanized steel fittings.

## 2.12 WIRE CONNECTIONS AND SPLICE MATERIALS

### A. Compression Connectors:

- 1. Compression connectors for in-line, multi-splices, and tap splices shall be "C" taps made of conductive wrought copper, sized to fit the wires being spliced.
- 2. Compression connectors shall be applied with the crimp tool and die recommended by the manufacturer for the wire and tap connector size.
- 3. Acceptable Type "YC" wire compression connectors as manufactured by
  - a) Burndy, LLC;
  - b) Thomas and Betts;
  - c) Or approved equal.
- 4. Inline "butt" type wire splice connectors or wire nuts are **NOT** acceptable.
- 5. Split bolts are acceptable only if silver soldered after a physical connection is made and both the wires are equal to or smaller than No. 10 AWG size.
- 6. Silver Brazing Alloy:

- a) Brazing Alloy with minimum 15 percent silver content, 1185° to 1300° F melting range.
  - b) Provide suitable silver brazing alloy and flux recommended by manufacturer for materials being connected (i.e. copper to stainless steel, copper to steel, and/or copper to copper, etc.).
- B. Splices shall be made with suitably sized copper compression connectors and insulated with either a hand tape system, with a specially formulated splicing kit, or with an epoxy splice kit depending on wire size.
- 1. Smaller wires (equal to or smaller than No. 8 AWG) can be repaired with tape, or insulated with a specially fabricated splicing kit, or made with an approved epoxy insulated splice kits.
  - 2. Insulation damage or splices to large cathodic protection cables (No. 4 AWG or larger) shall only be made with an approved epoxy type splice kit.
  - 3. Electrical Splicing Tapes and Sealers: Tape for wire splice insulation shall be UL and CSA approved, cold and weather resistant, highly elastic, with a high dielectric strength and highly resistant to sun, water, oil, acids, alkalis, and corrosive chemicals.
  - 4. Tapes and electrical sealers shall be suitable for moist or wet environments and may include the following:
    - a) Rubber High Voltage Electrical Tape: Linerless 30 mil rubber high voltage splicing tape suitable for splicing cables through 69kV
      - 1) Scotch Professional Grade Linerless Rubber Splicing Tape 130C by 3M Products;
      - 2) Plymouth L969 Plyvolt Linerless EPR High Voltage Tape by Plymouth Bishop;
      - 3) Or approved equal.
    - b) High Voltage Vinyl Electrical Tape: All weather, minimum 7 mil thick, vinyl electrical tape suitable for cable splices up to 600 volts
      - 1) Scotch Super 33+ Vinyl Electrical Tape as 3M Products;
      - 2) Plymouth Premium 111 Black Vinyl Plastic Electrical Tape by Plymouth Bishop;
      - 3) Or approved equal.
    - c) Filler Tapes: Low voltage rubber filler tapes or putties that can be wrapped, stretched or molded around irregular shapes for quick, smooth insulation build-up to insulate connections up to 600 volts for topcoating with vinyl electrical tapes

- 1) Scotchfill by 3M Products;
  - 2) Plymouth 125 Electrical Filler Tape by Plymouth Bishop;
  - 3) Or approved equal.
- d) Electrical Coating Sealer: Electrical coating for sealing tape insulation on splices in severe conditions, suitable for direct burial, direct water immersion, and above grade applications
- 1) Scotchkote Electrical Coating by 3M Company;
  - 2) Or approved equal.
5. Specially formulated splicing kit shall consist of an elastomeric insulating compound that seals and waterproofs connection area with a resin-impregnated, moisture-cured fabric bandage shell such as Royston SpliceRight Splicing Kit available from Chase Industries.
6. Epoxy Splice Kits: Epoxy splice kit shall be type suitable for abovegrade and buried applications and rated for non-shielded cables up to 5 kV and multi-conductor cables through 1,000 volts.
- a) Splice kit shall consist of snap together plastic mold sized to fit around splice, funnels, tape for sealing ends of mold, and two-part epoxy resin in a single pouch for mixing.
  - b) Epoxy resin shall be electrical insulating low viscosity type that will harden (cure) quickly with time.
  - c) In-Line type splice insulating kit for insulation repair shall be epoxy resin, 3M Company Scotchcast Series 82; Plymouth Bishop Plycast Splicing Kit 2638; or approved equal.
  - d) Wye type splice insulating kit for insulation repair shall be epoxy resin, 3M Company Scotchcast Series 90B1; Plymouth Bishop Plycast Splicing Kit 2636; or approved equal.

C. Terminal and Connection Coating and Electrical Sealers:

1. Electrical Insulating Spray: Electrical insulating spray for sealing tape insulation on splices, or on terminals to minimize external corrosion;
  - a) Scotch 1601 Insulating Spray by 3M Company;
  - b) Royston Protective Coating Product Data No. 614 Royston Laboratories;
  - c) Or approved equal.
2. Oxidation Inhibiting Compound: - Oxidation inhibiting compound shall be non-water soluble, non-petroleum based and suitable for aluminum, copper, steel and rubber and polyethylene type insulating materials,

- a) Penetrox A-13 by Burndy Products;
  - b) Contax Inhibiting Compound Type CTB by Thomas and Betts (T&B);
  - c) Or approved equal.
- D. Wire Connector Terminals: A ring tongue terminal or single hole solderless lug type connector shall be installed on the end of all stranded wire before connecting it to test station, terminal box, or junction box terminal studs.
- 1. Wire connector terminals shall be sized to fit wire and stud size and be suitable for use with copper conductors.
  - 2. One-piece heavy duty, tin-plated copper crimp-on ring tongue terminal. Acceptable ring tongue wire connectors are manufactured by
    - a) Burndy LLC;
    - b) 3M;
    - c) Thomas and Betts;
    - d) Or approved equal.
  - 3. Single hole seamless copper Lug-it type connector rated shall be UL listed for 600-volt service with off-set tongue suitable for wire size being terminated.
    - a) Acceptable No. 4 and No. 2 AWG wire single hole solderless lugs are
      - 1) L125 by Burndy;
      - 2) BTCO208-B2 by Thomas and Betts;
      - 3) Or approved equal.
  - 4. Wire forked end type terminals are **NOT** acceptable.
  - 5. Acceptable one hole non-insulated copper crimp wire lug terminals sizes for ¼-inch stud sizes are listed in Table 8B.8.
- E. Electrical Connectors: Hardware used in electrical connections including bolts, studs, nuts, washers, and lock-washers shall be tin or nickel plated copper, brass, bronze, or 300 series stainless steel for electrical conductivity and atmospheric corrosion resistance.

## 2.13 PLASTIC CONDUIT SHEATHING

- A. Plastic conduit for cathodic protection cable sheathing for cathodic protection cables or wires shall be 1-inch minimum diameter Schedule 40 polyethylene (PE) or polyvinyl chloride (PVC) plastic pipe.

**Table 8B.8 Stranded Copper Wire Ring Tongue Terminal Connectors**

Stranded Cable Size (AWG)	Bolt or Stud Size	MANUFACTURER AND MODEL			
		Anderson	Blackburn	Burndy	T and B
No. 14 to 20	1/4"	-----	-----	YAV14 Box	Series 54100 Model C10-14
No. 10 to 12	1/4"	-----	-----	YAV10 Box	Series 54100 Model C10-14
No. 8	1/4"	-----	CTL8-14	YA8C-L Box	54130
No. 6	1/4"	VHCS-6-14	CTL6-14	YA6C-L Box	54105
No. 4	1/4"	VHCS-4-14	CTL4-14	YA4C-L Box	54106
No. 2	1/4"	VHCS-2-14	CTL2-14	YA2C-L2 Box	54107

**2.14 LOCATION MARKING TAGS**

- A. Test station locations shall be identified with stamped brass or aluminum marking tags.
  - 1. Minimum tag size shall be 2-inch diameter.
  - 2. Marking tags are available from
    - a) Western Electromarker, Edmonton, Alberta, Canada (866-486-4250);
    - b) Or approved equal.
- B. Contractor shall supply the type and number of location marking tags sufficient for the number of test stations listed in the Test Station Schedule for the project.
  - 1. One UNSTAMPED tag shall be left in each test station.
  - 2. City personnel or Engineer will stamp the tags with appropriate identification at the time of final acceptance testing.

**2.15 WARNING TAPE**

- A. Warning tape shall be heavy-gauge, 4 mil minimum thickness, plastic tape for use in trenches.
  - 1. Warning tape shall be non-traceable type. Warning tape shall be resistant to corrosive soil and intended for extended direct burial service.

2. Tape shall meet A.P.W.A. national color code and shall be imprinted with an appropriate legend to define the type of utility. Tape shall be labeled with bold black letters for full length of tape.
3. Warning tape for buried cathodic protection cables and conduits shall be yellow and labeled "CAUTION: CABLES BURIED BELOW" and a minimum of 3-inch width.
4. Acceptable products are available from
  - a) ITT Blackburn;
  - b) Allen Systems, Inc.;
  - c) Reef Industries;
  - d) Or approved equal.

## 2.16 TRACER WIRE

### A. Tracer Wire:

1. Tracer Wire
  - a) No. 10 AWG wire for tracer wire may be single-conductor, stranded copper wire with 600-volt, TW, THWN, THHN or HMWPE insulation.
  - b) No. 10 AWG wire for tracer wire may be a hard-drawn, copper-clad steel conductor wire with a 45-mil high density high molecular weight polyethylene (HDPE) insulation.
    - 1) Acceptable bi-metallic tracer wire Pro-Trace (HDD-CCS PE45) as manufactured by Pro-Line Safety Products;
    - 2) Or approved equal.
2. Tracer wire will only be required for non-metallic pipe sections.
3. Tracer wire insulation shall be resistant to corrosive soil and intended for extended direct burial service.
4. Tracer wire color and tape markings shall be in accordance with other sections of this Specification.
5. Tape for attachment of tracer wire to pipe shall be 1-inch minimum width polyethylene tape intended for direct burial service.
6. Tracer Wire Splices
  - a) Compression connectors for in-line, multi-splices, and tap splices shall be "C" taps made of conductive wrought copper, sized to fit

the wires being spliced in accordance with "Wire Connections and Splice Materials" this section.

- b) Acceptable Type "YC" wire compression connectors as manufactured by
  - 1) Burndy LLC;
  - 2) T and B;
  - 3) Or approved equal.
  - 4) Wire compression connectors shall be supplied with tape or epoxy resin type splice insulation kits.
  
- c) Electrical Spring Connector (Wire Nut) Pigtail Wire Type Connectors with silicone gel insulation filled resin tube.
  - 1) The electrical spring connector shall consist of a steel spring, metal shell, with a flame retardant PVC insulator outer covering.
  - 2) The plastic tube assembly shall consist of a polypropylene tube with locking fingers to hold the electrical spring connector in the bottom portion of the tube and a plastic cap.
  - 3) The tube shall be prefilled with non-hardening silicone electrical insulating gel sealant.
  - 4) The electrical spring connector and plastic tube assembly shall be UL listed and CS Certified for 600 volts direct bury and submersible applications.
  - 5) The electrical spring connector is suitable for copper wires only and shall be sized to fit three No. 10 AWG tracer wires.
  - 6) Suitable tracer wire splice kits shall be 3M Direct Bury Splice Kit (DBR-6) or approved equal.
  
- d) Compression Connectors or split bolts with silver solder and specially formulated splicing kit shall consist of an elastomeric insulating compound that seals and waterproofs connection area with a resin-impregnated, moisture-cured fabric bandage shell
  - 1) Royston SpliceRight Splicing Kit available from Chase Industries or approved equal.

B. Tracer Wire Access Boxes:

- 1. Flush Mounted Tracer Wire Access Terminal Box:

- a) Flush mounted tracer wire access terminal boxes shall be standard unless specifically indicated on the plans.
- b) Plastic flush terminal box body (18" long shaft, 4" diameter minimum size) with cast iron collar and lockable cast iron lid, suitable for traffic conditions.
  - 1) Minimum four (4) wire non-conductive terminal board with ¼-inch diameter stainless steel, nickel-plated brass, or bronze hardware for wire terminations.
  - 2) Terminal board shall not be connected to flush tracer wire access box cap or be constructed in a manner that will accidentally allow wires to be shorted together through terminal board.
- c) Acceptable flush mounted tracer wire access boxes are:
  - 1) Model No. P445 DT Test 4" Shaft Cathodic Protection Test Boxes by Bingham and Taylor;
  - 2) Model NM-7 5" ID 18" Shaft Cathodic Protection Test Station by C.P. Test Services – Valvco, Inc;
  - 3) Model T4 4" ID 18" Shaft Cathodic Test Stations by Handley Industries;
  - 4) Model TWAB4PT 4" Tracer Wire Access Box by Drainage and Water Solutions, Inc.
  - 5) Or approved Equal.

## 2.17 INSULATING JOINTS

### A. General:

- 1. Insulating joints shall be dielectric unions, flanges, or couplings. The complete assembly shall have an ANSI rating equal to or higher than that of the joint and pipeline. All materials shall be resistant for the intended exposure, operating temperatures, and products in the pipeline.
- 2. No size restrictions for monolithic type insulators in buried, submerged or abovegrade locations.
- 3. No size restrictions for insulated flange or insulated couplings in abovegrade or vault type locations.

### B. Flange Insulating Kits for Flanges and Restrained Rod Harness Sets:

#### 1. Gaskets:

- a) Low Pressure (Less than 150 psi) or Small Pipe Diameter (Less than 22-inch) - Provide full-face Type E with O-ring seal, style as

recommended by manufacturer for flange face type. The 1/8-inch minimum thick flanged gasket shall be supplemented with a neoprene facing on each side to accomplish a seal. Sealing element shall be designed so as to seal either flat, raised face, or RTJ flanges.

- b) High Pressure (150 psi or greater) or Large Pipe Diameter (22-inch or larger) - Provide full-face Type E with O-ring seal, style as recommended by manufacturer for flange face type. The 1/8-inch minimum thick flanged gasket shall be supplemented with a Nitrile (240 degree maximum operating temperature) O-ring seal and a phenolic or G-10 (Pyrox) retainer facing on each side to accomplish a seal. Sealing element shall be designed so as to seal either flat, raised face, or RTJ flanges.
2. Insulating Sleeves: Individual full-length fiberglass reinforced epoxy, NEMA G-10 Grade material (Glass Reinforced Epoxy, Pyrox) or NEMA G-11 Grade material (Glass Reinforced Epoxy). Tube shall be 1/32-inch thick and extend ½ way into both of the inner steel washers next to the flange. Sleeve shall be a length so as to provide a small air gap between sleeve and nut when flange is tightened down in accordance with the manufacturer's recommendations.
  3. Insulating Washers: Individual high-strength fiberglass reinforced epoxy NEMA G-10 Grade material (Glass Reinforced Epoxy, Pyrox) or NEMA G-11 Grade material (Glass Reinforced Epoxy). Size shall be 1/8-inch thick, standard SAE washer dimension.
  4. Steel or Stainless Steel Washers: Plated, hot-rolled steel, Minimum 1/8-inch thick. If in area where stainless steel bolts and nuts required, provide Series 300 stainless steel materials or coated washers.
    - a) Provide two washers per bolt for flange diameters less than 36-inch diameter.
  5. Flange Holes and Fasteners (Bolting)
    - a) For steel pipe flange, oversize bolt holes as recommended by insulated sleeve manufacturer. For ductile iron provide standard bolt hole size as recommended by sleeve manufacturer.
    - b) Fasteners in accordance with AWWA C207 for steel and AWWA C110 for ductile iron and the following:
    - c) Minimum bolt length shall be a minimum 1/8-inch to ¼-inch longer (before torquing or tightening down) than the sum of all of the materials being jointed together. This would include but not be limited to the maximum thicknesses of the mating flanges surfaces, the sealing gasket, the insulating and metal washer thicknesses, and the depth of the nut.

- d) Provide bolts with full thread cut lengths or threaded rod as required to meet inside diameter dimension requirements of insulating sleeves. Insulated sleeves may not fit over unthreaded portions of the bolt body.
  - e) Coordinate bolt length and diameter with flange, bolt, and insulating sleeve manufacturers.
6. Provide Single Insulating Washer Set Kits for Buried Applications.
  7. Provide Double Insulating Washer Set Kits for Above Grade Applications.
  8. Acceptable flange insulating kits are available from:
    - a) Trojan Sealing Insulating Gaskets by Advance Products and Systems, Inc., Lafayette, LA (800-335-6009), [www.apsonline.com](http://www.apsonline.com);
    - b) Type E Jock by Central Plastics Co., Shawnee, OK (800-654-3872), [www.centralplastics.com](http://www.centralplastics.com);
    - c) Low Pressure Linebacker Type E Sealing Gasket and High Pressure Gasket Seal Type E Sealing Gasket by GPT Industries (formerly Pacific Seal and Insulator, Inc. (PSI) and Pikotek) Houston, TX. (800-423-2410), [www.gptindustries.com](http://www.gptindustries.com);
    - d) Or approved equal.

C. Flexible Insulated Couplings:

1. Insulating Couplings shall meet AWWA C219 Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe. The coupling type, size, and clearance shall be style intended by coupling manufacturer to be utilized with two insulating boots (sleeves, bands, etc.) with a small lip that fits over pipe end to keep pipe separated.
  - a) Insulated couplings shall be factory provided by coupling manufacturer and not be made with field conversion kits.
2. Coupling Coating and Linings: Insulated fittings shall be steel and externally coated and lined with factory epoxy coating internally and externally in accordance with AWWA C210, AWWA C213, or AWWA C550.
  - a) Minimum surface preparation shall be white metal blast (SSPC SP-5) for internal surfaces and near white blast (SSPC SP-10) or better for external surfaces.
  - b) Liquid epoxy coating shall be a minimum of two coats for 14 MDFT.
  - c) Fusion bonded epoxy coating shall be a minimum of 10 MDFT.

- d) Provide repair kits for epoxy-coated materials.
  - e) Provide a manufacturing affidavit or certification that all coating furnished complies with AWWA standards and that all AWWA standard's inspection and tests have been completed.
3. Buried, submerged, or immersed insulating couplings bolts, nuts, and washers shall either be Series 300 stainless steel or fusion bonded steel coupling bolts, nuts, and washers per requirements of this specification. *Corrten bolts are not acceptable for buried, submerged, or immersed fitting or piping locations.*
4. Insulating boots shall be type and thickness as recommended by coupling manufacturer for intended service including products carried and pipe temperature. The insulating boots shall be factory fabricated and provided by coupling manufacturer. Insulating boots shall be size and type that do not interfere with correct installation and operation of the coupling.
- a) Two insulating boots shall be provided for each coupling. Insulating boot shall be a one piece type and have an insulating shape with a lip or edge that fits over the end of the pipe. Boot shall be long enough to extend past end of coupling assembly body and be visible when coupling is assembled.
  - b) Insulating boot material shall be neoprene, nitrile, or EPDM or approved equal per coupling manufacturer's recommendation depending on pipe size and type of service.
  - c) Minimum insulating boot thickness shall be:
    - 1) 1/8-inch for pipe up to 60-inch size,
5. Insulated couplings at restrained joints shall be provided with the necessary supplemental insulated restrained joint harness assemblies as described below.
- a) The use of field conversion kits will not be allowed except to insulate the restrained joint harness assembly.
  - b) Insulated Flexible Coupling Restrained Harness Assembly: Where shown on the Drawings and/or as required and specified provide insulated restraint/harness assembly at insulated couplings on metallic pipelines. Harness bolts shall be of sufficient length, with harness lugs placed so that coupling can be slipped at least in one direction to clear joint.
  - c) Provide an insulating flange conversion kit consisting of individual one-piece flange insulating sleeves and insulating washers to electrically isolate restraint harnessing assembly on both ends of harness rod.

- 1) Insulating sleeves shall be individual full-length 1/32-inch thick fiberglass reinforced epoxy, NEMA G-10 Grade material (Glass Reinforced Epoxy, Pyrox) sleeves of sufficient length to extend completely through harness lug assembly.
  - 2) Insulating washers shall be 1/8-inch thick individual high-strength fiberglass reinforced epoxy NEMA G-10 Grade material (Glass Reinforced Epoxy, Pyrox) with a metallic washer at standard SAE washer dimension.
  - 3) G-10 One-Piece Sleeve and Washer from PSI;
  - 4) Or approved equal.
- d) Harness lugs and harness bolts shall be sized as required to allow easy installation of insulating sleeves.
- 1) Harness assembly rods and bolts shall be stainless steel (Series 300) for buried or submerged locations, fusion bonded epoxy coated for dry abovegrade conditions,
  - 2) Individual rods or entire assemble shall be heat shrink coated, coated with a 100-percent moisture cure epoxy repair coating at 20-mils,
  - 3) Petrolatum tape coated after assembly and insulator testing,
  - 4) Bitumastic type coatings are not an acceptable option for coating of restraining rods.
6. Insulating Flexible Couplings shall be F x E Type 1 insulated style that is electrically insulating type with two insulated boots (or bands) to be installed on the pipe under the coupling. Acceptable insulating flexible couplings are:
- a) Series 216 by Baker Couplings, Los Angeles, CA (800-247-7164);
  - b) Dresser Style 39 by Dresser Industries, Inc., Bradford, PA (814-368-3131);
  - c) Style 416 by Smith-Blair, Inc., Texarkana, AR (501-773-5127);
  - d) Depend-O-Lok by Victaulic, Inc., Atlanta, GA (800-841-6624);
  - e) Series 200 couplings by Baker Coupling Company, Los Angeles (323-583-3444);
  - f) Or approved equal.
7. All buried or submerged flexible coupling fasteners shall be Series 300 stainless steel.

D. Copper Service Line Insulators:

1. Insulated service fittings shall consist of brass union body that encapsulates a nylon insulator specially designed to provide electrical isolation for this type of intended use:
  - a) Insulated corporation ball valves, insulated curb ball valves, and service line insulators shall be provided to insulate copper or metallic service lines.
2. Acceptable service line insulators are available from:
  - a) Mueller Co., Decatur, IL (800-423-1323);
  - b) Or approved equal.
3. Consult manufacturer for model number and installation procedures for each application.

## 2.18 INSULATING FLOOR AND WALL SLEEVES AND MODULAR SEALS

- A. Wall Sleeves: Pipe wall sleeves or cored openings shall be provided at all wall and floor locations in accordance with pipe and sleeve manufacturer's recommendations.
1. The pipe wall sleeves shall be of sufficient thickness to resist any deformation. The pipe wall sleeves shall be round with a maximum +/- 1/8-inch variation in diameter allowed. The wall sleeve shall be a minimum wall thickness of 0.375-inch or standard wall thickness. The minimum width of the wall sleeve shall be per the modular seal manufacturer's recommendations to meet minimum width requirements based on seal type and pipe diameter and weight.
  2. Pipe wall sleeves shall be provided with a minimum three-inch (3") water stop collar that evenly contacts the wall or floor opening all the way around for a minimum length of one-inch (1") or more if recommended by the sleeve manufacturer. The water stop (collar) shall be of the same type of material as the wall sleeve. The wall sleeve shall have a smooth continuous weld with no welding slag or rough or high welds. The water stop collar shall be continuously welded on both sides of the collar for the entire circumference of the wall sleeve.
  3. The wall sleeve and the water stop collar shall be positioned such that it is located in the center of the structure wall or floor, when the wall sleeve is positioned in place. Steel wall sleeves and water stop collars shall be coated. The wall or floor penetration diameter and width shall be sized sufficiently to allow correct installation of the wall sleeve and water stop.
  4. Wall penetrations and wall sleeves types and sizes shall be coordinated with sleeve manufacturer, modular seal manufacturer, and pipe

manufacturer to provide proper type of opening to provide a liquid tight connection.

5. Wall pipe sleeves placed around pipe and grouted in place in accordance with sleeve and pipe manufacturer's recommendations are an acceptable method of wall openings.
6. Coordinate wall sleeve type, model, size, and location with modular seal and pipe manufacturers.
7. Prefabricated Coated Steel Pipe Wall Sleeves shall be preprimed or coated minimum Schedule 40 wall thickness with standard 12-inch length, centered type with a minimum 3" water stop sized to fit pipe size.
  - a) Depending on location, wall size, and pipe size prefabricated steel pipe wall sleeves are available from
    - 1) Model WS Steel Wall Sleeves (coated steel with a welded water stop) by GPT Industries (formerly PSI), Houston, TX (800-423-2410);
    - 2) Model SWS (primed steel with a welded water stop), or Model GWS (steel with a welded water stop and Galvo-Plast coating) by Advance Products and Systems, Inc., Lafayette, LA (800-335-6009);
    - 3) Or approved equal.
  - b) Consult manufacturer for specific model required.

B. Insulating Wall or Floor Modular Seals. Insulating wall and floor seals shall be adjustable modular mechanical type seals able to provide a positive seal (liquid tight) and long lasting electrical insulation for wall or floor penetrations for pressures up to 40-feet of static head. Coordinate with and provide pipe and modular seal manufacturer's recommended modular seal type and size for pipe type, pipe diameter, casing or hole opening size, environmental exposure, operating temperature, and intended installation conditions.

1. The modular seals shall consist of synthetic rubber bolted links, heavy duty reinforced high density nylon polymer plastic pressure plates, and Type 316 stainless steel hardware (bolts, nuts, washers, etc.) for adjustment. The modular seals shall be manufactured at a plant with a current ISO-9001 registration which shall be included as part of the submittal.
2. The rubber links shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the opening. The individual links shall be colored and permanently identified with the manufacturer's name and model number. The link shall be sized per the manufacturer's recommendations. The links shall have the following properties per ASTM standards for standard type applications (-40

degrees to 250 degrees F) Model C EPDM = ASTM D2000 M3 BA510 Black.

3. The pressure plates shall be molded glass reinforced nylon polymer with an integrally molded compression assist boss on pressure plated top side (bolt entry side). The pressure plate shall incorporate an integral recess ("Hex Nut Interlock") to accommodate commercially available fasteners. The individual pressure plates shall be colored and permanently identified with the manufacturer's name. The pressure plate shall be sized per the manufacturer's recommendations. The links shall have the following properties per ASTM standards for standard type applications:
  - a) ASTM D-256 Izod Impact = Minimum 2.05 foot-pound/inch
  - b) ASTM D-790 Flexure Strength at Yield = Minimum 30,750 PSI
  - c) ASTM D-790 Flexure Modulus = Minimum 1,124,000 PSI
  - d) ASTM D-638 Elongation Break = Minimum 11.07%
  - e) ASTM D-792 Specific Gravity = Minimum 1.38
4. The modular seal hardware shall be sized according to the seal manufacturer's recommendations depending on the size and type of modular seal. The 316 Stainless Steel hardware shall have the following properties per ASTM standards for standard type applications including ASTM F593 with an average tensile strength of a minimum 85,000 PSI.

C. Modular Wall Seals: Acceptable modular wall seal insulators for pipe diameters equal to or smaller than 24-inch diameter are:

1. Thunderline Link-Seal Model LS-300 or LS-400 by GPT Industries (formerly Pacific Seal and Insulator, Inc. PSI) Houston, TX. (800-423-2410);
2. Pipe Linx Model PL-300 or PL-400 by Calpico, Inc. South San Francisco, CA. (650-588-2241);
3. Innerlynx Model IP-300 or IP-400 by Advance Products and Systems, Inc., Lafayette, LA (800-315-6009);
4. Or approved equal.

D. Wall sleeves passing through walls of structures containing liquids shall be provided with double sets of modular wall seals to provide pipe support at the penetration and protection against leakage.

## 2.19 COATING AND LINING FOR FITTINGS, INCIDENTAL PIPING AND VALVES

- A. Supply incidental pipe, valves, fire hydrants and fittings with linings and coatings of the same type as adjacent pipe, except where shown on the Drawings. Coat incidental pipe and fittings installed as specified in this specification section.
- B. Coat and line all buried metallic (steel, ductile iron, and cast iron) valves, fittings, miscellaneous piping, and hydrants internally and externally. Supply factory

coated valves and fittings with linings and coatings of the same type as adjacent abovegrade pipe, except where shown on the Drawings or where coating or lining specified for buried main pipeline is not feasible for fabricated items or special pipe pieces (such as incidental metallic piping, valves, fittings, tees, flexible couplings, glands, hydrants, etc.).

1. Internal linings and coatings exposed to water shall be NSF approved for potable water service.
2. Minimum surface preparation shall be white metal blast (SSPC SP-5) for internal surfaces and near white blast (SSPC SP-10) or better for external surfaces.
3. Provide tight bonded coating and lining of pipe and fitting joints at maximum thicknesses shall be as recommended by the pipe or fitting manufacturer so as to not impair engagement of pipe or fitting joint or function of fitting.
4. All ferrous interior mounting faces/surfaces shall be prepared and shop primed with a suitable rust-inhibitive holding primer applied in accordance with this specification and the coating manufacturer's recommendations. Holding rust-inhibitive primer shall be compatible with specified top coats. Apply per coating manufacturer's recommendations to a thickness that will not impair the clearances required for proper installation of the joint or fitting (valve, coupling, flange, etc.) operation.
5. Valve bolts, nuts, and washers, (including in valve bonnet and stuffing) box) shall be Series 300 stainless steel.

C. Ductile Iron and Cast Iron Factory Coating Surface Preparation:

1. Use SSPC SP grades as surface preparation guide only as it applies to cast iron or ductile iron in percentage cleanliness required and surface contaminants removed, not the color of the metal.
2. The abrasive blast cleaning operation shall remove the same percentage of all surface contaminants (including tightly adhered annealing scale) as the SSPC SP grade referenced.
3. The entire surface area shall be abrasive blasted. No tight rust stains shall be allowed.
4. Avoid overblasting, high nozzle velocities, and excessive blast times.
5. Cast iron and ductile iron attain a gray color when abrasive blasted due to the higher carbon content compared to steel
6. SSPC SP-10 Near White Grade is specified for cast iron or ductile iron, the degree of surface cleanliness is comparable to a near white blast for steel and requires 95 percent removal of all surface contaminants

including tightly adhered annealing scale. Ductile or cast iron will not be required to be near-white but will only be required to be a near-gray color.

D. At Contractor's option, factory coat or line the incidental piping, valves, or fittings with liquid epoxy or with fusion-bonded epoxy coating in accordance with these specifications and AWWA C210, AWWA C213, AWWA C116, or AWWA C550. Coating shall meet all AWWA standard requirements and tests and this specification section.

E. **Liquid Epoxy:**

1. Provide factory applied liquid epoxy lining and coating in accordance with AWWA C210 and AWWA C550 and these specifications. Epoxy material shall meet the performance requirements of the referenced AWWA standards. Epoxy material shall be the product of a coating manufacturer normally engaged in production of such material and shall be for intended service conditions.
2. Coating in contact with potable water shall conform to NSF Standard 61.
3. The liquid epoxy coating shall be a two part chemically cured coating or 100-percent material. Coating shall be mixed and applied per coating manufacturer's directions. Liquid-epoxy lining of metallic pipe and fittings shall be potable grade epoxy coating approved for potable water contact and this type of intended service.
4. Abrasive blast with material and in manner as recommended by coating manufacturer to produce surface profile depth and angular shape needed. Surface preparation shall be a minimum of SSPC SP-5 (White) for immersion service and SSPC SP10 (Near White) or better for external service.
5. Coating shall be a minimum of two or more coat system with a minimum thickness of 14 MDFT.
6. Minimum adhesion to prepared steel shall be 400 psi per ASTM D1002 or per coating manufacturer's printed literature, which ever is higher.
7. Acceptable liquid epoxy materials for linings in contact with potable water or buried-service metallic fittings, valves, etc are
  - a) Carboguard as manufactured by Carboline®;
  - b) Bar-Rust 233H as manufactured by ICI Devoe;
  - c) SherPlate PW Epoxy B62 as manufactured by Sherwin-Williams;
  - d) PotaPox Plus Series N140 or L140 manufactured by Tnemec;
  - e) Or approved equal.

8. Acceptable liquid epoxy materials for abovegrade structures are
  - a) Carbothane 133 LH as manufactured by Carboline®;
  - b) Devthane 379 UVA Polyurethane Enamel as manufactured by ICI Devoe;
  - c) Hi-Solids Polyurethane Enamel B65 by Sherwin-Williams;
  - d) Series 1074U Endura-Shield II Aliphatic Acrylic Polyurethane;
  - e) Or approved equal.
9. Finish for abovegrade structures shall be high gloss with color selected by the Owner for the intended service.

**F. Fusion-Bonded Epoxy:**

1. Provide factory applied fusion-bonded epoxy lining and coating in accordance with AWWA C213, AWWA C116, and AWWA C550, and these specifications.
2. Fusion-bonded epoxy material shall meet the performance requirements of the referenced AWWA standards.
3. Coating in contact with potable water shall conform to NSF Standard 61.
4. Fusion-bonded epoxy material shall be the product of a coating manufacturer normally engaged in production of such resin and shall be for intended service conditions.
5. The fusion bonded epoxy coating shall be a 100-percent powder epoxy based thermosetting coating. Coating shall be applied by flocking, fluidized bed, or electrostatic method per coating manufacturer's directions.
6. Fusion-bonded epoxy lining of metallic pipe and fittings shall be potable grade epoxy coating approved for potable water contact and this type of intended service.
7. Abrasive blast with material and in manner as recommended by coating manufacturer to produce surface profile depth and angular shape needed. Surface preparation shall be a minimum of SSPC SP-5 (White) for immersion service and SSPC SP10 (Near White) or better for external service.
8. Fusion bonded epoxy coating shall be one or two-coat system with a minimum thickness of 8 MDFT.
9. Minimum adhesion to prepared steel shall be 3,000 psi per ASTM D1002 or per coating manufacturer's printed literature, which ever is higher.

10. Acceptable fusion-bonded epoxy materials are listed below:
  - a) Scotchkote 206N, 323 or 162 as manufactured by 3M™;
  - b) Nap-Gard® 7-2500 pipe coating as manufactured by DuPont;
  - c) Nap-Gard 7-4500 (CV Red FBE) for valves and fittings as manufactured by DuPont;
  - d) Valspar 1F1947T as manufactured by Valspar General Industrial;
  - e) Or approved equal.
  
- G. Conduct dry film thickness measurements and 100-percent holiday inspection of all factory epoxy-coated items prior to shipment.
  1. Conduct dry film thickness measurements in accordance with SSPC PA-2 with exception that the specified thickness is the absolute minimum.
  2. A minimum of two dry film thickness measurements shall be completed for each fitting or appurtenance.
  3. Repair all defects with approved repair material according to original coating manufacturer's directions prior to shipment.
  
- H. Provide field repair kits for all types of coated materials.
  
- I. Provide exterior coating for all above-grade piping, fittings, and vent pipes with two coats of polyamide epoxy coats at a minimum 2.5 MDFT per coat (MDFTPC) and with one top coat of polyurethane enamel at a minimum 3 MDFT or with a minimum 10 MDFT fusion-bonded epoxy coating system. Minimum surface preparation shall be near-white metal blast (SSPC SP-10) for external surfaces. Color specified by Engineer.
  1. Hot dipped galvanized or plastic (PVC) type vent pipes do not require epoxy/polyurethane coating system.
  
- J. Coating for valves, fittings and fire hydrant legs shall consist of one of the following:
  1. *Liquid epoxy coating* shall be a minimum of two coats or more for a minimum 14 MDFT coating thickness.
  2. *Fusion bonded epoxy coating* shall be one or more coats for a minimum coating thickness of 8 MDFT.

3. *Nylon coating* shall be one or more coats for a minimum coating thickness of 10 MDFT applied in a fluidized bed.
  4. *Polyurethane coating* shall be a minimum 40 MDFT for ductile iron valves and fire hydrant legs and stub pieces (American AVK fusion-bonded epoxy interior with polyurethane coated exterior or approved equal).
  5. Maximum coating thickness shall be as recommended by fitting manufacturer so as to not impair engagement of joint or function of fitting.
- K. Provide a manufacturing affidavit for all factory epoxy coated or stainless steel items that list:
1. Applicator of coating including name, address, phone number and date of Application
  2. Coating Material Manufacturer and Product Designation with a product data sheet.
  3. Certification that all coating furnished complies with AWWA standards and these specification requirements and that all AWWA standard's inspection and tests have been completed and were met.
  4. Certification that stainless steel items are provided as specified including name of stainless steel manufacturer and Series 300 grade provided.
- L. Restraint Fitting Coating System
1. Restrained fittings (casting bodies, wedge assemblies, and related parts, etc.) shall be abrasive blasted followed by a phosphate wash, rinse, and drying pretreatment process just prior to coating.
  2. Restrained fittings (casting bodies, etc.) shall be coated immediately following the pretreatment process. The coatings shall be electrostatically applied and heat cured. Acceptable casting body coating systems shall consist of:
    - a) A sealer prior to pretreatment drying and two coats of a *thermosetting powder coating* at minimum 3 to 6 MDFT.
    - b) Acceptable TGIC polyester powder coatings for restrained fittings (casting bodies) are
      - 1) EBAA Iron Mega-Bond Restraint Coating System;
      - 2) Star-Bond Coating System;
      - 3) Or approved equal.
    - c) A *fusion bonded epoxy coating* at a minimum 8 MDFT, Romac Industries Romacote Corvel Black;

- d) A *nylon coating system* at minimum 10 MDFT Romac Industries Romac Nylon Coating;
  - e) Or approved equal.
3. Wedge assemblies and related parts shall be coated immediately following the pretreatment process with an approved coating system consisting of either:
- a) A thermoplastic flouropolymer type fastener coatings specifically designed for that type of application at a minimum 1 to 2 MDFT.
  - b) The thermoplastic flouropolymer coating system shall consist of two or more coats of liquid thermoset epoxy coating with heat cure following each coat.
  - c) Acceptable flouropolymer coatings for the wedges and wedge actuators are
    - 1) EBAA Iron Mega-Bond Restraint Coating System;
    - 2) Star-Bond Coating System;
    - 3) Or approved equal.
- M. A fusion bonded coating system consisting of one or more coats of fusion bonded epoxy electrostatically applied and heat cured following each coat with a total fusion bonded epoxy coating system minimum thickness of 6 MDFT.
- N. Provide stainless steel materials or coat all other miscellaneous buried metallic items, (tie rods, thrust restraints, tapping saddles, harnesses, etc.). Coat tie rods and rebar when directly exposed to soil. Provide with factory applied epoxy coating, fusion bonded epoxy coating, heat shrink sleeves, or with coating recommended by coating manufacturer for buried application and approved by Engineer for intended exposure.
- O. Bolts, nuts, and washers, for valves (including in valve bonnet and stuffing box) shall be Series 300 stainless steel.
- P. Galvanized or black steel materials (piping, nipples, unions, fittings etc.) shall not be used in wet, immersed, or buried locations or vaults unless tight-bonded coated as specified.

## 2.20 FASTENERS (BOLTS, NUTS, WASHERS, ETC.)

- A. All fasteners (bolts, nuts, tee bolts, and washers) type, size, and strength shall be according to this specification unless other design information is provided in the plans or detailed specifications. All nuts shall be fully seated. Nuts shall be compatible with the bolts and have a proof stress equal or greater than the tensile strength of the bolts. Minimum bolt size, lengths, and tensile shall be as designed for the application.

- B. Coated fasteners (bolts, nuts, tee bolts, and washers) are allowed. Coated fasteners shall meet the following requirements:
1. Coated bolts shall be undersized or the nuts oversized as required to minimize damage to coatings, however, size shall still satisfy design and manufacturer's requirements for bolt strength and size in the particular application. Provide with applicator name, coating manufacturer and product number, and certification that coating was applied as specified.
  2. Coated bolts, nuts, and washers for ductile iron pipe and fittings shall be low carbon weathering steel meeting the strength, physical, marking, traceability, and chemical requirements of AWWA C111 and coated with an approved fastener coating system.
  3. Bolts, washers, nuts, and T-bolts shall be pretreated and coated with a *thermosetting powder coating* or *fusion bonded epoxy* type fastener coating system.
    - a) Thermosetting powder coatings shall be at a minimum 1 MDFT with Xylan, Type E, Flour Kote #1, or thermoplastic fluoropolymer type fastener coatings specifically designed for that type of application.
    - b) Fusion bonded coated steel bolts, nuts, and washers, fittings, and bodies shall be coated with a minimum 6 MDFT epoxy coating per AWWA C213. Surface preparation shall be SSPC SP-10 (near white).
- C. Stainless Steel Fasteners (bolts, nuts, T-bolts, washers, etc.)
1. Stainless steel bolts, tee bolts, nuts, and washers shall be Series 304 or Series 316 for the specific environment of use.
  2. Stainless steel bolts and nuts shall be provided with an anti-galling lubricating compound or coated with a 1-mil fluoropolymer or equal fastener coating system to aid in preventing galling.
- D. Corten® bolts are not acceptable for buried, submerged, or immersed fitting or piping locations.
- E. Bolts and nuts shall be adequately labeled to provide traceability of the material and producer.
1. The identification mark shall be cast, forged or stamped on the bolt and nut. Painted markings are not acceptable.
  2. The bolt and nut manufacturer shall provide information on the type of material provided and corresponding identification mark, and country of origin.

3. Markings and traceability requirements shall be in accordance with the Industrial Fasteners Institute and AWWA C111.
- F. All bolts and nuts shall be installed according to manufacturer's requirements including the use of anti-galling lubricant compound or use of a thermosetting fluoropolymer type coating for stainless steel materials.
1. If galling or seizing of the nut and bolt occurs they shall be cut off and replaced with a new nut and bolt.

## 2.21 STAINLESS STEEL FABRICATION AND PASSIVATION

- A. Utilize Type L grade stainless steel for all items to be welded.
- B. During fabrication, handling, and installation take necessary precautions to prevent mild carbon steel impregnation of stainless steel members.
- C. Utilize brushes (stainless steel, non-metallic), grinding wheels (aluminum oxide discs), and tools intended for stainless steel and not used previously for carbon steel work.
- D. Degrease and clean prior to welding with non-chlorinated solvents.
- E. Weld stainless steel with approved materials and techniques.
- F. Clean and remove contamination, remove weld heat tint, and repassivate welds per ASTM A 380 and ASTM A967.
- G. After treatment visually inspect surfaces for compliance.
- H. Pack stainless steel parts and pad mild steel fork lift forks and use straps instead of metal chains to handle stainless steel parts to avoid iron contamination of stainless steel.
- I. After installation, visually inspect stainless steel surfaces for evidence of iron cross contamination, rust, oil, paint, and other forms of contamination. Repair as required and reinspect.

## 2.22 PIPE AND FITTING FIELD COATING REPAIR MATERIALS

- A. Field repair incidental pipe and fitting coatings and linings in accordance with this specification section.
- B. Field repair coating shall be compatible with factory coating and linings and be approved by factory coating manufacturer for repair on their products.
- C. Field Coating Repair Materials:
  1. Heat Shrink Sleeve and Sleeve Repair Materials: Heat shrink sleeve repair materials shall consist of either heat shrink sleeve in tube form or

heat shrink patch kit depending on size and shape of repair. Acceptable heat shrink products are

- a) Raychem WaterWrap sleeve or PERP Repair Patch Kit available from Tyco Adhesive (Polyken Kendall) Mansfield, MA.;
- b) CANUSA Aqua-Shield Aqua-Sleeve or CANUSA CRPK Repair Patch Kit available from CANUSA, Inc., The Woodlands, TX.;
- c) Or approved equal.

2. Tape: Cold-applied field repair polyethylene repair type coatings shall consist of suitable primer and minimum 35-mil thick patch/repair/joint tape with aggressive adhesive and release liner, 4 or 6-inches width. Suitable primer shall be provided with the repair coatings as recommended by the repair-coating manufacturer. Acceptable products are

- a) Tapecoat H35 Gray by The TAPECOAT Company, Evanston, IL.;
- b) Polyken 1027 primer and Polyken 934-35 tape by Tyco Adhesive (Polyken Kendall) Mansfield, MA.;
- c) Tek-Rap 200-23 Series primer and Tek-Rap 280 tape by Tek-Rap, Inc., Houston, TX.;
- d) Or approved equal.

3. Epoxy Repair Coatings: Provide 100-percent epoxy coatings that can cure under wet or dry conditions

- a) A-788 Splash Zone Compound by Koppers, Pittsburgh, PA;
- b) Aquata Poxy by Raven (King Adhesive Corporation), St. Louis, MO;
- c) Concrevice No. 1438 or No. 1170 by Adhesive Engineering Company, San Carlos, CA;
- d) Protal 7125 Repair Coating by Denso North America;
- e) Tnemec FC 22 Epoxoline by Tnemec Company Incorporated, Kansas City, Missouri;
- f) HBE-95 WG High Build Epoxy, CANUSA-CPS, Inc., The Woodlands, TX.;
- g) Or approved equal.

4. Four layer petrolatum wax-tape system (AWWA C-217) intended for burial conditions.

- a) Completed buried system shall consist of a minimum four layer system consisting of a primer, mastic filler, petrolatum wax tape and an outerwrap.

- b) Acceptable petrolatum coating systems are
  - 1) STAC Coating System by Central Plastics Company, Shawnee, OK.;
  - 2) Denso Pipe and Fittings Petrolatum System by Denso Products, Houston, TX.;
  - 3) No. 1 Wax-tape Coating Systems for buried locations by The Trenton Corporation, Ann Arbor, MI;
  - 4) No. 2 Wax-tape Coating Systems for above grade and vault applications by The Trenton Corporation, Ann Arbor, MI;
  - 5) Or approved equal.

## 2.23 CORROSION TEST EQUIPMENT

- A. Obtain and furnish the following equipment and materials for corrosion and tracer wire functional testing. Arrange and have test equipment at project site before construction begins:
  - 1. One Heavy Duty, Digital Multimeter, with case and test leads. Instrument shall be suitable for field conditions, be sealed to meet IP 67 waterproof and dust conditions, meet CAT IV minimum 600 volt rating, and comply with IEC and ANSI electrical safety standards. Acceptable digital multimeters are
    - a) Model No. 27 II or Fluke 28 II by John Fluke Mfg. Co., Inc. Everett, WA;
    - b) Amprobe Model HD-160C by Amprobe Test Tools ( formerly Wavetek Instruments, Beckman) Everett, WA;
    - c) Or approved equal.
  - 2. Two Copper-Copper Sulfate Reference Electrodes with cone shaped tip,
    - a) Model 6B by Tinker and Razor, San Gabriel, CA;
    - b) Model RE-5C by M C MILLER Co., Vero Beach, FL;
    - c) Or approved equal.
  - 3. One 32 oz bottle of Copper-Copper Sulfate Anti-Freeze Solution as manufactured by Tinker and Razor, San Gabriel, CA; M C MILLER Co., Vero Beach, FL; or approved equal.
  - 4. One 3/4 pound bottle of Copper-Copper Sulfate Crystals as manufactured by Tinker and Razor, San Gabriel, CA; M C MILLER Co., Vero Beach, FL; or approved equal.

5. The test equipment shall be stored at the project site and shall be maintained in accurate, working condition. The test equipment shall be available to Engineer and Owner for testing purposes.
6. For projects with a combined pipe length of two miles or more, Contractor shall obtain and furnish new equipment outlined above. At the completion of the project, the equipment shall be turned over to the Rapid City Utility Maintenance Department.

## 2.24 MANUFACTURER'S CERTIFICATIONS

- A. Manufacturer's certifications of materials and installation are provided at the end of this specification section. Attachments A, B and C shall be completed and submitted as outlined in the attachments.

## 8B.3 EXECUTION

### 3.01 GENERAL

- A. All materials and equipment associated with pipe connecting wires, joint bonding, test stations, reference electrodes, galvanic anodes, insulating joints, and casing insulators as shown and specified herein shall be furnished and installed by the Contractor.
- B. Coordinate installation of the specified work as necessary such that installation of the items herein specified can be completed concurrently with pipeline installation. Test leads shall be installed only during pipe installation. Items not installed before backfilling of the pipe shall be installed at the Contractor's sole expense. Additional excavation of pipe after backfilling shall be minimized to protect pipe and coating from possible damage. Galvanic anodes shall be only installed at the same time as metallic fitting installations are being constructed.
- C. Nothing included or omitted in this specification shall relieve the Contractor of the obligation of providing a complete and satisfactory pipeline that is electrically continuous, electrically isolated, and provided with a functioning cathodic protection system with test stations as specified.
- D. Weather Conditions:
  1. Installation of the corrosion protection system components, such as splices, bonds, and wire installation shall only be allowed when ambient temperature are above ten degrees (10°) F. (-12° C.) and rising to minimize wire and insulation damage.
  2. Materials shall be stored in covered and heated storage units to maintain minimum temperatures above restricted temperature limits.
- E. Do not thermite (exothermic) weld, pin braze, weld, or utilize open flame or torches in areas of flammable vapors or air borne particles, where a fire or explosion could result.

- F. Install and work around abovegrade and buried AC powerlines and gas pipelines with extreme care, follow minimum separation distances per foreign company requirements and regulations. Do not work next to powerlines during times of high lightning activity.
- G. Installations shall be completed per the National Electrical Code (NEC), and as specified in this section.

### 3.02 MATERIAL STORAGE AND HANDLING

- A. Store materials in secure, protected location in accordance with material manufacturer's recommendations. Store thermite weld materials, reference electrodes and prepackaged galvanic anodes off the ground and keep them dry at all times.
- B. Equipment or materials damaged in shipment or in the course of installation shall be replaced. Immediately remove from site all mechanically damaged materials. Prepackaged corrosion control items shall be handled with care to prevent loss of backfill material. Do not lift, lower, or hold anodes and reference electrodes by the lead wire.
- C. Do not allow reference electrodes to freeze. Store in protected area, off the ground. Utilize before expiration of shelf life .

### 3.03 PIPE JOINT AND FITTING BONDING

- A. To form an electrically continuous pipeline and associated appurtenances the joints of all buried metallic pipe, vault, and manhole piping and all appurtenances, tees, elbows, restrained joints, valves, and fittings including hydrant and blow-off piping shall be electrically joint bonded. All joints including all bolted and restrained joints shall be joint bonded, except those joints specified to be threaded, welded, or insulated. Blow off and hydrant pipe and fittings shall also be bonded. Do **NOT** joint bond across insulating joints.
- B. Various components of metallic fittings (thrust restraint devices, follower rings or glands, etc.) on plastic or ductile iron pipelines shall be bonded together to provide an electrically continuous fitting or appurtenance.
- C. Place metallic fitting bond wires on top quadrant of pipe or fitting to bolt pattern area or where flange edges are to minimize damage to internal coating or joint materials. Bonding can be completed abovegrade prior to fitting assembly.
- D. Wire connections to pipes or fittings shall be as specified under WIRE CONNECTIONS.
- E. Install one insulated joint bond wire or bond strap per joint on all pipe or fittings 10 inches in diameter or smaller. Install a minimum of two or more insulated joint bond wires per joint on all pipe or fittings 12 inches in diameter or larger for redundancy.

- F. Bond wire size may be No. 4 AWG on pipe sizes equal to or smaller than 15-inch diameter. Insulated joint bond wires or coated or bare copper straps may be utilized depending on joint coating type. Place bond wires on top quadrant of pipe.
- G. Minimum number of bond wires or straps per pipe size is as follows:
- H. Factory Coated or Tape Coated Pipe Joints: Use insulated stranded copper joint bond wires or insulated copper strap bonds for bell and spigot locations where heat shrink sleeves are not used.
  - 1. Use insulated stranded copper joint bond wires or insulated strap bonds for all other locations where joints or fittings are already coated such as for factory coated bolted fittings, where a heat shrink sleeve is not specified.
- I. Bond bolted restrained type joints, multiple segmented fitting sections, and metallic gland connection pieces on fittings on plastic pipe, and metallic pipe into cathodic protected metallic fittings or pipe with single No. 12 AWG stranded insulated copper wires with sleeves. Length of pigtail bond wire as required. Bond across the joint with the specified number and larger sized bonds listed above based on pipe size and material.
- J. Joint bonding of cast iron soil pipe not required unless specifically shown on Drawings. Joint bonds for cast iron soil pipe and fittings and high silicon cast iron pipe and fittings shall be in accordance with the manufacturer's recommendations.
- K. Bronze wedges, restrained joints, bolted or compression sleeved wires or copper straps, thrust restraints, or welded "Z" bars are **NOT** acceptable methods of achieving electrical continuity.

### 3.04 WIRE CONNECTIONS

- A. The electrical connection of copper wire or copper strap to metallic (steel, cast iron, and ductile iron) surfaces shall be by the thermite weld method. Prepare surface and make connections in accordance with the thermite weld manufacturer's recommended procedures and these specifications, which ever one is more stringent.
- B. Provide adequate ventilation and safety equipment (gloves, safety glasses, etc.) and follow safety and training requirements as recommended by the thermite weld material manufacturer. Avoid contact with hot materials. Remove or protect fire hazards in the area during the thermite welding operations.
- C. Assure that pipe or fitting wall thickness is of sufficient thickness that the thermite weld process will not damage the pipe or fitting wall's integrity or damage the lining in any way. Do not use on Cast Iron Soil Pipe (ASTM 74-93)

- D. Complete thermite or pin brazing weld connections at locations and in a manner that does not damage sealing materials, gaskets, plastic pipe, and/or coatings, and/or polyethylene encasement. Maintain minimum two-inch (2") separation from pipe O-ring gasket in accordance with the pipe or fitting manufacturer recommendations.
- E. Complete thermite weld wire connections on horizontal surfaces, if at all possible. Thermite weld connections to vertical surfaces should be minimized and only if approved by Engineer. Conduct horizontal type thermite weld wire connections to fire hydrant risers and pipe stubs in horizontal positions abovegrade prior to installation in excavations. Pin brazing type connections can be completed in horizontal or vertical positions.
- F. All connections to stainless steel materials, copper, and light wall steel tubing (0.035-inch or less), shall be either with a silver soldered connection (silver brazing) or a physical type connection.
- G. Connections to stainless steel fittings and appurtenances can be made with a ring tongue terminal placed under a bolt or a soldered connection as approved by the Engineer. Thermite weld connections to stainless steel are NOT allowed.
- H. Exothermic Thermite Weld Method.
  - 1. The Contractor is responsible for repair of any damage to pipe, fitting, lining, or coating as a result of the thermite weld process.
  - 2. Make thermite weld connections at locations as directed by the pipe or fitting manufacturer so as to not damage pipe gasket or internal linings exposed to liquid.
  - 3. The electrical quality and resistance of the connection is dependent on proper adhesion of the welded connection to the pipe or fitting surface. Observe proper thermite weld material selection, safety precautions, surface preparation, and welding procedures as recommended by the material manufacturer.
  - 4. Use cast iron type charges for all cast iron and ductile iron pipe and fitting thermite weld connections. Use steel type charges for all steel pipe and fitting thermite weld connections. Utilize correct sized mold (as shown on metal tag on graphite mold) based on wire and pipe or fitting size and type. Utilize correct type and size of charges for each connection based on wire and pipe or fitting size and type. Cartridge charge type and size in grams is shown on box and charge tube.
  - 5. The wire and cable to be exothermically welded shall be clean, bright, and dry. Clean all wire that is contaminated with oil and grease in accordance with the thermite weld manufacturer's recommendations. Remove all corroded cable including the individual strands.

6. Before the connection is made, clean the surface to bare metal by making a two-inch (2") by two-inch (2") window in the coating, and then filing or grinding the surface with a grinding wheel to produce a bright (white) metal finish.
7. All power grinding shall be with a vitrified type-grinding wheel. The use of resin, rubber, or shellac-impregnated type grinding wheels is not recommended by the thermite weld manufacturer and will not be acceptable.
8. Contractor shall take appropriate actions for existing coatings with asbestos to minimize worker exposure and to contain, handle, and dispose of asbestos per regulations.
9. After the surface is cleaned to a smooth, white metal finish, lightly tap the pipe surface with a sharp tool (back of claw hammer or metal chisel edge, etc.) so as to produce dimples to improve surface profile and adhesion for the weld material.
10. In certain high humidity conditions, cold weather, or on cold or wet surfaces, preheating of the metal surface and/or molds may be required to improve successful connections and minimize porous welds.
11. Exothermic welding should be completed immediately following preparation of the metal surface before surface flash rusting or oxidation can occur.
12. Where specified wire sleeves shall be firmly attached to the end of the wire before thermite welding to the metal surface. Wire and sleeve shall be clean and dry. Wire shall extend 1/4-inch out of field formed sleeves. Factory formed sleeves shall be provided with end of sleeve beveled or angled so that wire is exposed to thermite weld material.
13. Utilize exothermic weld packing compound around mold as required on irregular or small weld surface areas to seal bottom of welder mold to prevent molten metal leakage.
14. Replace worn molds at intervals as recommended by the thermite weld manufacturer to minimize the possibility of molten metal leakage during the thermite welding process.
15. The mold and base metal should always be clean and dry. Avoid moisture and contaminants in mold and materials being welded as this may result in spewing of hot molten material.
16. Place a metal disk in the bottom of the graphite mold and then pour in the weld material or place the prepackaged weld material cartridge in mold. Squeeze the plastic cylinder to get all of the starting powder out. Close the mold body lid.

17. Place the graphite mold on the prepared pipe surface and install the wire in the slot at the bottom of the mold. Confirm that the mold and wire provide a proper fit and that the mold is in intimate contact on all sides with the surface being welded to. Hold the wire and mold steady and firm on the pipeline or fitting surface.
  18. Ignite the weld material with the spark gun or electrical starter depending on type of charge. Lightly tap the mold body during the ignition fusion process. Carefully remove the graphite mold after the exothermic fusion process is completed approximately 15 to 20 seconds later.
  19. Care should be taken during the thermite welding process, as the exothermic process produces a molten liquid metal that is extremely hot, 2,500° F (1,400° C) and will result in a local release of smoke. Do not watch the bright light (flash) or breathe the fumes from the thermite welding process.
  20. Do NOT sharply hit or move the graphite mold body during the thermite weld process to minimize expelling the molten metal out of the graphite mold.
  21. The graphite mold should not be touched or allowed to come in contact with the pipe coating or other flammable or meltable materials, as it is extremely hot. Carefully clean the slag out of the graphite mold body with the mold cleaner intended for that mold size and type.
  22. After the weld connection has cooled, remove slag, visually and physically test quality of connection by tapping with a hammer and lightly pulling on the wire. The completed weld should visually present a good appearance of a well-formed connection with a minimum loss of weld material or splatter. All portions of the wire and sleeve shall be covered with the weld material. Remove and replace all visually defective, porous, or poor welds.
- I. Narrow or Small Fitting Attachment Locations: Thermite weld connections on metallic fittings, restraint devices, sleeve type coupling rings, mechanical joint follower gland rings, or bolted restraint joint ring type joints, and couplings where only a small or narrow metallic surface is available shall be carefully done so as to not damage the internal lining, O-ring, or damage the fitting.
1. Two or more wires can be attached under the same thermite weld connection as long as the bond or pigtail wires are not being connected to the same structure under the same thermite weld.
  2. Apply approved mastic packing material around mold to keep molten thermite material in place. Do not hold mastic packing material in-place with bare or gloved hands.

3. Completing connections prior to complete fitting assembly and installation of the fitting into the trench so as to allow the thermite weld connection to be made to a level surface on top of the fitting is the preferred method.
4. Vertical connections after the fitting is assembled and in the trench is a more difficult type connection to make.
5. Coat with epoxy repair coating as provided in these specifications.

J. Pin Brazing Method:

1. Authorized BAC pin brazing manufacturer technical representative shall demonstrate and observe proper connection procedures for a minimum of ten (10) connections for each type of joint bond and test wire size and type utilized on project.
  - a) Weld connection shall be cleaned to bare white metal similar to that for thermite weld type connections.
  - b) Load pin brazing gun with proper sized and type of pin and ferrule. Only direct to metal type connections are allowed. No threaded bolts or nuts are allowed.
  - c) Activate pin brazing unit to braze the cable and lug to the pipe or fitting surface.
  - d) Visually inspect, physically test with hammer, and conduct DLRO electrical test of completed connection.
  - e) Coat similar to that for thermite weld type connections.

K. Silver Solder:

1. Use for electrical connection of copper wire to thin-wall steel tubing (0.035-inch wall or less), copper, or stainless steel pipe and pin brazing connectors.
2. Silver solder connections shall be made at locations on the edge of the fitting lip at a location that will not damage the rubber gaskets.
3. Before the connection is made, clean and flux the area around the connection with a suitable flux as recommended by the pipe manufacturer for the materials being soldered.
4. Weld the copper sleeved wire to the fluxed area with the suitable silver brazing alloy in such a manner that the completed connection is free of cracks or crevices in accordance with the solder manufacturer's recommendations.
5. After the connection is completed, allow to cool, and remove the remaining flux by wire brush and solvent clean (SSPC-SP-1).

6. Clean and coat silver soldered connections on copper and steel appurtenances with epoxy repair coating. Stainless steel connections do not require coating.
- L. Ground Clamps:
1. Wire connections to copper service pipe shall be made with a bronze clamp. Clean service pipe and wire and attach to service pipe in accordance with ground clamp manufacturer's recommendations.
- M. Pipe coating shall be protected during thermite welding or soldering procedures. Coating damaged by welding or weld splatter shall be repaired per this specification section. Welded area shall be allowed to cool to "warm to touch" condition prior to application of primer and field coating.
- N. Each bond wire shall be visually and physically tested before coating according to the "Electrical Continuity Testing" section of this specification. Remove, replace or install additional joint bonds at all locations not passing electrical or physical tests.
- O. All damage to pipe or fitting coatings or linings, gaskets or O-rings, and/or plastic pipe or fittings, etc., shall be repaired by the Contractor at his sole expense.

### 3.05 WIRE CONNECTION COATING

- A. Clean weld area and coat with epoxy repair coating per manufacturer's directions over each completed connection after testing.
- B. In cold weather, store coating repair materials in a heated location and keep warm until use.
- C. The pipe and factory-coating surface shall be clean and dry before application of epoxy repair coating.
- D. Liquid Repair Epoxy Coating Application - Wire connection shall be completed with a liquid one hundred percent repair type coatings.
1. Complete surface preparation and apply one hundred percent (100%) solids, low temperature epoxy repair coating in accordance with coating manufacturer's directions.
  2. Total minimum dry film thickness shall be 20-mils, apply in multiple coats if required by manufacturer of specific coating utilized.
  3. Allow coating to cure to sufficient degree to prevent damage to coating, prior to handling and backfilling.
  4. Strictly follow minimum cure time recommended by coating manufacturer based on surface and ambient temperatures.

- E. All exposed metallic surfaces not covered by the epoxy repair coating, shall be repaired per PIPE AND FITTING COATING REPAIR.

### 3.06 PREPACKAGED GALVANIC ANODE INSTALLATION

#### A. General:

1. Remove plastic or paper shipping wrap from prepackaged anode prior to placement. Galvanic anodes packaged in cardboard type chip-tube shall be thoroughly perforated just prior to installation.
2. Install galvanic anodes a minimum of 1-foot below the fitting invert and 3 to 5-feet from buried metallic piping or 3-feet from metallic fittings to be protected.
  - a) Space galvanic anodes equally around the fitting, pipe section, or appurtenance. Locate at bottom edge of pipe trench as shown on the Drawings or as specified.
  - b) If two or more anodes installed at the same location, place on opposite side of the pipe or fitting.
  - c) Provide a minimum anode spacing of 5-feet from other unprotected pipelines.
  - d) In general, the standard location for galvanic anodes shall be on the north or east side of the fitting, valve or other metallic appurtenance being protected. However, it may be necessary to adjust the location dependent upon underground obstructions. Regardless, the installed location of the anodes shall be marked on the Contractor's red line drawings.
3. Handle prepackaged anode with care. Damage to the anode, anode to wire connection, or prepackaged backfill bag will require replacement of the entire assembly.
4. Place anode in native earth backfill do not use pipe zone bedding material.
5. Earth backfill around each anode shall be thoroughly compacted to a point 1-foot above the anode. Backfill material around each anode shall be native soil free of roots, organic matter, trash, and rocks. Stop backfill at specified grade to allow for placing of topsoil, pavement, or concrete, when required.
6. All anode wires shall be buried a minimum of 36-inches below finish grade. Wires shall be handled with care. Splices or damage to the insulation on any wire shall be repaired in accordance with WIRE INSULATION REPAIR and be approved by Engineer.

7. Electrical connection of the anode wire to steel, cast or ductile iron metallic pipe or fittings shall either be directly to the pipe or fitting by the thermite weld or pin brazing type method or through a test station with shunt as shown on the Standard Details.
8. Electrical connection of the anode wire to stainless steel fittings shall either be directly to the stainless steel fitting with a silver solder or ring tongue terminal physical type connection or through a test station with a shunt as shown on the Standard Details.
9. Electrical connection of the anode wire to copper services shall either be directly to the copper service by a ground clamp or through a test station with a shunt as shown on the Standard Details.

B. Installation:

1. Each buried or submerged metallic (steel, ductile, or cast iron) pipeline section, appurtenance, intermediate pipe restraint, valve, or fitting shall receive a minimum of one galvanic anode.
2. All metallic valves, blow-offs, air valves, or fittings located in vaults on plastic pipeline, which will be either continuously or intermittently under the water table shall be cathodic protected as if buried. Place galvanic anode inside vault and attach directly to metallic fitting.
3. Install a minimum of one each or more 17-pound or 18-pound galvanic anode for each copper service line on each side of the curb stop or insulated coupling at the tie-in to the existing service line.
4. Install a minimum of one each or more 17-pound or 18-pound galvanic anode for each connection to existing ductile, cast iron, steel, or PCCP piping. Type of Prepackaged Anodes is project specific.
  - a) Prepackaged zinc galvanic anodes for protection of metallic pipe and fittings in lower resistivity soils (1,500 ohm-cm or below).
  - b) Prepackaged magnesium galvanic anodes for protection of metallic pipe and fittings in soils with higher resistivity soils (1,501 ohm-cm or above).
5. Where two or more metallic fittings are adjacent to each other, install joint bonds as specified in PIPE CONNECTING WIRES, and install the specified quantity of galvanic anodes for each metallic pipe section, appurtenance, valve, or fitting used in conjunction with nonmetallic pipe.
6. At the Contractor's option, larger anodes may be used in place of multiple smaller anodes for a group of bonded metallic components on non-metallic piping provided the same total bare weight of galvanic anode is used. Maximum separation distance shall be 5-feet on fittings to be protected with one anode, if multiple fittings are bonded together.

7. For metallic (steel, ductile iron and cast iron) fittings, where specified coating thickness is not provided or specified holiday testing and/or 100% holiday free coatings are not completed by the fitting manufacturer, or bare fitting is coated with petrolatum tape type coating system; then install one specified size larger anode or double the number of anodes for each fitting than listed on the following table.
  - a) If one 17 or 18 pound anode is required per the following table and coating thickness is not as specified, then at Contractor's option, install either a 30-pound anode or two 17 or 18 pound anodes.
  - b) Existing fittings that are exposed and coated with a four layer petrolatum tape type coating system, shall receive double the number of anodes specified or the next largest anode size shown in these specifications.
    - 1) For example, if a bare fitting (16-inch or less) is exposed and petrolatum tape coated, it shall receive a 17 or 18 pound size.
8. The minimum number of anodes to be installed on buried or submerged factory coated metallic fittings, pipeline sections, or appurtenances with non-metallic pipelines shall be in accordance with Table 8B.9.

### 3.07 TEST STATION AND/OR TRACER WIRE ACCESS BOX INSTALLATION

- A. Cathodic protection test stations and tracer wire access boxes of the types indicated shall be installed and located as specified herein and as shown on the Drawings. Current span wires, reference electrode, coupon, plastic reference pipe, or resistance probe shall be installed only at test station locations indicated on test station schedule.
- B. Install test wires to pipe and tracer wires only during pipe construction at time of pipe installation along with the necessary reference electrode, coupons (minimum of two each), plastic reference monitoring pipe, drain/ground anode, or resistance probes if required before the pipe is backfilled and compacted around. Install sufficient wire to reach test station final location. Test station boxes and support posts can be completed at a later date. Take actions to protect wires from damage if not terminated in test station or junction box at this time.
  1. Test station or tracer wire access box types shall be installed on metallic pipelines or fittings as shown on test station schedule or drawings per the test station types as follows:
    - a) Install flush-mounted test stations at specified galvanic anode installation locations on metallic fittings on plastic pipeline sections.

**Table 8B.9 Minimum Quantity and Size of Galvanic Anodes**

<b>DESCRIPTION</b>	<b>0" TO 16" DIAMETER</b>	<b>18" TO 30" DIAMETER</b>
Single Coated Metallic Fitting	1-17# Mg or 1-18# Zn Anode	1-17# Mg or 1-18# Zn Anode
Two (2) Metallic Fittings (5-foot separation MAX)	1-17# Mg or 1-18# Zn Anode	2-17# Mg or 2-18# Zn Anodes
<b>COATED</b> Fire Hydrant or Blowoff Assembly (coated tee, valve and hydrant) with <b>PVC</b> main and 6-inch <b>PVC</b> lead less than 10 feet long	1-17# Mg or 1-18# Zn Anode	1-17# Mg or 1-18# Zn Anode
<b>COATED</b> Fire Hydrant or Blowoff Assembly (coated tee, valve and hydrant) with <b>PVC</b> main and 6-inch <b>METALLIC</b> lead less than 10 feet long	2-17# Mg or 2-18# Zn Anode	2-17# Mg or 2-18# Zn Anode
1-inch thru 2-inch copper service line	1-17# Mg or 1-18# Zn Anode	1-17# Mg or 1-18# Zn Anode
Existing metallic pipe tie-in, concrete encased stub piece or on existing metallic main at new service tap	1-17# Mg or 1-18# Zn Anode	1-17# Mg or 1-18# Zn Anode
Existing metallic pipe LEAK location	2-17# Mg or 2-18# Zn Anode	2-17# Mg or 2-18# Zn Anode

2. Tracer Wire Access Boxes

- a) Install flush-mounted tracer wire access boxes at each end of all plastic pipe runs and at specified locations on plastic pipeline sections.
  - 1) Install tracer wire access boxes at each end of all plastic pipe runs whether shown on the test station and tracer wire access box schedule or drawings or not.
    - a. This includes plastic water services between the curb stop and the building being served.
    - b. In the instance of private plastic water services, the tracer wire access box shall be placed within the street right-of-way adjacent to the curb stop or within a utility easement.
  - 2) Install tracer wire access boxes at locations shown on test station and tracer wire access box schedule or drawings at

maximum two thousand foot (2,000') spacing for cross-country transmission type pipelines and five hundred feet (500') for in-town transmission or distribution type pipelines or shorter spans.

- b) Cased Crossings
  - 1) Install flush-mounted tracer wire access boxes on each side of cased crossings.
  - 2) Install flush-mounted tracer wire access boxes on each side of cased crossings where anodes connected directly to casings.
- C. Color-code wires per specifications before installation of wires in conduit or backfilling of the test station wires.
- D. Wherever possible test stations or access boxes shall be located directly over the centerline of the pipeline. In locations, where pipe is in field and parallels a fence, install test station or access box next to and on parallel fence line. Desired maximum offset distance from pipe centerline shall be 15 feet or at edge of right-of-way which may be up to 50-feet as directed by Engineer for future physical protection of test station.
- E. Locate next to other above-grade facilities and structures for protection, where possible. Install in protected locations, so as to not restrict intended use of the land, outside roadways, cultivated fields, and irrigation facilities.
- F. Install at protected locations such as next to pipeline structures, fences and road crossings. The Engineer shall determine the final location. Changes in the location of any test station shall be reviewed and approved by Engineer prior to installation.
- G. At test stations, where multiple metallic fittings are bonded together by No. 12 AWG bond wires on plastic pipelines, install one test lead to first fitting from the test station and second test lead to farthest fitting from the test station. This will allow the continuity between the metallic fittings to be confirmed.
- H. Flush mounted test stations or tracer wire boxes shall be located directly over pipeline, except in areas of heavy traffic conditions. Where heavy traffic conditions exist, locate to the side of the street.
  - 1. Compact under, and install flat support blocking or brick under flush mounted test stations or tracer wire boxes for support. Install supports and concrete collar around test station so as to prevent settlement.
  - 2. Install a minimum 6-inch thick concrete collar either in a minimum 2-foot square pad or 3-foot diameter round pad around flush mounted test stations or tracer wire boxes as shown on Drawings. Shape as selected by Owner.

3. When installed in roadway, rotate flush mounted test station or tracer wire box square concrete slabs so that slab points toward traffic flow.
  4. Concrete collar and test station lid shall be set level and flush with the top of curb, sidewalk or roadway. Concrete collar and test station or tracer wire lid shall be set level and ½ to 1-inch higher than finished grade in open dirt and lawn areas. Test stations and collars that settle or are set too low or high shall be replaced at Contractor's sole cost.
  5. Provide sufficient slack in test wires to allow terminal block to extend a minimum 18-inches out of test station body or tracer wire box.
  6. Do not connect test or tracer wire terminal board to flush mounted test stations or access box lids that may short wires together.
- I. Test wires shall be attached to the pipe as specified under WIRE CONNECTIONS, this section and if possible installed under the heat shrink sleeve joint coating.
  - J. Test wires shall be provided with sufficient slack and looped or coiled at the test station and pipeline to prevent the wire from being unduly stressed or broken during backfilling operations. Install test wires to top test station terminals. Wires shall be installed in a continuous length.
  - K. All cathodic protection and test wires shall be buried a minimum of 36-inches below finished grade.
  - L. Test stations shall be located and identified by test station location tags. Contractor shall supply the type and number of location tags sufficient for the number of test stations listed in the Test Station Schedule for the project. One UNSTAMPED tag shall be left in each test station. City personnel or Engineer will stamp the tags with appropriate identification at the time of final acceptance testing.
  - M. Wire connections to test station terminals shall be with crimp-on ring tongue terminals, or lug-it connectors, except where terminal strips with tubular clamps are used.
  - N. Connect wires to test station terminals as shown on Drawings. Wire type, color code, and marker tag designations as shown on Drawings and specified under PRODUCTS in this section, shall be maintained throughout project.
  - O. Seal completed wire connection test lead terminals with electrical sealer for all buried flush mounted test stations and at above grade test station locations where high atmospheric corrosion may occur. Clean surface of all dirt, wax, grease and other surface contaminants. Protect or mask other areas from spray application, vigorously shake aerosol can before and during spray application. Apply 2 to 3 mil layer from a 12 to 15-inch distance in light even coats. Allow to dry and close up test station.

### 3.08 WIRE INSULATION REPAIR

- A. Wire splices shall be made with suitably sized Type C compression connectors as specified or mechanically secured and silver soldered. Inline type butt connectors or wire nuts are **NOT** allowed. Split bolts are **NOT** allowed unless silver soldered and both wires are No. 10 AWG wire or smaller.
- B. Minor insulation damage to small cathodic protection wires (equal to or smaller than No. 8 AWG) shall be repaired by spirally wrapping (minimum of 50 percent overlap) with two layers of high voltage rubber splicing tape and two layers of vinyl electrical tape coated with an approved electrical seal coat in accordance with the tape manufacturer's installation instructions, or with a specially fabricated splicing kit, or made with an approved epoxy insulated splice kit.
- C. Insulation damage or splices to large cathodic protection cables (No. 4 AWG or larger) shall only be made with an approved epoxy insulated splice kits.
- D. Install splice kits in accordance with the product manufacturer's written directions. Allow splice kits to cool and set before moving.
- E. All wire splices and wire insulation repair locations shall be observed by the Engineer.

### 3.09 WARNING TAPE

- A. Bury warning tape above all underground cathodic protection cable and conduit. Warning tape shall be placed approximately 12-inches above pipe and structures being identified or at specified depths as required in other sections of this contract document or shown on the details. Align parallel to and within two (2) inches of the centerline of conduit or cable run.

### 3.10 PLASTIC PIPE TRACING WIRE

- A. Insulated stranded copper or copper clad steel tracer wire shall be installed on all non-metallic pipe sections.
- B. Pipe tracing wire shall be taped to top of plastic or non-metallic pipeline at a maximum distance of every ten feet (5') with polyethylene tape with full circumferential wraps.
- C. For short section of plastic pipe (if less than 50-foot distance), where two No. 12 AWG wires are already used to bond the metallic fittings to the metallic main line, the No. 12 AWG bond wires can be utilized in place of the tracer wire for these locations. These No. 12 AWG bond wires are not the same as test station wires. If listed on the test station schedule install separate wires for the test leads.
- D. For plastic pipe installed by directional drilling in bores, install tracer wire in heavy duty plastic conduit bored in at the same time as the waterline. Terminate tracer wires at each bore pit in flush type tracer wire access boxes.

- E. Do not attach tracing wire directly to metallic fittings or appurtenances.
- F. Install tracer wire access boxes and terminate tracer wires at all fire hydrant assemblies, each end of all casings, bores, building or tank walls, and each end of a pipe run.
- G. Install test station or tracer wire access boxes at the end of all plastic pipe runs whether shown or not on the test station and tracer wire access boxes schedule and/or drawings.
- H. Maximum tracer wire span distance shall be:
  - 1. **Rural Plastic Pipelines:** Two thousand feet (2,000') for cross-country type pipelines. If no existing pipe appurtenances are available for a distance up to four thousand feet (4,000'), then install flush type tracer wire access boxes. Equally divide span distance and install a tracer wire access box or test station at mid-point in a protected location.
  - 2. **In Town Plastic Pipelines:** For in-town transmission or distribution type pipelines, the maximum span distance shall be five hundred feet (500') or less.
- I. On private plastic water service lines, tracer wire shall extend from the curb stop to the residence. The tracer wire from the plastic service line shall be clamped to the copper service line using a brass ground clamp. A single tracer wire shall be extended up the curb stop box and terminate above ground in order to trace both to the main and to the residence.
- J. Field terminate tracer wires in accordance with the Drawings by:
  - 1. Bring end of tracing wire leg from each pipe direction to above grade surface elevation by installing a tracer wire flush or abovegrade access box or test station. One tracer wire end shall come from each pipe direction.
  - 2. Terminate tracing wire abovegrade at flush or abovegrade test access boxes or test stations located next to pipe appurtenances (vaults, vent pipes, blow-offs, or at fire hydrant bases).
  - 3. Tracer wire shall be electrically continuous between tracer wire access boxes and/or test station locations. Tracer wires shall not be terminated in valve boxes or below grade.
  - 4. Make tee or inline splices and insulate as specified under section "Wire Insulation Repair" only when observed by Engineer.
  - 5. Terminate tracer wire in a flush or abovegrade access boxes per test station schedule in accordance with Engineer direction.
  - 6. If tracer wires in vault, drill vault wall or roof above maximum waterline and terminate outside vault in an access box next to the vault or vent pipe

(if present). Seal so as to minimize entry of liquid in the conduit or vault structure. Terminate tracer wire in vaults next to ladder to allow easy access for attachment only if approved by Engineer.

7. Install access boxes in accordance with test station installation procedures and terminate in box with ring tongue terminals.
- K. Test tracer wire for *continuity* with an approved method in accordance with the specified functional testing per this specification section, prior to final acceptance of the pipeline installation. Functional testing to be completed by Contractor as a minimum shall consist of the following:
1. Test tracer wire prior to placement of curb and gutter.
  2. In roads and streets, test tracer wire after placement of road base but prior to placement of pavement.
  3. At end of project after all excavations have been completed.
  4. Use of pipeline locator equipment for functional testing is not recommended.

### 3.11 INSULATED JOINTS

- A. Insulated joints shall be installed to electrically isolate the pipeline from other structures.
1. Insulated joints shall be located at connections to existing metallic pipe, where loose bonded coated (polyethylene encased) pipe is connected to tight bonded coated pipe, where concrete encased pipe is connected to dielectric coated pipe, where cathodically protected pipe connects to pipe not intended to have cathodic protection, and where shown. Install a Type I test station at each buried insulated joint.
  2. Insulated joints shall be utilized to isolate electric motors and magnetic water meters from cathodically protected pipeline sections.
  3. Provide electrical shields at locations where other metallic structures (pipe supports, conduit, bare ground wires, etc.) either may be in contact with piping or are in close proximity to the pipe. Install on both sides of the insulated joint so as to maintain electrical isolation.
  4. Install electrical shield between pipelines at crossings or close parallels as shown on drawings or specified.
  5. Install copper insulating joints where copper services are connected to metallic water mains and at service meters or curb stops where ownership of copper service lines changes.

- B. Install insulated joints at locations listed on test station schedule or as shown on the Drawings. Coordinate and carefully follow both insulating joint and manufacturer's recommendations for large diameter insulating joint installations.
- C. Allowable insulating joint type for maximum pipe diameter size for buried locations shall be 36-inches for insulating flanges.
- D. Install insulated joints abovegrade in buildings, vaults, and manways whenever possible. Insulated joints shall be installed a minimum of 12-inches clearance above floor or from wall to allow access for testing and maintenance. Maintain clearance from other structures or provide electrical shields as required to maintain electrical isolation.
- E. Insulated joints shall be provided over-voltage protection with ground cells, flange protectors, or polarization cell replacement (PCR) devices at locations as shown on the Drawings and/or listed on the test station schedule.
- F. General:
  - 1. Carefully align and install insulating joints according to the manufacturer's recommendations to avoid damaging insulating materials.
  - 2. Support, backfill, and compact pipe and fitting in accordance with the insulator and pipe manufacturer's recommendations so as to not cause leaks or damage to the insulating joint.
  - 3. Test each insulating joint as specified under FUNCTIONAL AND PERFORMANCE TESTING this specification section. Test buried insulating joints before and after backfilling.
- G. Insulated Flanges: Install insulated flanges, sleeves, and washers according to manufacturer's recommendations.
  - 1. Bolts for insulated flanges and restrained couplings should be undersized or holes slightly oversized to allow installation of insulating sleeves. Bolts shall be threaded for full length. Coordinate with fitting manufacturer and insulating flange manufacturer.
  - 2. Clean flange surface and holes of all dirt, grease, oil, and contamination. Examine flange and bolt holes for burrs, sharp edges, or spurs. Remove any irregularities.
  - 3. Confirm that both flange faces are free of all pits, dents, gouges, grooves, corrosion, burrs, or other type of irregularities. Both flange faces surfaces shall be smooth with a finish no rougher than 250 RMS. Refinish flange faces if surface too rough in accordance with flange insulator manufacturer's recommendations.
  - 4. Align flanges so that they are concentric and parallel and carefully install flange gasket so as to not damage sealing element. Do not use grease, lubricant or adhesives on either the flange faces or the flange gasket.

5. Check bolts and nuts and clean as required. Apply non-conductive lubricant to all threads and flange side of nuts.
6. Carefully align bolt holes to minimize damage to insulating sleeves during assembly. Line up bolt holes with non-tapering drift pins at a minimum three locations with 120 degrees separation.
7. Carefully measure and adjust sleeve length as required to provide an air gap (space) between end of sleeve and nut after flange is tightened down, length as recommended by the insulator manufacturer.
8. Carefully insert sleeves over bolts and place insulating washer and metal washer over end, line up holes in fitting, install bolt with sleeve into place. Do not force bolt insulating sleeves into the flange hole. If force is required to insert the insulating sleeve, check alignment and readjust as required. Replace any damaged insulating bolt sleeves as required. Place insulating washer and metal washer on opposite end with nut.
9. Two insulated washers, one on either side of insulator are required for all abovegrade applications. Insulating washers are only required on the unprotected pipe side for buried or immersed insulated flange locations.
10. Tighten bolts a few turns at a time in sequence and procedure as recommended by insulator manufacturer until all bolts are uniformly tightened. Repeat torque sequence; repeat tightening in sequence to final torque. Do not exceed manufacturer's recommended pounds per square inch of pressure during initial torque-up. Go completely around flange rechecking all bolts for correct torque. All bolt tightening shall be done in accordance with insulating flange manufacturer's recommended sequence with torque wrenches (mechanical or hydraulic) or with a stud tension measuring device.
  - a) For all above grade flange locations recheck bolt tightness after system has been pressurized.
11. Visually inspect for physical damage to insulating sleeves or washers, replace if cracked or damage observed. Check flanges (visually with a flashlight, calipers, or feeler gauge, etc.) for a section that may not be aligned correctly and which may show a gap or separation. Correct in accordance with the insulating flange manufacturer.
12. Test for electrical isolation before top-coating.
  - a) In abovegrade locations where high humidity or high contamination present, seal with rubber caulk type sealer or provide and install above grade flange protectors at insulating flange locations in corrosive or wet environments in accordance with specific product manufacturer's instructions.
  - b) In buried locations, coat after assembly and testing as specified.

- H. Insulated Couplings: Install insulating boots and insulated flexible couplings in accordance with the manufacturer's recommendations and AWWA Standard C219.
1. Clean, and install insulated boot (sleeve, band, etc.) over end of each pipe, two boots required for each location. Push insulating boot into place over pipe until small insulating boot lip contacts pipe end. Clean, lubricate, and install other sealing gaskets, middle ring and follower rings according to manufacturer's recommendations.
  2. Line up and install bolts as required. Tighten bolts a few turns at a time in sequence and procedure as recommended by insulator manufacturer until all bolts are uniformly tightened. Do not exceed manufacturer's recommended pounds per square inch of pressure during initial torque-up. For all above grade locations recheck bolt tightness after system has operated.
  3. Insulating boot should be visible on either side of coupling when completed.
  4. Bond buried coupling body into protected pipe side with pigtail wires.
  5. Test for electrical isolation both before top-coating insulated couplings and after burial.
- I. Restrained Insulated Joints:
1. If insulated flexible coupling are utilized electrically isolate restraining rod assembly with insulating G-10 sleeves and washers on both ends of restraining rods. Oversize restraining device bolt holes or undersize restraining rod as required to not damage insulating materials and still meet specified restraining strength and pressure requirements. For buried or submerged insulator locations, only install insulating sleeve and insulating washer on unprotected end of restraining rod assembly.
  2. Test restrained rod installation for electrical isolation prior to top-coating or backfill. Coat per specification if not stainless steel or fusion bonded coated rod, with heat shrink, liquid 100 percent moisture cured epoxy repair coating, or petrolatum tape coated.
  3. Test buried insulator both prior to and after backfill.
- J. Buried Flange Insulator Coating: At buried insulated flange locations, Contractor shall coat exterior portion of insulating joint after assembly and testing. At Contractor's option, coating shall consist of either:
1. Four layer petrolatum wax-tape system intended for burial conditions per AWWA C217.
  2. A 100-percent solids epoxy mastic coating, filler tape top-coated with two layers of specified pipeline joint/repair tape coating, or heat shrink sleeve.

- K. Copper Service Line Insulators: Install insulated corporation ball valves, insulated curb ball valves, and insulated service fittings at locations as shown on the Drawings in accordance with the service liner manufacturer's instructions.

### 3.12 INSULATING WALL AND FLOOR SLEEVES

- A. Coordinate and install pipe and wall sleeve so as to provide a smooth uniformly round shape opening per pipe and modular seal manufacturer's recommendations.
- B. Coordinate pipe fabrications, wall sleeves and modular seal types and sizes for wall or floor penetrations to allow for the watertight sealing system used at wall or penetrations. Install pipe and wall sleeve or core wall so as to provide uniformly round shape, grind as required to control weld seam height per pipe and modular seal manufacturer's recommendations. Factory grind all welds at wall sleeve location and a minimum of 12-inches on either side of wall or floor opening, do not remove parent material during grinding operations. Repair coating as required.
- C. Insulating wall or floor sleeves or seals shall be installed according to manufacturer's recommendations. Wall sleeves shall be positioned so that the water stop (collar) is centered in the width of the opening and the water stop (collar) contacts the opening evenly for the minimum 1-inch distance or more as recommended by the modular seal manufacturer. Center the pipe in the opening and adequately support on both sides. Make sure that the pipe, opening, and wall sleeve are clean, smooth, and round. Install the exact number of links per the manufacturer's recommendations for the size and type of opening and pipe diameter.
- D. Install the links in the same direction so that the bolts can be tightened from the inside of the building or vault location. Assemble, insert, align, and evenly tighten insulating modular seal in accordance with the manufacturer's installation instructions so as to not damage pipe coating or insulating modular seal. Position centering blocks for casing end seal type installations on bottom one-half of the pipeline as recommended by the modular seal manufacturer. Position the modular seal so that it is centered in the wall sleeve and that when tightened down it provides an even, uniform spacing in the wall sleeve. Take up free slack in bolts and then tighten each bolt clockwise in opposing succession at torque and sequence as recommended by seal manufacturer. Evenly tighten the individual bolts the maximum number of turns as recommended by the manufacturer until the sealing elements bulges around all of the pressure plates. Do not use power tools to tighten stainless steel bolts. Completed installation shall provide long term insulated and sealed (liquid tight) connection between pipe and floor or wall opening, sleeve, or casing.
- E. Insulating wall or floor sleeve shall be positioned so as to allow adjustment from interior side of building and vault locations and exterior side of water bearing structure locations.

- F. For water bearing structures or for locations if shown on the drawings install a second modular wall seal.

### 3.13 ELECTRICAL SHIELDS

- A. Install electrical shields between sections of cathodically protected pipe and pipe supports connected to or sitting on unprotected supports or structures, so as to maintain electrical isolation as shown on the drawings.

### 3.14 FACTORY AND FIELD REPAIR COATINGS FOR PIPING, FITTINGS AND ACCESSORIES

- A. Miscellaneous Incidental Metallic Pipe, Fitting, and Appurtenance Coating Field Quality Control Testing
  1. Conduct quality control testing in the field on miscellaneous factory coated fittings and appurtenance in accordance with this specification section. Conduct dry film measurements and holiday test to confirm conformance with specifications and referenced standards.
  2. Conduct dry film thickness measurements in accordance with SSPC PA-2 with exception that the specified thickness is the absolute minimum.
    - a) A minimum of 10 dry film thickness measurements shall be completed on each 40 foot length of pipe.
    - b) A minimum of two dry film thickness measurements shall be completed for each fitting or appurtenance.
  3. Conduct 100-percent holiday inspection of all factory-applied coatings.
  4. Repair with provided repair kits or repair materials recommended and approved by the original coated material manufacturer.
- B. Field testing, surface preparation and coating for field coating or repair of damaged coating on new or existing pipe, piping, appurtenances, and fittings shall be in accordance with this specification section
  1. Inspect and repair any coating or lining damage with original manufacturer's approved repair kit.
  2. Follow coating manufacturer's written directions for surface preparation and repair coating application.
  3. Utilize potable water approved materials for coatings and linings in contact with potable water.
  4. Complete surface preparation and field repairs of coatings and linings in accordance with coating manufacturer's written directions.
  5. Observe environmental (weather and surface temperature) requirements.

6. Allow to cure in strict accordance with coating manufacturer's recommendations based on surface and weather conditions prior to handling, burial, or exposure to liquids.
- C. External incidental pipe and fitting field or repair coatings shall consist of external coating materials and repair procedures as recommended by the original pipe or fitting coating manufacturer.
1. Fusion-bonded epoxy coated items shall be repaired with epoxy repair coating outlined in these specifications.
  2. Epoxy coated items shall be repaired with repair coating from the original coating manufacturer.
  3. Spot coating damage at thermite weld connections shall be repaired with a 100-percent solids epoxy repair coating that can cure in either wet or dry conditions.
  4. Field epoxy coat, tape coat or heat shrink sleeve, short sections of buried metallic piping such as vent pipes, blow-off assemblies, and pipe stubs to be concrete encased under or next to buildings or tanks if not already coated with an approved specified factory applied coating system.
  5. Provide epoxy coatings for pipe and fittings in vaults if not already coated with an approved specified factory applied coating system. Provide epoxy/polyurethane enamel type coating system for abovegrade appurtenances if not already factory coated with an approved specified factory applied coating system.
- D. Repair or field coatings shall overlap intact factory coating a minimum of 1/2" inch in all directions from the damaged area.
- E. Install coated valves, fittings, and miscellaneous metallic pieces so as to not damage coating or lining.
- F. Coat rebar or tie-rods where utilized as tie-downs or thrust restraints and exposed to soil or liquid with fusion bonded epoxy, heat shrink tube, or four layer petrolatum tape system.
- G. Fitting and Appurtenance Fasteners (Bolts, Nuts, and Similar Items): Series 300 stainless steel or fusion bonded epoxy coated depending on specified location.
1. All bolts and nuts shall be installed according to manufacturer's requirements including the use of anti-galling lubricant compound for stainless steel materials.
    - a) If galling or seizing of the nut and bolt occurs they shall be cut off and replaced with a new nut and bolt.
    - b) Exercise care to assure tightening of the nut is against the flange or gland and not due to galling or seizing.

2. Conduct testing of Series 300 stainless steel materials with magnet to confirm Series 300 stainless steel provided prior to installation.
- H. If approved by Engineer, coat miscellaneous hard to coat items with four layer petrolatum tape system or heat shrink repair coating.

### 3.15 FIELD COATING FOR INCIDENTAL STEEL AND DUCTILE IRON PIPE STUB PIECES, FITTINGS

- A. Field tape coat or heat shrink sleeve, short sections of buried metallic piping such as vent pipes, blow-off assemblies, and pipe stubs to be concrete encased under or next to buildings or tanks if not already coated with an approved specified factory applied coating system.
1. Bituminous asphaltic coating does not qualify as an approved factory tight bonded coating.
- B. Follow the coating manufacturer's recommendations, and the referenced AWWA Standards.
1. Acceptable products are specified under "PIPE AND FITTING COATING REPAIR MATERIALS".
  2. Solvent wipe per SSPC SP-1 if required to remove contamination.
  3. Hand tool clean surfaces for small surfaces only. Abrasive blast location areas larger than 12-inch square. Abrasive blast to SSPC SP-10 (Near White) for external surfaces and SSPC SP-5 (White) for internal surfaces.
  4. Repair coating should overlap intact factory coating a minimum of four inches in all directions from the damaged area.
  5. Field Tape Coating:
    - a) For hand taping, provide suitable field primer (if required) and 35-mil field applied repair tape with aggressive adhesive and release liner, 4 or 6-inches width. Apply with 50-percent overlap for a minimum 70 mil hand tape coating system.
    - b) Pipe shall be clean and dry prior to and during application of both primer and tape coating. Tape shall be applied in a spiral wrap with a 50 percent overlap in accordance with AWWA C209 Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
  6. Heat Shrink Field Coating:
    - a) For heat shrink sleeve installation, provide suitable filler material and heat shrink sleeve material for pipe size required or heat shrink repair patch as required for field repair.

- b) Pipe shall be clean and dry prior to and during installation of heat shrink sleeve. Install sleeve in accordance with AWWA C216 Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines in accordance with coating manufacturer's recommendations and these specifications.

7. Moisture Cure 100-Percent Epoxy Repair Coating

- a) Spot coated damaged locations and hard to coat fittings and appurtenance (edges, flanges, tie-rods, bolts, nuts, etc.) locations shall be coated with a moisture cure 100-percent epoxy repair coating.
- b) Clean and prepare surface in accordance with repair coating manufacturer's directions. Wire brush and sand as required. Clean per SSPC SP-1 if required.
- c) Mix epoxy repair coatings at ratio and for time per repair coating manufacturer's directions. Apply to repair area by hand application method (brush, trowel, spatula, etc.) and smooth out onto intact coating in accordance with repair coating manufacturer's recommendations.
- d) Provide manufacturer recommended 25 to 30 MDFT coating thickness.

8. Petrolatum Tape Coating System

- a) Field apply petrolatum tape system for all restraining fittings and rods if not already coated with an approved specified factory applied coating system or stainless steel.
- b) Provide petrolatum system coating at insulated location to existing pipe or appurtenances exposed as part of connection installation if not already coated.
- c) Provide petrolatum system coating for isolated copper fittings if not already protected by a galvanic anode system.
- d) For petrolatum system tape installation per AWWA C217, provide suitable primer, filler material (mastic), petrolatum tape and outer wrap material for burial application.
  - 1) Pipe or fitting shall be clean and dry prior to and during installation of four layer petrolatum wax tape system.
  - 2) Install petrolatum tape system in accordance with coating manufacturer's instructions and these specifications.

- 3) Apply primer in an even uniform manner to entire tie rod, pipe, or fitting surface area to be coated to achieve minimum primer thickness of 3-mil wet film thickness. Increase amount of primer at and work primer into threads, cavities, pits, angles, edges, and other irregular areas. Apply primer with brush or glove.
  - 4) Apply mastic immediately after application of primer, drying of primer is not required. Work and mold mastic into irregular shapes so as to fill voids and achieve a uniform contour to provide a smooth even support for the tape coating system to avoid bridging.
  - 5) Apply one or more petrolatum tape layer(s) in a spiral wrap fashion around the tie rod or fitting circumference with a 50 percent minimum overlap onto the proceeding layer.
- e) Apply the 10-mil PVC outer wrap tape layer in a spiral fashion around the pipe or fitting with a 50 percent minimum overlap.
  - f) The completed petrolatum coating system shall be a minimum of 40 MDFT and adhere tightly to the coated structure and present a smooth unwrinkled appearance.

### 3.16 FUNCTIONAL AND PERFORMANCE TESTING

- A. Functional Testing: Provide the Engineer with a minimum of seven (7) calendar days' advance notice before beginning functional testing unless the Engineer is already scheduled to or already onsite doing construction observations (services during construction). At such a time as the Engineer may indicate, the Contractor, in the presence of the Engineer shall conduct the following functional testing.
- B. Test Stations:
  1. Test each test station wire for continuity, correct termination, and proper connection and color code to the designated structure.
  2. Test each wire for continuity with potential measurements to a copper/copper sulfate reference electrode and with an ohm-meter between wires prior to connecting together on the terminal board.
  3. Test the buried permanent reference electrode, if present, test leads and potentials to confirm correct operation. If the reference electrode does not provide equal or near equal potential measurements to a portable copper/copper sulfate reference electrode (convert if required depending on buried reference electrode type), then saturate the buried reference electrode by pouring water down the plastic monitoring pipe. Retest the buried reference electrode again several days later after the buried reference electrode is moist.

4. Testing results shall be recorded on Form 8B.1 and transmitted to the Engineer following completion of functional testing.
5. Do not connect reference electrodes to pipe test lead terminals.

C. Electrical Insulating Joints:

1. Test each insulated joint after assembly for electrical isolation in accordance with the insulation checker manufacturer's written instructions and by potential measurements.
2. Test insulator with radio frequency type insulator checker prior to backfill. Utilize a radio frequency type meter that is self zeroing such as the Model RF-IT manufactured by Tinker and Rasor or approved equal.
3. Test and provide electrical isolation as specified in accordance with NACE RPO286 "Electrical Isolation of Cathodically Protected Pipelines."
4. Buried electrical insulating joints shall be tested both before and after burial.
5. Test for electrical isolation at electrical shields between pipe and pipe supports and at wall or floor penetrations.
6. All defective electrical shields, pipe supports, wall penetrations, insulating joints, and/or damaged or defective insulation parts shall be corrected or replaced by the Contractor at his sole expense.

D. Tracer Wires:

1. Demonstrate correct installation of tracer wire access boxes and tracer wire continuity by field functional tests.
2. Acceptable tracer wire continuity testing methods shall consist of:
  - a) Electrical continuity (four wire) type testing that demonstrates voltage (potential) changes at end of line from temporary connection to a DC current source at far end of the tracer wire,
  - b) Verification of a voltage measurement to a test battery with the tracer wire as one side of the two wire circuit, and/or
  - c) Use of commercially available cable continuity verification testing equipment utilized in accordance with the test equipment manufacturer's written instructions.
  - d) Use of typical pipe locating type equipment may walk through tracer wire breaks and is not an acceptable continuity verification test method.

3. Contractor shall utilize Form 8B.2 for recording continuity testing results and transmit results to Engineer following functional testing. Test data to will be reviewed by Engineer prior to acceptance of tracer wires and access boxes.

E. Galvanic Anode Energizing and Testing:

1. Some of the galvanic anodes will be connected to the pipe or the fittings in the anode test stations with calibrated shunts after the installation of the galvanic anode cathodic protection system is completed.
2. Test continuity of each anode lead wires and to confirm correct type of anode with potential measurements prior to connecting to test station terminal board.
  - a) Zinc anodes should read a minimum of -1.0 volt and
  - b) High potential magnesium anodes shall read a minimum of -1.6 volt to a copper/copper sulfate reference electrode
3. Do not connect anode and pipe or fitting leads together with a shunt in test stations until Engineer is present.

### 3.17 FINAL TESTING

A. General:

1. After construction is complete and all of the individual functional tests have been completed by the Contractor, the Engineer shall conduct final testing on the pipeline to ensure proper installation of the specified corrosion protection items.
2. At Contractor's option, he may be present during this final testing if desired.

B. Galvanic Anodes Cathodic Protection System:

1. The Engineer shall make sufficient tests throughout the network of galvanic anode cathodic protected metallic pipe and fittings to determine proper installation of the galvanic anode cathodic protection system.

C. Any construction defects or incomplete work identified by the Engineer during functional or final testing or during warranty inspections shall be located and corrected by the Contractor at his sole expense including additional Engineering, retesting, and inspection time.

D. Any defects in the corrosion protection system, (including but not limited to coating or lining, pipeline continuity, pipeline electrical isolation, cathodic protection system, test stations, etc.) when discovered shall immediately be repaired and retested in a timely manner (warranty work shall be completed within 60 days of notice) by the Contractor in accordance with this specification

and the written product manufacturer's instructions as reviewed and approved by the Engineer.

1. Contractor shall provide the Engineer with a minimum of 7 days advance notice before beginning warranty repairs.

#### **8B.4 METHOD OF MEASUREMENT**

##### **A. Galvanic Anodes**

1. Anodes and the attachment of lead wires to fittings, valves or other metallic components shall be incidental to each of the new metallic water system components installed. No separate measurement will be made.

##### **B. Cathodic Test Stations**

1. Cathodic test stations shall be counted on a per each basis for "Flush Mounted Test Station". The cathodic test station bid item shall include all items specified and necessary to install and to make operational a complete test station.

##### **C. Tracer Wire and Tracer Wire Boxes**

1. Tracer wire and all accessory items necessary for the installation of an electrically-continuous tracing system shall be incidental to the pipe installed. No separate measurement will be made.
2. Tracer wire boxes shall be counted on a per each basis for "Flush-Mounted Tracer Wire Box".

##### **D. Service Line Insulators**

1. Service line insulators shall be incidental to the service line installed. No separate measurement will be made.

##### **E. Coating Repairs**

1. Coating repairs to fittings, existing coated pipe or project specified coated pipe are considered incidental to the pipe or fittings installed. No separate measurement will be made.

##### **F. Functional Testing**

1. Functional testing of the cathodic protection and tracer wire systems shall be incidental to the water system components installed. No separate measurement will be made.

##### **G. Final Acceptance Testing**

1. Final acceptance testing will be performed by the City.

## **8B.5 BASIS OF PAYMENT**

- A. Galvanic Anodes
  - 1. No separate payment will be made.
- B. Cathodic Test Stations
  - 1. Payment for cathodic test station bid item shall be made for “Flush-Mounted Test Station” and shall include all items specified and necessary to install and to make operational a complete test station.
- C. Tracer Wire and Tracer Wire Boxes
  - 1. No separate payment will be made for tracer wire and all accessory items necessary for the installation of an electrically-continuous tracing system.
  - 2. Payment for tracer wire box bid item shall be made for “Flush-Mounted Tracer Wire Box” and shall only include furnishing and installing a complete tracer wire box.
- D. Service Line Insulators
  - 1. No separate payment will be made.
- E. Coating Repairs
  - 1. No separate payment will be made.
- F. Functional Testing
  - 1. No separate payment will be made.
- G. Final Acceptance Testing
  - 1. No separate payment will be made.
  - 2. If final acceptance testing shows inconsistencies in the cathodic protection or tracer wire systems, the Contractor shall be responsible for all labor, equipment and materials necessary to determine the cause and the location of the inconsistencies and the repair of the problem.
    - a) The Contractor is also responsible for the costs of subsequent acceptance testing associated with the cost of repairs incurred by the Engineer.

**END OF SECTION**



**FORM 8B.2**

<b>CITY OF RAPID CITY</b> <b>CORROSION PROTECTION - PLASTIC PIPE SYSTEMS</b>
---

SHEET \_\_\_\_\_ OF \_\_\_\_\_  
 DATE: \_\_\_\_\_

TEST TAKEN BY: \_\_\_\_\_

**TRACER WIRE POTENTIAL AND ELECTRICAL CONTINUITY TEST WORKSHEET**

CLIENT: \_\_\_\_\_  
 PROJECT: \_\_\_\_\_

PROJECT#: \_\_\_\_\_  
 LOCATION: \_\_\_\_\_

PURPLE COLOR: _____ NORTH OR _____ WEST	/	TERMINAL LOCATION: _____ TOP OR _____ BOTTOM
GRAY COLOR: _____ SOUTH OR _____ EAST	/	TERMINAL LOCATION: _____ TOP OR _____ BOTTOM
FROM STATION _____ + _____ TO STATION _____ + _____		TOTAL DISTANCE (FT) = _____

***PROVIDE A SKETCH BELOW (INCLUDE TEST CONNECTIONS, DISTANCES, STATIONING, ETC.):***

START TEST POINT STA					
END TEST POINT STA					
AT START, TOP TERMINAL COLOR _____ POTENTIAL <u>BEFORE</u> <b>TEST</b>	NOTES	V	NOTES	V	NOTES
AT START, TOP TERMINAL COLOR _____ POTENTIAL <u>AT</u> TEST		V		V	
AT START, BOT TERMINAL COLOR _____ POTENTIAL <u>BEFORE</u> <b>TEST</b>		V		V	
AT START, BOT TERMINAL COLOR _____ POTENTIAL <u>AT</u> TEST		V		V	
AT END, TOP TERMINAL COLOR _____ POTENTIAL <u>BEFORE</u> <b>TEST</b>		V		V	
AT END, TOP TERMINAL COLOR _____ POTENTIAL <u>AT</u> TEST		V		V	
AT END, BOTTOM TERMINAL COLOR _____ POTENTIAL <u>BEFORE</u> <b>TEST</b>		V		V	
AT END, BOTTOM TERMINAL COLOR _____ POTENTIAL <u>AT</u> TEST		V		V	
<b>RESULTS/NOTES:</b>					



**ATTACHMENT A and B  
PVC PIPE and DUCILE IRON FITTINGS CERTIFICATION**

CONTRACT: \_\_\_\_\_ DATE: \_\_\_\_\_

CONTRACTOR: \_\_\_\_\_

PIPE MANUFACTURER: \_\_\_\_\_

DUCTILE IRON FITTINGS MANUFACTURER: \_\_\_\_\_

This certification applies to PVC pipe and Ductile Iron Fittings, as may be provided by Manufacturers as identified above. Omission of any required project certification herein does not relieve the Pipe or Ductile Iron Fittings Manufacturers or the CONTRACTOR from responsibilities of performance as may be required by the Contract Documents.

For pipe and pipe materials, joints and fittings to be supplied on the above referenced contract, the listed Pipe Manufacturer certifies as follows:

1. The PVC pipe shall be manufactured as specified in Section 8A – Water Piping Systems – of the Standard Specifications.
2. Ductile Iron Fitting Manufacturer shall provide required coatings and linings in accordance with Section 8B – Corrosion Protection - Plastic Pipe Systems – of the Standard Specifications.

[Remainder of page left blank intentionally]

**ATTACHMENT A  
PVC PIPE CERTIFICATION**

**IN CERTIFICATION THEREOF:**

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Signature: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Phone: \_\_\_\_\_ e-mail: \_\_\_\_\_

This certification shall be sent by the Pipe Manufacturer to the CONTRACTOR, and then forwarded by CONTRACTOR to ENGINEER. This certification shall be signed by an authorized representative (with power of attorney) of the Pipe Manufacturer.

**NOTARY:**

The above certification was signed by \_\_\_\_\_ of \_\_\_\_\_

in my presence on \_\_\_\_\_, 20\_\_\_\_

Notary Public: \_\_\_\_\_

My Commission Expires On: \_\_\_\_\_ 20\_\_\_\_\_

**ATTACHMENT B  
DUCTILE IRON FITTINGS CERTIFICATION**

**IN CERTIFICATION THEREOF:**

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Signature: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Phone: \_\_\_\_\_ e-mail: \_\_\_\_\_

This certification shall be sent by the Ductile Iron Fittings Manufacturer to the CONTRACTOR, and then forwarded by CONTRACTOR to ENGINEER. This certification shall be signed by an authorized representative (with power of attorney) of the Ductile Iron Fittings Manufacturer.

**NOTARY:**

The above certification was signed by \_\_\_\_\_ of \_\_\_\_\_

in my presence on \_\_\_\_\_, 20\_\_\_\_\_

Notary Public: \_\_\_\_\_

My Commission Expires On: \_\_\_\_\_ 20\_\_\_\_\_

**ATTACHMENT C (Part 1)**  
**MATERIAL HANDLING AND INSTALLATION CERTIFICATION**

CONTRACT: \_\_\_\_\_ DATE: \_\_\_\_\_

CONTRACTOR: \_\_\_\_\_

PIPE MANUFACTURER: \_\_\_\_\_

This certification applies to all plastic pipe, fittings, and materials as may be provided by Pipe Manufacturer as identified above. Omission of any required project certification herein does not relieve the Pipe Manufacturer or the CONTRACTOR from responsibilities of performance as may be required by the Contract Documents.

For pipe and pipe materials, joints and fittings to be supplied on the above referenced contract, the listed Pipe Manufacturer certifies as follows:

1. The Pipe Manufacturer has been present and observed the CONTRACTOR's work for the placement of the first \_\_\_ feet of pipe from Station \_\_\_\_\_ to Station \_\_\_\_\_ for the dates of \_\_\_\_\_ to \_\_\_\_\_. During their observation of the CONTRACTOR, the CONTRACTOR was following the Pipe Manufacturer's recommendation for handling, storing, assembling and installing pipe, pipe joints, fittings, and repair procedures for coating and linings.
  
2. During the site visit, Pipe Manufacturer observed construction from Station \_\_\_\_\_ to Station \_\_\_\_\_ between the dates of \_\_\_\_\_ to \_\_\_\_\_. The Pipe Manufacturer has observed the CONTRACTOR's storage and handling of the pipe, assembly of pipe joints, fittings, and proper repair procedure for coatings and linings, where applicable, and all are in conformance with the Pipe Manufacturer's recommendations.

A trip report with summary of observations shall be attached to this certification and shall include any additional items that may be need to be addressed by the Contractor or problems resolved during site visits.

The Pipe Manufacturer has reviewed the Contract Documents and has taken into consideration the contract requirements governing pipe manufacture and installation as specified therein.

[Remainder of page left blank intentionally]

**ATTACHMENT C (Part 2)**  
**MATERIAL HANDLING AND INSTALLATION CERTIFICATION**

**IN CERTIFICATION THEREOF:**

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Signature: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Phone: \_\_\_\_\_

e-mail: \_\_\_\_\_

This certification shall be sent by the Pipe Manufacturer to the CONTRACTOR, and then forwarded by CONTRACTOR to ENGINEER. This certification shall be signed by an authorized representative (with power of attorney) of the Pipe Manufacturer.

## SECTION 03 4100 - PRECAST STRUCTURAL CONCRETE

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Precast monument sign.
- B. Grout packing.
- C. Connection and supporting devices.

#### 1.02 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 2200 - Unit Prices, for additional unit price requirements.
- B. Precast: Monument sign.

#### 1.03 REFERENCE STANDARDS

- A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2011.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- D. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.
- E. ASTM A416/A416M - Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete; 2012a.
- F. ASTM A497/A497M - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete; 2007.
- G. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2012.
- H. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.
- I. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2009.
- J. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2007b.
- K. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.
- L. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy Coated Reinforcing Steel Bars; 2001 (Reapproved 2007).
- M. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2010.
- N. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; American Welding Society; 2011.
- O. IAS AC157 - Accreditation Criteria for Fabricator Inspection Programs for Reinforced and Precast/Prestressed Concrete; 2010.
- P. PCI MNL-116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products; Precast/Prestressed Concrete Institute; 1999, Fourth Edition.
- Q. PCI MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete; Precast/Prestressed Concrete Institute; Seventh Edition, 2010.
- R. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete; Precast/Prestressed Concrete Institute; 1988, Second Edition.
- S. PCI MNL-124 - Design for Fire Resistance of Precast Prestressed Concrete; Precast/Prestressed Concrete Institute; 1989, Second Edition.

- T. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction; Precast/Prestressed Concrete Institute; 2000.
- U. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate standard component configurations, design loads, deflections, cambers, and bearing requirements.
- C. Shop Drawings: Indicate layout, unit locations, fabrication details, reinforcement, connection details, support items, dimensions, openings, and relationship to adjacent materials. Indicate design loads, deflections, cambers, bearing requirements, and special conditions.
  - 1. Submit reviewed shop drawings and design data to authorities having jurisdiction for approval.
- D. Samples: Submit one, 12 x 12 inch (25 x 25 mm) in size, illustrating surface finish treatment.
- E. Fabricator's Qualification Statement: Provide documentation showing precast concrete fabricator is accredited under IAS AC157.
- F. Design Data: Submit design data reports indicating calculations for loadings and stresses of fabricated, designed framing.
- G. LEED Submittal: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete, mix design(s) used showing the quantity of Portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used; use LEED New Product Content Form.

#### **1.05 QUALITY ASSURANCE**

- A. Designer Qualifications: Design precast concrete members under direct supervision of a Professional Engineer experienced in design of precast concrete and licensed in the State in which the Project is located.
- B. Fabricator Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of experience.
- C. Welder Qualifications: Qualified within previous 12 months in accordance with AWS D1.1 and AWS D1.4.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Handle precast members in position consistent with their shape and design. Lift and support only from support points.
- B. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.
- C. Protect members to prevent staining, chipping, or spalling of concrete.
- D. Mark each member with date of production and final position in structure.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Structural Precast Concrete:
  - 1. Any manufacturer holding a PCI Group A Plant Certification for the types of products specified; see [www.pci.org/find/manufacturer](http://www.pci.org/find/manufacturer).
  - 2. Gage Brothers Concrete.
  - 3. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 PRECAST UNITS**

- A. Precast Structural Concrete Units: Comply with PCI MNL-116, PCI MNL-120, PCI MNL-123, PCI MNL-135, ACI 318 and applicable codes.

1. Design components to withstand dead loads and design loads in the configuration indicated on the drawings and as follows:
  - a. Exterior Vertical Assembly: 25 psf (1.2 kPa) positive and negative wind loads.
2. Calculate structural properties of framing members in accordance with ACI 318.
3. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with strength requirements.
4. Design members exposed to the weather to provide for movement of components without damage, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to seasonal or cyclic day/night temperature ranges.
5. Design system to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings.

### **2.03 MATERIALS**

- A. Cement: White Portland type, conforming to ASTM C150, Type I/II.
- B. Aggregate, Sand, Water, Admixtures: Determined by precast fabricator as appropriate to design requirements.

### **2.04 REINFORCEMENT**

- A. Tensioning Steel Tendons: ASTM A416/A416M, Grade 270 (1860); seven-wire stranded steel cable; low-relaxation; stress-relieved type; full length without spliced.
- B. Reinforcing Steel: ASTM A615/A615M Grade 60 (420).
  1. Plain billet-steel bars.

### **2.05 ACCESSORIES**

- A. Connecting and Supporting Devices: Plates, angles, items cast into concrete, and inserts conforming to PCI MNL-123, and as follows:
  1. Material: Stainless steel conforming to ASTM A666.
  2. Finish: Unfinished.
- B. Grout:
  1. Non-shrink, non-metallic, minimum yield strength of 10,000 psi (69 MPa).
- C. Bearing Pads: High density plastic
- D. Bolts, Nuts and Washers: stainless steel.

### **2.06 FABRICATION**

- A. Conform to fabrication procedures specified in PCI MNL-116.
- B. Fabricate and handle epoxy-coated reinforcing bars in accordance with ASTM D3963/D3963M.
- C. Maintain plant records and quality control program during production of precast members. Make records available upon request.
- D. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are embedded and located as indicated on shop drawings.
- E. Tension reinforcement tendons as required to achieve design load criteria.
- F. Provide required openings with a dimension larger than 10 inches (250 mm) and embed accessories provided under other sections of the specifications, at indicated locations.
- G. Exposed Ends at Stressing Tendons: Fill recess with non-shrink grout, trowel flush.

### **2.07 FINISHES**

- A. Ensure exposed-to-view finish surfaces of precast concrete members are uniform in color and appearance.
- B. Cure members under identical conditions to develop required concrete quality, and minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
- C. Finish members to PCI MNL-116 Finish A grade.

- D. Plant Finish: Normal plant finish; surface may contain small surface holes caused by air bubbles, minor chips or spalling at edges or ends, without major discoloration.
- E. Exposed-to-View Finish: Normal plant finish with fins and protrusions removed, ground edges and ends, flat face surfaces.
- F. Architectural Finish: Surface holes or bubbles over 1/4 inch (6 mm) filled with matching cementitious paste, fins or protrusions removed and surface ground smooth.
- G. Rubbed Finish: Surface holes or bubbles over 1/4 inch (6 mm) filled with matching cementitious paste, fins or protrusions removed and surface ground smooth, surface then rubbed with neat cementitious paste to smooth and even color and texture.
- H. Sandblast Finish: Lightly sandblast to achieve partial exposure of aggregate.

## **2.08 FABRICATION TOLERANCES**

- A. Conform to fabrication tolerances specified in PCI MNL-135, except as specifically amended below.
  - 1. Variation From Nominal Dimension: Plus or minus 1/2 inch (12.5 mm).
  - 2. Variation from End Squareness: Plus or minus 1/8 inch/12 in (3 mm/300 mm), maximum 3/8 in (9 mm).
  - 3. Maximum Misalignment of Anchors, Inserts, Openings: Plus or minus 1/8 inch (3 mm).

## **2.09 SOURCE QUALITY CONTROL**

- A. Section 01 4000 - Provide mix design for concrete.
- B. Provide shop inspection and testing.
- C. Test samples in accordance with applicable ASTM standard.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that site conditions are ready to receive work and field measurements are as shown on shop drawings.

### **3.02 PREPARATION**

- A. Prepare support equipment for the erection procedure, temporary bracing, and induced loads during erection.

### **3.03 ERECTION**

- A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.
- B. Align and maintain uniform horizontal and vertical joints, as erection progresses.
- C. Maintain temporary bracing in place until final support is provided. Protect members from staining.
- D. Provide temporary lateral support to prevent bowing, twisting, or warping of members.
- E. Install bearing pads.
- F. Set vertical units dry, without grout, attaining joint dimension with lead or plastic spacers.
- G. Grout joints between members.
- H. Secure units in place. Perform welding in accordance with AWS D1.1.

### **3.04 TOLERANCES**

- A. Erect members level and plumb within allowable tolerances.
- B. Conform to PCI MNL-135 for erection tolerances, except as specifically amended below.
  - 1. Maximum Jog in Alignment of Matching Ends: Plus or minus 1/2 inch (12.5 mm).
  - 2. Exposed Joint Dimension: Plus or minus 3/8 inch (9 mm).
  - 3. Differential Top Elevation As Erected: Plus or minus 3/8 inch (9 mm).
  - 4. Differential Bottom Elevation of Exposed Members: Plus or minus 3/16 inch (4.5 mm).

- C. When members cannot be adjusted to conform to design or tolerance criteria, cease work and advise Engineer. Execute modifications as directed.

**3.05 PROTECTION**

- A. Protect members from damage caused by field welding or erection operations.
- B. Provide non-combustible shields during welding operations.

**3.06 CLEANING**

- A. Clean weld marks, dirt, or blemishes from surface of exposed members.

**END OF SECTION**



# Geotechnical Engineering Report

Mt. Rushmore Road Utility Reconstruction

Tower Road to St. Patrick Street

Rapid City, South Dakota

November 14, 2011

Terracon Project No. B4115030

City of Rapid City Project No. SSW11-1926/CIP No. 50840

**Prepared for:**

CETEC Engineering Services, Inc.  
Rapid City, South Dakota

**Prepared by:**

Terracon Consultants, Inc.  
Rapid City, South Dakota



Offices Nationwide  
Employee-Owned

Established in 1965  
terracon.com

# Terracon

Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

November 14, 2011

Mr. Rich Marsh, P.E.  
CETEC Engineering Services, Inc.  
1560 Concourse Drive  
Rapid City, South Dakota 57703

**Subject:       Geotechnical Engineering Report  
                  Mt. Rushmore Road Utility Reconstruction  
                  Tower Road to St. Patrick Street  
                  Rapid City, South Dakota  
                  Terracon Project No. B4115030  
                  City of Rapid City Project No. SSW11-1926/CIP No. 50840**

Dear Mr. Marsh,

Terracon Consultants, Inc. (Terracon) has completed the geotechnical services for the proposed utility reconstruction project along Mt. Rushmore Road, from Tower Road to just north of St. Patrick Street, in Rapid City, South Dakota. This study was performed in general accordance with Terracon's proposal dated April 15, 2011, and CETEC's Authorization and Agreement for Subconsultant Services, dated October 3, 2011. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and utilities for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,  
**Terracon Consultants, Inc.**



Teresa Serie, E.I.T.  
Staff Professional



Walt Feeger, P.E.  
Office Manager

Copies:       Client (3)  
                  File (1)



**Geotechnical Engineering Report**

Mt. Rushmore Road Utility Reconstruction ■ Rapid City, South Dakota  
November 14, 2011 ■ Terracon Project No. B4115030



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- General Notes
- Unified Soil Classification
- Laboratory Test Significance
- Report Terminology

**GEOTECHNICAL SERVICES REPORT  
MT. RUSHMORE UTILITY RECONSTRUCTION  
TOWER ROAD TO ST. PATRICK STREET  
RAPID CITY, SOUTH DAKOTA**

Terracon Project No. B4115030  
City of Rapid City Project No. SSW11-1926/CIP No. 50840  
November 14, 2011

## **1.0 INTRODUCTION**

Geotechnical services have been completed for the proposed utility reconstruction project along Mt. Rushmore Road, from Tower Road to just north of St. Patrick Street, in Rapid City, South Dakota. Ten (10) soil borings, designated B-1 through B-10, were advanced to depths of approximately 15½ feet below existing grades along the existing street alignment. This report specifically addresses the recommendations for utility placement and backfill recommendations. Logs of the borings along with a boring location diagram are included in Appendix A of this report.

## **2.0 PROJECT INFORMATION**

### **2.1 Project Description**

We understand the project will consist of the reconstruction of water mains, sanitary sewer mains, storm sewer and landscaping enhancements along Mt. Rushmore Road, from Tower Road to St. Patrick Street, in Rapid City, South Dakota. The project will be let in conjunction with the South Dakota Department of Transportation (SDDOT) Project P 0016(78)67 which will include grading, Portland Cement Concrete (PCC) pavement, storm sewer, curb & gutter, roadway lighting, and traffic signals.

### **2.2 Site Location and Description**

<b>ITEM</b>	<b>DESCRIPTION</b>
<b>Location</b>	The project is located along Mt. Rushmore Road, from Tower Road northward to the alley between St. Patrick Street and St. Andrew Street, in the southern part of Rapid City.
<b>Existing improvements</b>	The area is generally comprised of commercial/retail establishments.
<b>Existing topography</b>	The overall topography is comprised of rolling terrain generally sloping downward to the north from Tower Road and downward to the south from St. Patrick Street.

### 3.0 SUBSURFACE CONDITIONS

#### 3.1 Typical Profile

The existing pavement section encountered at our boring locations consisted of the following:

Location	Asphalt, in.	Concrete, in	Aggregate Base Course, in	Total, in
B- 1	9	--	27	36
B- 2	6	--	30	36
B- 3	6	--	29	35
B- 4	3	10	14	27
B- 5	3	10	14	27
B- 6	3	9	17	29
B- 7	3	9	18	30
B- 8	3.5	10.5	10	24
B- 9	4	9	11	24
B-10	4	12	12	28

Underlying the pavement section, the subsurface soils encountered within the borings generally consisted of the following:

Boring B-1 – Lean clay fill overlying weathered sandstone bedrock.

Boring B-2 – Sandstone bedrock

Boring B-3 – Clayey sand fill over lean to fat clay fill overlying sandstone bedrock

Boring B-4 – Sandy lean clay overlying weathered to competent shale bedrock

Boring B-5 – Weathered shale overlying competent shale

Boring B-6 – Lean to fat clay fill over native lean to fat clay soils

Boring B-7 – Lean clay soils overlying weathered shale bedrock

Boring B-8 – Lean to fat clay fill overlying native fat clay soils underlain by weathered shale

Boring B-9 – Shale bedrock

Boring B-10 – Sandy lean clay soils over shale bedrock

Conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs in Appendix A of this report.

### **3.2 Groundwater**

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Measurable groundwater was encountered in Borings B-3, B-5, and B-7 at depths ranging from 3 to 14 feet below existing grades. Borings B-1, B-2, B-5, B-7, and B-9 were backfilled with auger cuttings once groundwater measurements were made. Within Borings B-3, B-4, B-6, B-8, and B-10, one-inch PVC piezometers were installed to monitor future groundwater levels and potential season fluctuations.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff, local irrigation practices, and other factors not evident at the time the borings were performed. Due to the relatively low permeability of the clay soils encountered at the site, a relatively long period of time may be needed for a groundwater level to stabilize in the borings. The presence of groundwater and potential groundwater level fluctuations should be considered when developing the design and construction plans for the project. Evaluation of the factors that affect groundwater fluctuations is beyond the scope of this report.

## **4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION**

### **4.1 Utility Trench Excavations and Construction**

We recommend all utilities be placed in accordance with Sections 8 and 9 of the City of Rapid City's Standard Specifications for Public Works Construction, 2007 edition. Trench excavation and backfill operations should be performed in accordance Section 11 "Utility Excavation and Backfill" of the City of Rapid City Specifications.

In general, the excavations into the site soils along Mt. Rushmore Road from the area of Boring B-4 to Boring B-10 will mainly encounter fine grained clay soils and shale. Depending on the depths of excavations from Boring B-1 to B-3, fine grained sand and clay soils will be encountered overlying sandstone bedrock. It is anticipated that excavations into the clay, sand, and shale can be accomplished with conventional earthmoving equipment such as large tracked excavators. However, excavations into the sandstone bedrock may require the use of pneumatic hammers to facilitate excavation and removal.

Potential hydrocarbon contaminated soils were not encountered within the borings drilled along the existing Mt. Rushmore Road alignment. However, due to the presence of several fueling stations and the historical use of commercial businesses along Mt. Rushmore Road, contaminated soils may be encountered during the utility excavations. If encountered during construction, these soils will need to be tested to determine whether or not they need to be properly disposed of off-site or if they can be re-used as utility trench backfill. Excavation contractors bidding on this project should be made aware of the potential of encountering contaminated soils.

Groundwater was encountered during our field work and subsequent measurements in the piezometers installed. Depending on the time of year construction takes place groundwater or surface runoff accumulation may be encountered within utility excavations. Contractors working on the project should anticipate dewatering the excavations and have equipment on-site that will lower and maintain the groundwater level below the base of the excavations, if encountered.

The soil classifications shown on the logs are based solely on the materials encountered in the borings. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered during construction, the actual conditions should be evaluated by the contractor's competent person to determine any excavation modifications necessary to maintain safe conditions.

The individual contractor's competent person should be made responsible for designing and constructing stable, temporary excavations, as required, to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards. In our opinion, the soils encountered at the site can be classified as Type B with maximum allowable slopes of 1H:1V for excavations less than 20 feet in depth. The site shale bedrock should be classified as Type A soils with a maximum allowable slope of ¾H:1V for excavations less than 20 feet in depth.

Depending on the depths of excavations and subsurface soil and groundwater conditions, the use of temporary shoring and/or trench boxes may be required. As a safety measure, vehicles and stockpiles should be kept away from the excavation crest a distance at least equal to the slope height. Where practical, the exposed slope face should be protected against the elements.

## **4.2 Earthwork**

The excavated site soils and aggregate base course, cleaned of all organic/deleterious material, man-made debris, and rock greater than 3 inches in nominal size may be stockpiled on-site for re-use as trench backfill above the pipe bedding. The excavated sandstone and shale bedrock can also be used as backfill material provided it is processed to a nominal size of 3 inches or less.

Based on the moisture-density relationship (proctor) tests, the near surface soils are at or above the optimum moisture content. Earthwork contractors should anticipate processing and moisture conditioning the site soils prior to use as backfill material. If the amount of excavated on-site material is not sufficient for re-use as utility trench backfill, imported material will be required. The imported backfill material should be approved by the geotechnical engineer prior to use.

## Geotechnical Engineering Report

Mt. Rushmore Road Utility Reconstruction ■ Rapid City, South Dakota  
November 14, 2011 ■ Terracon Project No. B4115030



Prior to use, the backfill should be moisture conditioned to within  $\pm 3$  percent of optimum and compacted to at least 92 percent of the maximum dry density, as determined by ASTM D 1557 (modified proctor). Trench backfill should be placed and compacted in horizontal lifts not more than 8 inches thick, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

We recommend the pavement subgrade areas over utility trenches be thoroughly proofrolled with a loaded water truck or tandem axle dump truck after final grading and recompaction are complete, and prior to paving.

If disturbance has occurred or unstable subgrade soils are observed, pavement subgrade areas should be reworked, moisture conditioned, or removed and replaced with properly compacted engineered fill to the recommendations in this report prior to paving. All pavement subgrade areas should be moisture conditioned and properly compacted prior to paving. Geotextile material could also be used to help increase subgrade stability and help expedite construction where applicable.

### 4.3 Corrosion Protection

Samples of the site soils were submitted for soluble sulfate and testing. Results are summarized in the following table:

Boring	Depth, ft	Material Type	Soluble Sulfate Content, %
B-2	5-10	Sand	0.02
B-4	3-10	Clay/Shale	0.37
B-8	2-10	Clay	0.28
B-10	5-15	Shale	0.39

Soluble sulfate values between 0.00 and 0.10 are considered to have negligible attack on normal strength concrete while values between 0.2 and 2.0 are considered to have a severe attack potential on normal strength concrete. As a result, Type V Portland cement should be specified for project concrete placed in contact with the site clay soils and shale bedrock. If the use of Type V cement is not feasible, Type II cement may be used provided documented sulfate resistance is provided with the mix design submittal. Foundation concrete should be designed in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 4.

## Geotechnical Engineering Report

Mt. Rushmore Road Utility Reconstruction ■ Rapid City, South Dakota

November 14, 2011 ■ Terracon Project No. B4115030



Laboratory electrical resistivity tests were also performed on soil samples obtained from the borings. The results are summarized as follows:

Boring	Depth, ft	Material Type	Resistivity, ohm-cm	pH	Corrosion Potential
B-2	5-10	Sand	3,800	7.8	Moderate
B-4	3-10	Clay/Shale	340	6.7	Severe
B-8	1-10	Clay	400	6.3	Severe
B-10	5-15	Shale	330	6.7	Severe

The corrosion potentials provided are based on information published in the Department of the Army's Technical Manual TM 5-811-7 "Electrical Design, Cathodic Protection". Based on this information, the site soils and bedrock have a moderate to severe corrosion potential towards iron and other buried metals. If corrosion of buried metal is critical, it should be protected using a non-corrosive backfill, wrapping, coating, sacrificial anodes, or a combination of these methods, as designed by a qualified corrosion engineer.

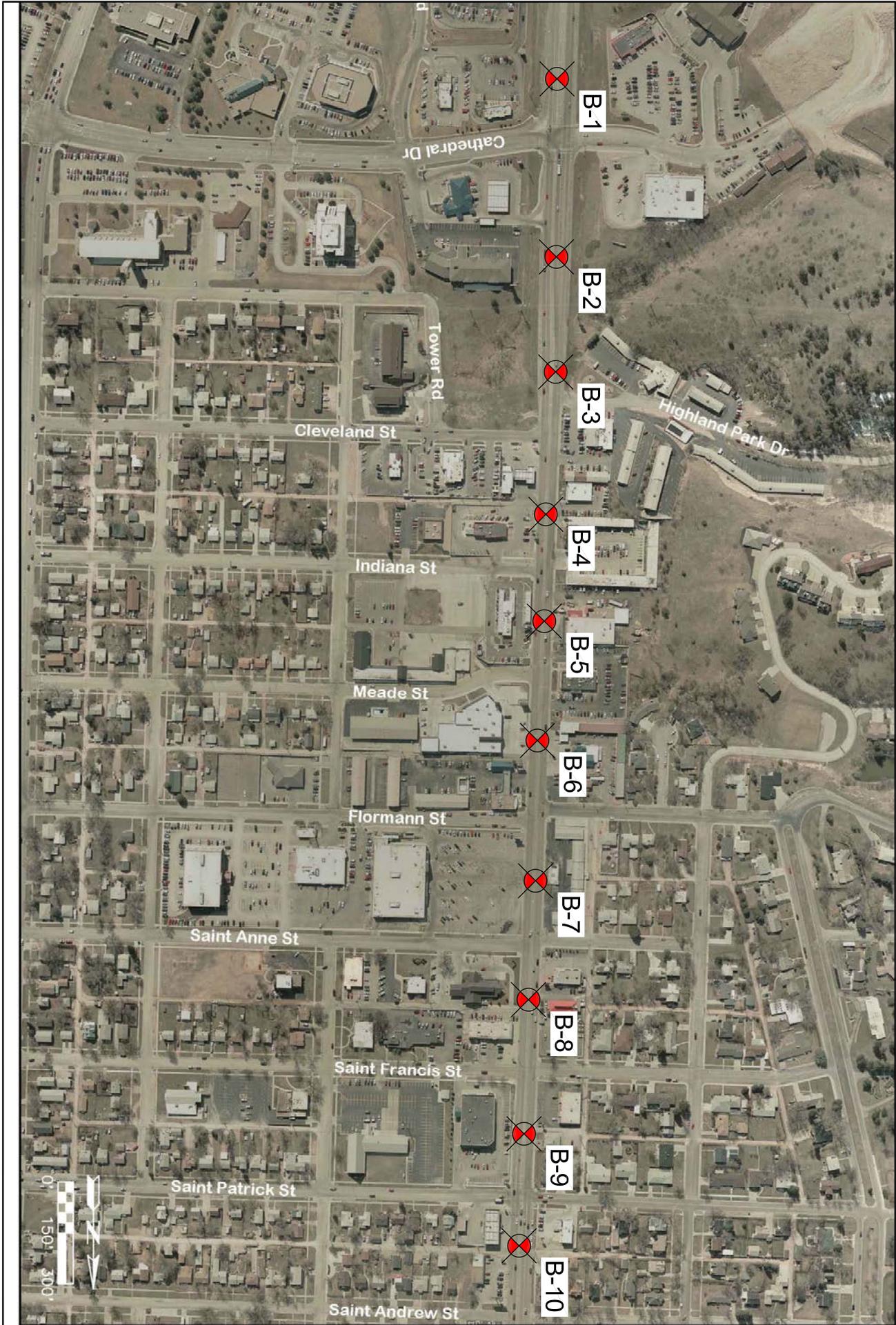
## 5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during earthwork phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either expressed or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project, as outlined in this report, are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

**APPENDIX A**  
**FIELD EXPLORATION**



APPROXIMATE LOCATION OF BORING.  
 Not a Legal Survey  
 All Boring Locations Approximate

Project Mgr: WF  
 Drawn By: TS  
 Checked By: WF  
 Approved By: WF

Project No: B4115030  
 Scale: As Shown  
 File No: 5030\_site plan  
 Date: Nov 2011

**Terracon**  
 Consulting Engineers and Scientists  
 2026 Sarnes Rd., Suite 101 Rapid City, SD 57702  
 P (605) 716 2264 F (605) 716 2265

BORING LOCATION DIAGRAM  
 Mt. Rushmore Road Utility Reconstruction  
 Mt. Rushmore Road  
 Rapid City, South Dakota

FIG. No.  
 1

LOG OF BORING NO. B- 1

OWNER <b>SDDOT and City of Rapid City</b>	ENGINEER <b>CETEC Engineering Services, Inc.</b>
SITE <b>Mt. Rushmore Road Rapid City, South Dakota</b>	PROJECT <b>Mt. Rushmore Road Utility Reconstruction</b>

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES			TESTS		
				NUMBER	TYPE	RECOVERY, ft.	SPT - N BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf
	Approx. Surface Elev.: 3420 ft								
0.8	<b>ASPHALT</b>	3419.2		1	SS	1.4	50	3	
3	<b>AGGREGATE BASE COURSE</b>	3417							
9	<b>FILL-Sandy Lean Clay, brown (CL)</b>	3411		2	SS	1.5	24	11	
15.5	<b>WEATHERED SANDSTONE, light brown, medium dense, interbedded shale lenses present</b>	3404.5		3	SS	1.5	10	13	
	End of Boring			4	SS	1.5	5	13	

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER DEPTH OBSERVATIONS, ft		BORING STARTED 10-15-11	
WD	∇ None 10/15/11 ∇	BORING COMPLETED 10-15-11	
WD	∇ ∇	RIG	CME-55 FOREMAN BC
WD		LOGGED	TS JOB # B4115030



BOREHOLE 99 B4115030.GPJ TERRACON.GDT 11/11/11

**LOG OF BORING NO. B- 2**

OWNER <p align="center"><b>SDDOT and City of Rapid City</b></p>	ENGINEER <p align="center"><b>CETEC Engineering Services, Inc.</b></p>
--	---

SITE <p align="center"><b>Mt. Rushmore Road Rapid City, South Dakota</b></p>	PROJECT <p align="center"><b>Mt. Rushmore Road Utility Reconstruction</b></p>
---	--

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES				TESTS	
				NUMBER	TYPE	RECOVERY, ft.	SPT - N BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf
	Approx. Surface Elev.: 3396 ft								
0.5	<b>ASPHALT</b>	3395.5							
3	<b>AGGREGATE BASE COURSE</b>	3393							
	<b>SANDSTONE</b> , tan to orange/brown, very dense to hard, interbedded shale layers present								
		5							
		10							
		15							
15.5	End of Boring	3380.5							

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER DEPTH OBSERVATIONS, ft WD <input type="checkbox"/> None 10/15/11 <input type="checkbox"/> WD <input type="checkbox"/> <input type="checkbox"/> WD <input type="checkbox"/> <input type="checkbox"/>		BORING STARTED 10-15-11 BORING COMPLETED 10-15-11 RIG CME-55 FOREMAN BC LOGGED TS JOB # B4115030
--	--	---

BOREHOLE 99 B4115030.GPJ TERRACON.GDT 11/11/11



**LOG OF BORING NO. B- 4**

OWNER <p align="center"><b>SDDOT and City of Rapid City</b></p>	ENGINEER <p align="center"><b>CETEC Engineering Services, Inc.</b></p>
SITE <p align="center"><b>Mt. Rushmore Road Rapid City, South Dakota</b></p>	PROJECT <p align="center"><b>Mt. Rushmore Road Utility Reconstruction</b></p>

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES				TESTS		
				NUMBER	TYPE	RECOVERY, ft.	SPT - N BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 3362 ft									
0.2	<b>ASPHALT</b>	3361.8								
1.1	<b>CONCRETE</b>	3360.9								
	<b>AGGREGATE BASE COURSE</b>									
2.7		3359.3								
	<b>SANDY LEAN CLAY</b> , dark brown (CL)									
7		3355								
	<b>WEATHERED SHALE</b> , olive brown to grey, very stiff									
12		3350								
	<b>SHALE</b> , dark grey, hard									
15.5		3346.5								
	End of Boring									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER DEPTH OBSERVATIONS, ft			
WD	∇ None	10/15/11	∇ 7 11/7/11
WD	∇		∇
WD	Piezometer Installed		



BORING STARTED	10-15-11
BORING COMPLETED	10-15-11
RIG	CME-55
FOREMAN	BC
LOGGED	TS
JOB #	B4115030

BOREHOLE 99 B4115030.GPJ TERRACON.GDT 11/11/11

**LOG OF BORING NO. B- 5**

OWNER <p align="center"><b>SDDOT and City of Rapid City</b></p>	ENGINEER <p align="center"><b>CETEC Engineering Services, Inc.</b></p>
SITE <p align="center"><b>Mt. Rushmore Road Rapid City, South Dakota</b></p>	PROJECT <p align="center"><b>Mt. Rushmore Road Utility Reconstruction</b></p>

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES				TESTS		
				NUMBER	TYPE	RECOVERY, ft.	SPT - N BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 3360 ft									
[Pattern]	0.2 <b>ASPHALT</b> 3359.8									
[Pattern]	1.1 <b>CONCRETE</b> 3358.9									
[Pattern]	<b>AGGREGATE BASE COURSE</b>									
[Pattern]	2.3 3357.7									
[Pattern]	<b>WEATHERED SHALE</b> , olive brown to grey, stiff									
[Pattern]	4 3356									
[Pattern]	<b>SHALE</b> , dark grey, very stiff to hard									
	▽									
	15.5 3344.5									
	End of Boring									

BOREHOLE 99 B4115030.GPJ TERRACON.GDT 11/11/11

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER DEPTH OBSERVATIONS, ft		
WD	▽ 9	10/15/11 ▽
WD	▽	▽
WD		



BORING STARTED		10-15-11
BORING COMPLETED		10-15-11
RIG	CME-55	FOREMAN BC
LOGGED	TS	JOB # B4115030





**LOG OF BORING NO. B- 8**

OWNER <b>SDDOT and City of Rapid City</b>	ENGINEER <b>CETEC Engineering Services, Inc.</b>
--	---

SITE <b>Mt. Rushmore Road Rapid City, South Dakota</b>	PROJECT <b>Mt. Rushmore Road Utility Reconstruction</b>
---	--

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES				TESTS	
				NUMBER	TYPE	RECOVERY, ft.	SPT - N BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf
	Approx. Surface Elev.: 3330 ft								
0.3	<b>ASPHALT</b>	3329.7							
1.2	<b>CONCRETE</b>	3328.8							
2	<b>AGGREGATE BASE COURSE</b>	3328							
	<b>FILL-Sandy Lean to Fat Clay</b> , mottled brown to grey, gravel present (CL-CH)								
7		3323							
	<b>FAT CLAY</b> , brown, stiff (CH)								
13		3317							
	<b>WEATHERED SHALE</b> , olive brown to grey, stiff								
15.5		3314.5							
	End of Boring								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER DEPTH OBSERVATIONS, ft			
WD	None	10/15/11	None 11/7/11
WD	None		
WD	Piezometer Installed		



BORING STARTED	10-15-11
BORING COMPLETED	10-15-11
RIG	CME-55
FOREMAN	BC
LOGGED	TS
JOB #	B4115030

BOREHOLE 99 B4115030.GPJ TERRACON.GDT 11/11/11



**LOG OF BORING NO. B-10**

OWNER <b>SDDOT and City of Rapid City</b>	ENGINEER <b>CETEC Engineering Services, Inc.</b>
--	---

SITE <b>Mt. Rushmore Road Rapid City, South Dakota</b>	PROJECT <b>Mt. Rushmore Road Utility Reconstruction</b>
---	--

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES				TESTS		
				NUMBER	TYPE	RECOVERY, ft.	SPT - N BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	Approx. Surface Elev.: 3330 ft									
0.3	<b>ASPHALT</b>	3329.7								
1.3	<b>CONCRETE</b>	3328.7								
1.3	<b>AGGREGATE BASE COURSE</b>									
2.3		3327.7								
2.3	<b>SANDY LEAN CLAY</b> , brown, very stiff (CL)									
5.3		3324.7								
5.3	<b>SHALE</b> , grey to dark grey, very stiff									
15.5		3314.5								
	End of Boring									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER DEPTH OBSERVATIONS, ft			
WD	None	10/15/11	None 11/7/11
WD			
WD	Piezometer Installed		



BORING STARTED	10-15-11
BORING COMPLETED	10-15-11
RIG	CME-55
FOREMAN	BC
LOGGED	TS
JOB #	B4115030

BOREHOLE 99 B4115030.GPJ TERRACON.GDT 11/11/11

## Geotechnical Engineering Report

Mt. Rushmore Road Utility Reconstruction ■ Rapid City, South Dakota  
November 14, 2011 ■ Terracon Project No. B4115030



### Field Exploration Description

The general boring locations were selected by CETEC Engineering and Terracon personnel and located in the field by personnel from Terracon. The approximate boring locations are indicated on the attached Boring Location Diagrams in Appendix A. The ground surface elevations indicated on the boring logs were interpolated from a topographic map of the area. The locations and elevations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were drilled with a CME-55 truck-mounted rotary drill rig using solid-stem flite augers to advance the boreholes. Samples of the soil encountered in the borings were obtained using split spoon samplers. Bulks samples of the auger cuttings from selected borings were also obtained.

In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a 140-pound C.M.E. auto-hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is used to estimate the in-situ relative density of cohesionless soils and consistency of cohesive soils.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with auger cuttings once groundwater measurements were recorded.

A field log of each boring was prepared by the field engineer. These logs included visual classifications of the materials encountered during drilling as well as the engineer's interpretation of the subsurface conditions between samples. Final boring logs included with this report represent the engineer's interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

**APPENDIX B**  
**LABORATORY TESTING**

## Geotechnical Engineering Report

Mt. Rushmore Road Utility Reconstruction ■ Rapid City, South Dakota  
November 14, 2011 ■ Terracon Project No. B4115030



### Laboratory Testing

As a part of the laboratory testing program, the soil samples were classified in the laboratory based on visual observation, texture, plasticity, and the laboratory testing performed as noted below. The soil descriptions presented on the boring logs for native soils are in accordance with our enclosed General Notes and Unified Soil Classification System (USCS). The estimated group symbol for the USCS is also shown on the boring logs, and a brief description of the Unified System is included in this report. Results of the laboratory tests are presented on the boring logs and/or included herein.

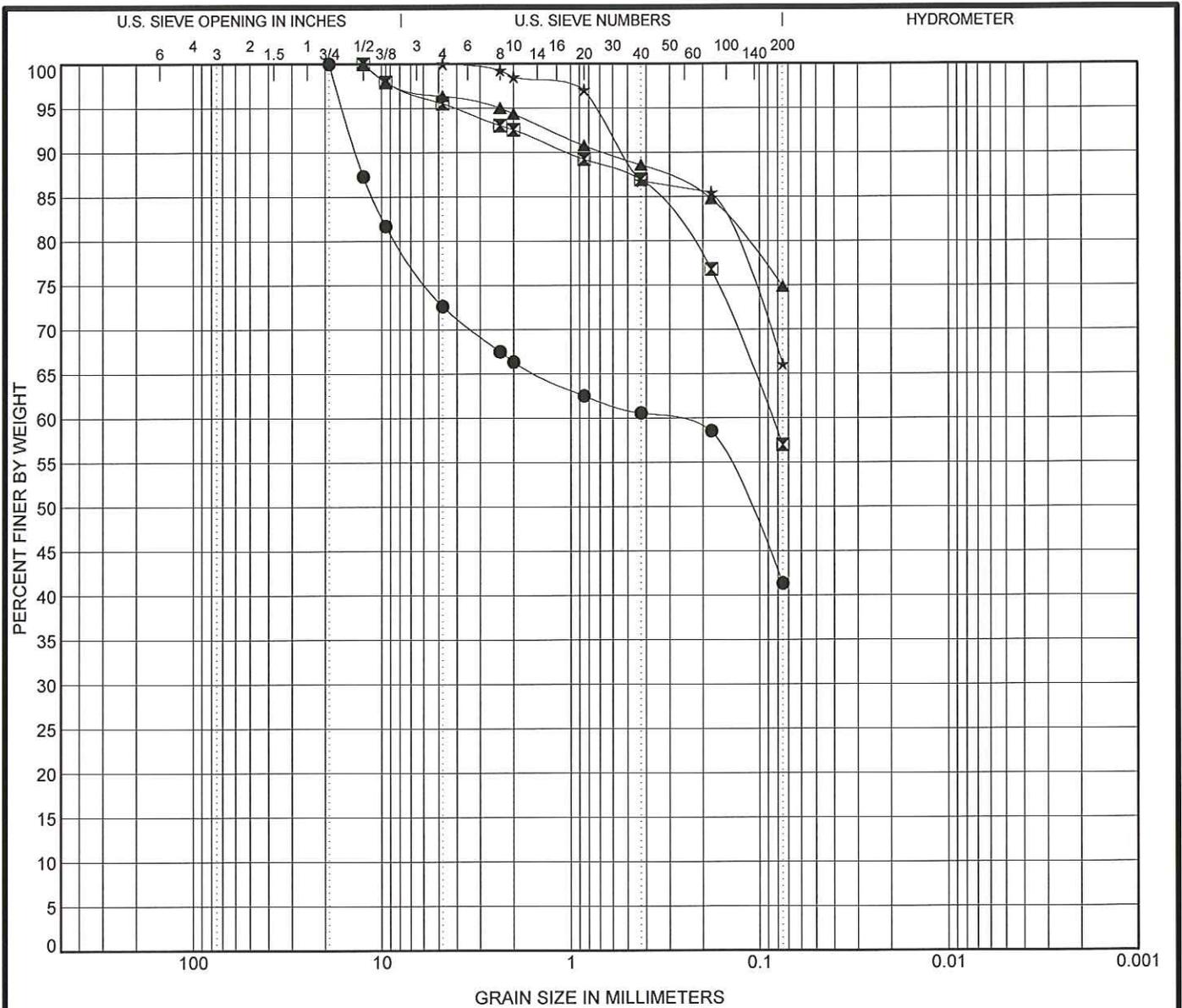
Selected soil samples were tested for the following properties:

- Moisture Content
- Grain Size Distribution
- Atterberg Limits
- Moisture-Density Relationship
- pH & Resistivity
- Soluble Sulfate

Results of the Moisture Density Relationship (proctor) tests performed on bulk samples obtained from the borings are summarized in the following table. Please note that the bulk samples are typically a mixture of the soils/bedrock encountered within the borings and the classifications may differ from those of individual soil layers as shown on the respective boring logs.

Boring	Depth	Material Type	Maximum Dry Density (ASTM D1557), pcf	Optimum Moisture Content (ASTM D1557), %
B-2	5-10	Silty Sand	131.1	10.0
B-4	3-10	Sandy Lean Clay	122.6	13.1
B-8	5-10	Sandy Lean to Fat Clay	126.6	12.8
B-10	5-15	Shale	114.3	17.5





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● B-1 4ft	SILTY SAND with SANDSTONE FRAGMENTS(SM)	22	15	7		
☒ B-4 4ft	SANDY LEAN CLAY(CL)	31	13	18		
▲ B-7 4ft	LEAN CLAY with SAND(CL)	31	11	20		
★ B-9 9ft	SHALE(CH)	61	21	40		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-1 4ft	19	0.332			27	31	41	
☒ B-4 4ft	12.5	0.086			4	39	57	
▲ B-7 4ft	12.5				4	22	75	
★ B-9 9ft	4.75				0	34	66	

**GRAIN SIZE DISTRIBUTION**



Project: Mt. Rushmore Road Utility Reconstruction  
 Site: Mt. Rushmore Road Rapid City, South Dakota  
 Job #: B4115030  
 Date: 11-11-11

TC\_GRAIN\_SIZE\_B4115030.GPJ\_TERRACON.GDT\_11/11/11

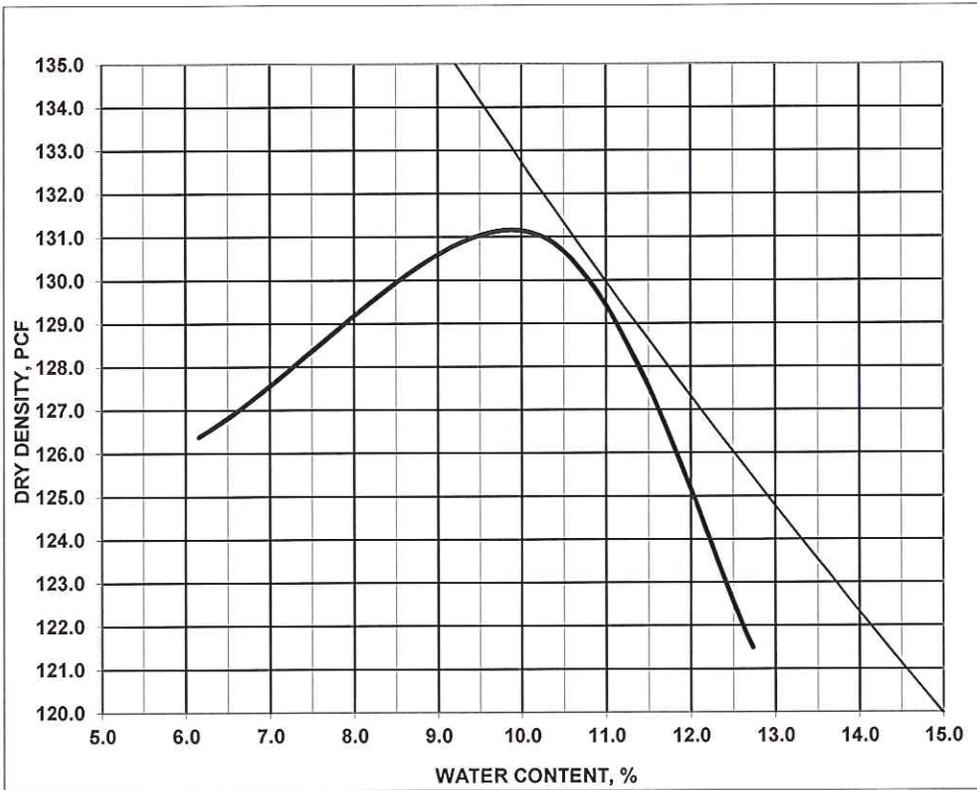


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(605) 716-2924 FAX: (605) 716-2926

### MOISTURE DENSITY RELATIONSHIP

<b>CLIENT NAME:</b> CETEC Engineering Services, Inc. Rapid City, South Dakota	<b>DATE:</b> 11/11/11 <b>LAB No.</b> 5030.001
<b>PROJECT NAME &amp; LOCATION:</b> Mt. Rushmore Road Reconstruction Rapid City, South Dakota	<b>REPORT NO.:</b>
<b>PROJECT NO.:</b> B4115030	<b>TEST RESULTS</b>
<b>SOURCE MATERIAL:</b> B-2 5'-10'	<b>MAXIMUM DRY DENSITY</b> 131.1 lb/ft <sup>3</sup>
<b>SAMPLE DESCRIPTION:</b> Silty Sand, light brown (SM)	<b>OPTIMUM MOISTURE</b> 10.0 %
<b>MATERIAL DESIGNATION:</b>	<b>ATTERBERG LIMITS</b>
<b>TEST METHOD:</b> D-1557	LIQUID LIMIT
<b>TEST PROCEDURE:</b> Method A	PLASTIC LIMIT
<b>SAMPLE PREPARATION:</b> Dry	PLASTICITY INDEX
	<b>REVIEWED BY:</b> WF

ZERO AIR VOIDS FOR SPECIFIC GRAVITY OF 2.70



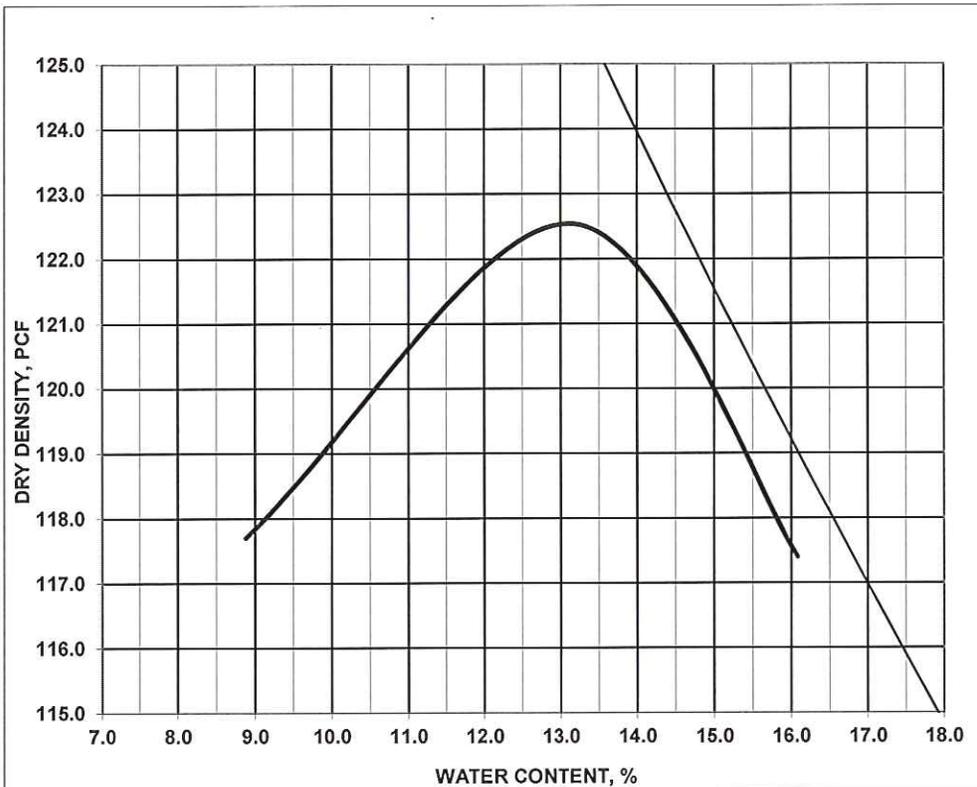


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### MOISTURE DENSITY RELATIONSHIP

<b>CLIENT NAME:</b> CETEC Engineering Services, Inc. Rapid City, South Dakota	<b>DATE:</b> 11/11/11 <b>LAB No.</b> 5030.002
<b>PROJECT NAME &amp; LOCATION:</b> Mt. Rushmore Road Reconstruction Rapid City, South Dakota	<b>REPORT NO.:</b>
<b>PROJECT NO.:</b> B4115030	<b>TEST RESULTS</b>
<b>SOURCE MATERIAL:</b> B-4 3'-10'	<b>MAXIMUM DRY DENSITY</b> 122.6 lb/ft <sup>3</sup>
<b>SAMPLE DESCRIPTION:</b> Sandy Lean Clay, brown (CL)	<b>OPTIMUM MOISTURE</b> 13.1 %
<b>MATERIAL DESIGNATION:</b>	<b>ATTERBERG LIMITS</b>
<b>TEST METHOD:</b> D-1557	LIQUID LIMIT
<b>TEST PROCEDURE:</b> Method A	PLASTIC LIMIT
<b>SAMPLE PREPARATION:</b> Dry	PLASTICITY INDEX
	<b>REVIEWED BY:</b> WF

ZERO AIR VOIDS FOR SPECIFIC GRAVITY OF 2.75



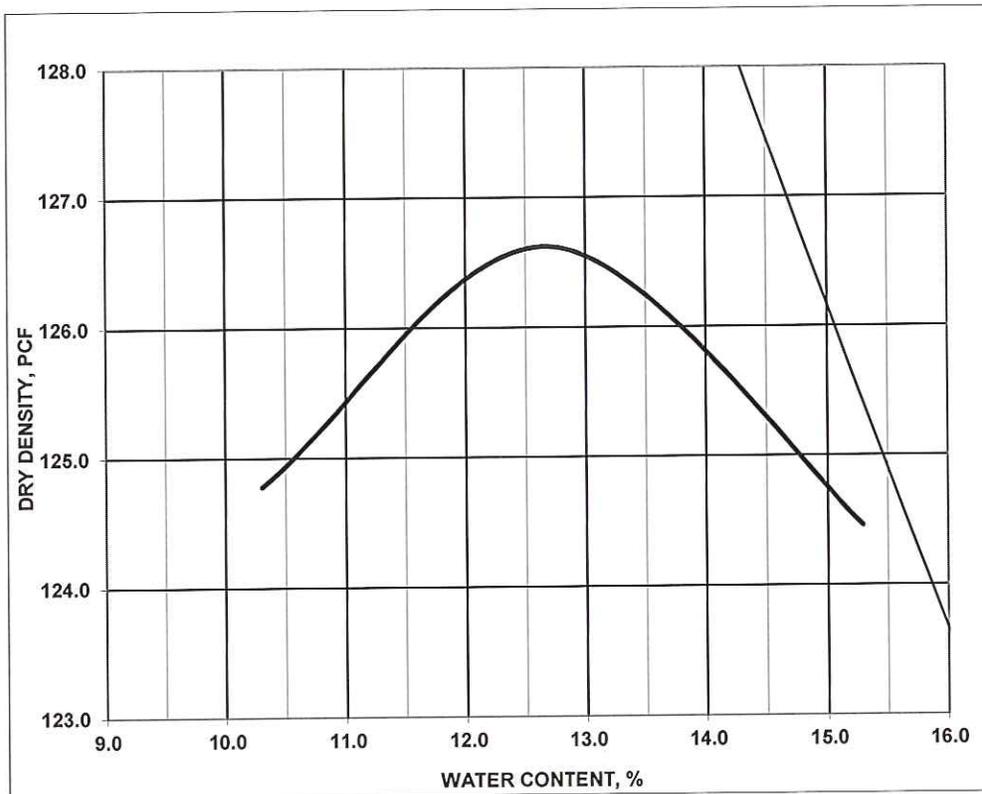


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### MOISTURE DENSITY RELATIONSHIP

<b>CLIENT NAME:</b> CETEC Engineering Services, Inc. Rapid City, South Dakota	<b>DATE:</b> 11/11/11 <b>LAB No.</b> 5030.003
<b>PROJECT NAME &amp; LOCATION:</b> Mt. Rushmore Road Reconstruction Rapid City, South Dakota	<b>REPORT NO.:</b>
<b>PROJECT NO.:</b> B4115030	<b>TEST RESULTS</b>
<b>SOURCE MATERIAL:</b> B-8 2'-10'	<b>MAXIMUM DRY DENSITY</b> 126.6 lb/ft <sup>3</sup>
<b>SAMPLE DESCRIPTION:</b> Sandy Lean to Fat Clay, brown (CL-CH)	<b>OPTIMUM MOISTURE</b> 12.8 %
<b>MATERIAL DESIGNATION:</b>	<b>ATTERBERG LIMITS</b>
<b>TEST METHOD:</b> D-1557	LIQUID LIMIT
<b>TEST PROCEDURE:</b> Method A	PLASTIC LIMIT
<b>SAMPLE PREPARATION:</b> Dry	PLASTICITY INDEX
	<b>REVIEWED BY:</b> WF

ZERO AIR VOIDS FOR SPECIFIC GRAVITY OF 2.90



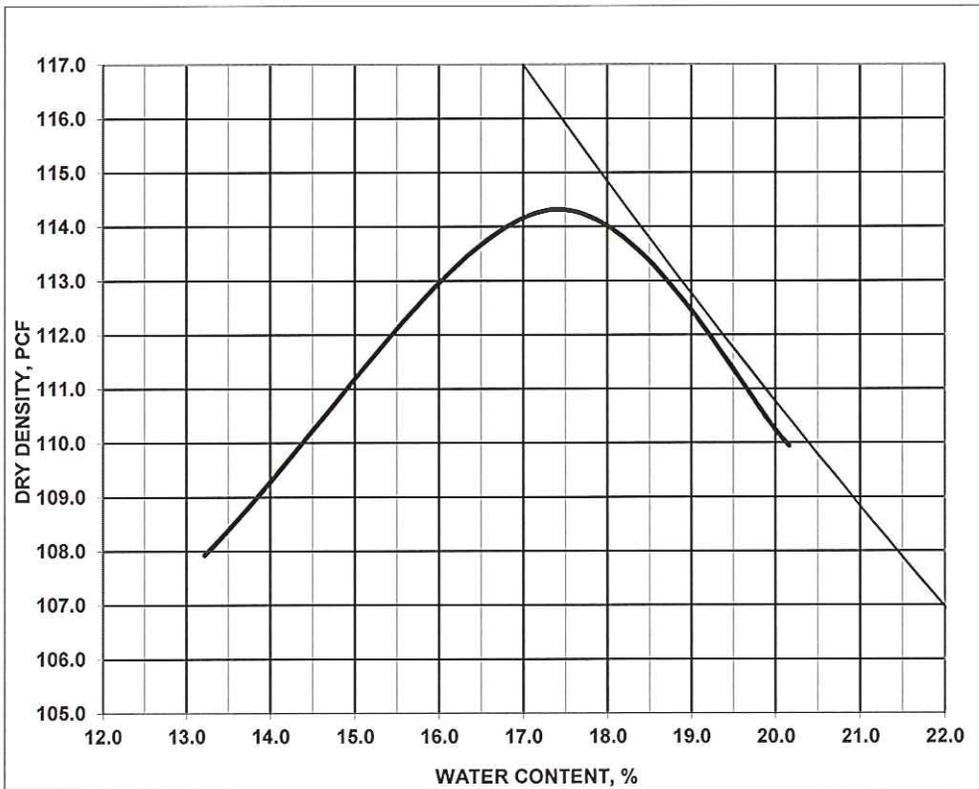


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### MOISTURE DENSITY RELATIONSHIP

<b>CLIENT NAME:</b> CETEC Engineering Services, Inc. Rapid City, South Dakota	<b>DATE:</b> 11/11/11 <b>LAB No.</b> 5030.004
<b>PROJECT NAME &amp; LOCATION:</b> Mt. Rushmore Road Reconstruction Rapid City, South Dakota	<b>REPORT NO.:</b>
<b>PROJECT NO.:</b> B4115030	<b>TEST RESULTS</b>
<b>SOURCE MATERIAL:</b> B-10 5'-15'	<b>MAXIMUM DRY DENSITY</b> 114.3 lb/ft <sup>3</sup>
<b>SAMPLE DESCRIPTION:</b> Shale, dark grey (CH)	<b>OPTIMUM MOISTURE</b> 17.5 %
<b>MATERIAL DESIGNATION:</b>	<b>ATTERBERG LIMITS</b>
<b>TEST METHOD:</b> D-1557	LIQUID LIMIT
<b>TEST PROCEDURE:</b> Method A	PLASTIC LIMIT
<b>SAMPLE PREPARATION:</b> Dry	PLASTICITY INDEX
	<b>REVIEWED BY:</b> WF

ZERO AIR VOIDS FOR SPECIFIC GRAVITY OF 2.75



**APPENDIX C**  
**SUPPORTING DOCUMENTS**

# GENERAL NOTES

## DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-3/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	PA:	Power Auger
CS:	Ring Sampler - 2" I.D., 2½" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value".

## WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling
WCI:	Wet Cave in	WD:	While Drilling
DCI:	Dry Cave in	BCR:	Before Casing Removal
AB:	After Boring	ACR:	After Casing Removal

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

**DESCRIPTIVE SOIL CLASSIFICATION:** Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

### FINE-GRAINED SOILS

### COARSE-GRAINED SOILS

### BEDROCK

<u>(RS)</u> <u>Blows/Ft.</u>	<u>(SS)</u> <u>Blows/Ft.</u>	<u>Consistency</u>	<u>(RS)</u> <u>Blows/Ft.</u>	<u>(SS)</u> <u>Blows/Ft.</u>	<u>Relative</u> <u>Density</u>	<u>(RS)</u> <u>Blows/Ft.</u>	<u>(SS)</u> <u>Blows/Ft.</u>	<u>Consistency</u>
< 3	0-2	Very Soft	0-6	< 3	Very Loose	< 30	< 20	Weathered
3-4	3-4	Soft	7-18	4-9	Loose	30-49	20-29	Firm
5-9	5-8	Medium Stiff	19-58	10-29	Medium Dense	50-89	30-49	Medium Hard
10-18	9-15	Stiff	59-98	30-50	Dense	90-119	50-79	Hard
19-42	16-30	Very Stiff	> 98	> 50	Very Dense	> 119	> 79	Very Hard
> 42	> 30	Hard						

### RELATIVE PROPORTIONS OF SAND AND GRAVEL

### GRAIN SIZE TERMINOLOGY

<u>Descriptive Terms of</u> <u>Other Constituents</u>	<u>Percent of</u> <u>Dry Weight</u>	<u>Major Component</u> <u>of Sample</u>	<u>Particle Size</u>
Trace	< 15	Boulders	Over 12 in. (300mm)
With	15 - 29	Cobbles	12 in. to 3 in. (300mm to 75 mm)
Modifier	> 30	Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
		Sand	#4 to #200 sieve (4.75mm to 0.075mm)
		Silt or Clay	Passing #200 Sieve (0.075mm)

### RELATIVE PROPORTIONS OF FINES

### PLASTICITY DESCRIPTION

<u>Descriptive Terms of</u> <u>Other Constituents</u>	<u>Percent of</u> <u>Dry Weight</u>	<u>Term</u>	<u>Plasticity Index</u>
Trace	< 5	Non-plastic	0
With	5 - 12	Low	1-10
Modifiers	> 12	Medium	11-30
		High	30+

# UNIFIED SOIL CLASSIFICATION SYSTEM

## Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests

				Soil Classification		
				Group Symbol	Group Name <sup>B</sup>	
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines <sup>C</sup>	$Cu \geq 4$ and $1 \leq Cc \leq 3^E$	GW	Well graded gravel <sup>F</sup>	
		Gravels with Fines More than 12% fines <sup>C</sup>	$Cu < 4$ and/or $1 > Cc > 3^E$	GP	Poorly graded gravel <sup>F</sup>	
			Fines classify as ML or MH Fines classify as CL or CH	GM GC	Silty gravel <sup>F,G,H</sup> Clayey gravel <sup>F,G,H</sup>	
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines <sup>D</sup>	$Cu \geq 6$ and $1 \leq Cc \leq 3^E$	SW	Well graded sand <sup>I</sup>	
		Sands with Fines More than 12% fines <sup>D</sup>	$Cu < 6$ and/or $1 > Cc > 3^E$	SP	Poorly graded sand <sup>I</sup>	
			Fines classify as ML or MH Fines classify as CL or CH	SM SC	Silty sand <sup>G,H,I</sup> Clayey sand <sup>G,H,I</sup>	
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silt and Clays Liquid limit less than 50	Inorganic	$PI > 7$ and plots on or above "A" line <sup>J</sup>	CL	Lean clay <sup>K,L,M</sup>	
		Organic	$PI < 4$ or plots below "A" line <sup>J</sup>	ML	Silt <sup>K,L,M</sup>	
			Liquid limit - oven dried Liquid limit - not dried	< 0.75	OL	Organic clay <sup>K,L,M,N</sup> Organic silt <sup>K,L,M,O</sup>
	Silt and Clays Liquid limit 50 or more	Inorganic	$PI$ plots on or above "A" line	CH	Fat clay <sup>K,L,M</sup>	
			$PI$ plots below "A" line	MH	Elastic silt <sup>K,L,M</sup>	
		Organic	Liquid limit - oven dried Liquid limit - not dried	< 0.75	OH	Organic clay <sup>K,L,M,P</sup> Organic silt <sup>K,L,M,Q</sup>
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat	

<sup>A</sup>Based on the material passing the 3-in. (75-mm) sieve

<sup>B</sup>If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

<sup>C</sup>Gravels with 5 to 12% fines require dual symbols: GW-GM well graded gravel with silt, GW-GC well graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

<sup>D</sup>Sands with 5 to 12% fines require dual symbols: SW-SM well graded sand with silt, SW-SC well graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

$$^E Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

<sup>F</sup>If soil contains  $\geq 15\%$  sand, add "with sand" to group name.

<sup>G</sup>If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

<sup>H</sup>If fines are organic, add "with organic fines" to group name.

<sup>I</sup>If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.

<sup>J</sup>If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

<sup>K</sup>If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

<sup>L</sup>If soil contains  $\geq 30\%$  plus No. 200 predominantly sand, add "sandy" to group name.

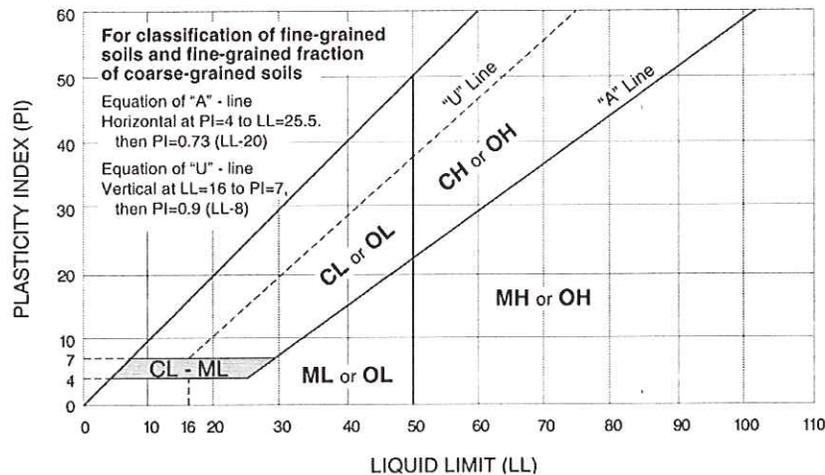
<sup>M</sup>If soil contains  $\geq 30\%$  plus No. 200, predominantly gravel, add "gravelly" to group name.

<sup>N</sup> $PI \geq 4$  and plots on or above "A" line.

<sup>O</sup> $PI < 4$  or plots below "A" line.

<sup>P</sup> $PI$  plots on or above "A" line.

<sup>Q</sup> $PI$  plots below "A" line.



**LABORATORY TEST  
SIGNIFICANCE AND PURPOSE**

<b>TEST</b>	<b>SIGNIFICANCE</b>	<b>PURPOSE</b>
<b><i>California Bearing Ratio</i></b>	Used to evaluate the potential strength of subgrade soil, subbase, and base course material, including recycled materials for use in road and airfield pavements.	<b><i>Pavement Thickness Design</i></b>
<b><i>Consolidation</i></b>	Used to develop an estimate of both the rate and amount of both differential and total settlement of a structure.	<b><i>Foundation Design</i></b>
<b><i>Direct Shear</i></b>	Used to determine the consolidated drained shear strength of soil or rock.	<b><i>Bearing Capacity, Foundation Design, and Slope Stability</i></b>
<b><i>Dry Density</i></b>	Used to determine the in-place density of natural, inorganic, fine-grained soils.	<b><i>Index Property Soil Behavior</i></b>
<b><i>Expansion</i></b>	Used to measure the expansive potential of fine-grained soil and to provide a basis for swell potential classification.	<b><i>Foundation and Slab Design</i></b>
<b><i>Gradation</i></b>	Used for the quantitative determination of the distribution of particle sizes in soil.	<b><i>Soil Classification</i></b>
<b><i>Liquid &amp; Plastic Limit, Plasticity Index</i></b>	Used as an integral part of engineering classification systems to characterize the fine-grained fraction of soils, and to specify the fine-grained fraction of construction materials.	<b><i>Soil Classification</i></b>
<b><i>Permeability</i></b>	Used to determine the capacity of soil or rock to conduct a liquid or gas.	<b><i>Groundwater Flow Analysis</i></b>
<b><i>pH</i></b>	Used to determine the degree of acidity or alkalinity of a soil.	<b><i>Corrosion Potential</i></b>
<b><i>Resistivity</i></b>	Used to indicate the relative ability of a soil medium to carry electrical currents.	<b><i>Corrosion Potential</i></b>
<b><i>R-Value</i></b>	Used to evaluate the potential strength of subgrade soil, subbase, and base course material, including recycled materials for use in road and airfield pavements.	<b><i>Pavement Thickness Design</i></b>
<b><i>Soluble Sulphate</i></b>	Used to determine the quantitative amount of soluble sulfates within a soil mass.	<b><i>Corrosion Potential</i></b>
<b><i>Unconfined Compression</i></b>	To obtain the approximate compressive strength of soils that possess sufficient cohesion to permit testing in the unconfined state.	<b><i>Bearing Capacity Analysis for Foundations</i></b>
<b><i>Water Content</i></b>	Used to determine the quantitative amount of water in a soil mass.	<b><i>Index Property Soil Behavior</i></b>

**REPORT TERMINOLOGY**  
**(Based on ASTM D653)**

<b><i>Allowable Soil Bearing Capacity</i></b>	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
<b><i>Alluvium</i></b>	Soil, the constituents of which have been transported in suspension by flowing water and subsequently deposited by sedimentation.
<b><i>Aggregate Base Course</i></b>	A layer of specified material placed on a subgrade or subbase usually beneath slabs or pavements.
<b><i>Backfill</i></b>	A specified material placed and compacted in a confined area.
<b><i>Bedrock</i></b>	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
<b><i>Bench</i></b>	A horizontal surface in a sloped deposit.
<b><i>Caisson (Drilled Pier or Shaft)</i></b>	A concrete foundation element cast in a circular excavation which may have an enlarged base. Sometimes referred to as a cast-in-place pier or drilled shaft.
<b><i>Coefficient of Friction</i></b>	A constant proportionality factor relating normal stress and the corresponding shear stress at which sliding starts between the two surfaces.
<b><i>Colluvium</i></b>	Soil, the constituents of which have been deposited chiefly by gravity such as at the foot of a slope or cliff.
<b><i>Compaction</i></b>	The densification of a soil by means of mechanical manipulation
<b><i>Concrete Slab-on-Grade</i></b>	A concrete surface layer cast directly upon a base, subbase or subgrade, and typically used as a floor system.
<b><i>Differential Movement</i></b>	Unequal settlement or heave between, or within foundation elements of structure.
<b><i>Earth Pressure</i></b>	The pressure exerted by soil on any boundary such as a foundation wall.
<b><i>ESAL</i></b>	Equivalent Single Axle Load, a criteria used to convert traffic to a uniform standard, (18,000 pound axle loads).
<b><i>Engineered Fill</i></b>	Specified material placed and compacted to specified density and/or moisture conditions under observations of a representative of a geotechnical engineer.
<b><i>Equivalent Fluid</i></b>	A hypothetical fluid having a unit weight such that it will produce a pressure against a lateral support presumed to be equivalent to that produced by the actual soil. This simplified approach is valid only when deformation conditions are such that the pressure increases linearly with depth and the wall friction is neglected.
<b><i>Existing Fill (or Man-Made Fill)</i></b>	Materials deposited throughout the action of man prior to exploration of the site.
<b><i>Existing Grade</i></b>	The ground surface at the time of field exploration.

**REPORT TERMINOLOGY**  
**(Based on ASTM D653)**

<b><i>Expansive Potential</i></b>	The potential of a soil to expand (increase in volume) due to absorption of moisture.
<b><i>Finished Grade</i></b>	The final grade created as a part of the project.
<b><i>Footing</i></b>	A portion of the foundation of a structure that transmits loads directly to the soil.
<b><i>Foundation</i></b>	The lower part of a structure that transmits the loads to the soil or bedrock.
<b><i>Frost Depth</i></b>	The depth at which the ground becomes frozen during the winter season.
<b><i>Grade Beam</i></b>	A foundation element or wall, typically constructed of reinforced concrete, used to span between other foundation elements such as drilled piers.
<b><i>Groundwater</i></b>	Subsurface water found in the zone of saturation of soils or within fractures in bedrock.
<b><i>Heave</i></b>	Upward movement.
<b><i>Lithologic</i></b>	The characteristics which describe the composition and texture of soil and rock by observation.
<b><i>Native Grade</i></b>	The naturally occurring ground surface.
<b><i>Native Soil</i></b>	Naturally occurring on-site soil, sometimes referred to as natural soil.
<b><i>Optimum Moisture Content</i></b>	The water content at which a soil can be compacted to a maximum dry unit weight by a given compactive effort.
<b><i>Perched Water</i></b>	Groundwater, usually of limited area maintained above a normal water elevation by the presence of an intervening relatively impervious continuous stratum.
<b><i>Scarify</i></b>	To mechanically loosen soil or break down existing soil structure.
<b><i>Settlement</i></b>	Downward movement.
<b><i>Skin Friction (Side Shear)</i></b>	The frictional resistance developed between soil and an element of the structure such as a drilled pier.
<b><i>Soil (Earth)</i></b>	Sediments or other unconsolidated accumulations of solid particles produced by the physical and chemical disintegration of rocks, and which may or may not contain organic matter.
<b><i>Strain</i></b>	The change in length per unit of length in a given direction.
<b><i>Stress</i></b>	The force per unit area acting within a soil mass.
<b><i>Strip</i></b>	To remove from present location.
<b><i>Subbase</i></b>	A layer of specified material in a pavement system between the subgrade and base course.
<b><i>Subgrade</i></b>	The soil prepared and compacted to support a structure, slab or pavement system.

**STATE OF SOUTH DAKOTA  
DEPARTMENT OF TRANSPORTATION**

**SPECIAL PROVISION  
FOR  
CONTRACTOR ADMINISTERED PRECONSTRUCTION MEETING**

**APRIL 18, 2013**

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**I. DESCRIPTION**

This work consists of the Contractor scheduling and conducting a preconstruction meeting prior to beginning work on this contract. Additionally this work consists of the Contractor providing the Area Engineer a completed list of required submittals.

**II. MATERIALS (Not Specified)**

**III. CONSTRUCTION REQUIREMENTS**

For the purposes of this special provision, a business day is any calendar day except Saturdays, holidays, and days designated by the Governor of this State as an administrative leave day for state employees.

The Department will provide the Contractor a list of required submittals and the Authorization Form for Preconstruction Meeting (Form DOT-270) within five (5) business days of the date of the Notice to Proceed.

The Contractor's Required Submittals Form (Form DOT-272) is a document outlining information required prior to the completion of the project. This list will include two types of submittals; 1) information required before scheduling a preconstruction meeting and 2) information required before the Contractor begins related work. The Department reserves the right to request additional information not included in the original list of required submittals. The list of required submittals will include, but is not limited to, proposed sequence changes, shop drawings, permits, certifications, mix designs, labor compliance, equal employment opportunity, and disadvantaged business enterprise documents.

Prior to scheduling the preconstruction meeting, the Contractor will complete and provide the Area Engineer all items on the list of required submittals that are required as described in 1) above. If the Contractor cannot complete and provide a submittal item required prior to scheduling the preconstruction meeting, the Contractor will contact the Area Engineer to establish a mutually agreed upon

date when the required submittal will be completed and provided to the Area office.

The Contractor will not begin work on an item until the Contractor has provided the Area Engineer with all required information for the applicable work item and the appropriate office has approved the information, if necessary. The Contractor will make every reasonable effort to deliver the required submittals at the earliest possible time.

The Contractor's authorized representative as indicated on the Signature Authorization Form (Form DOT-209) will complete, in its entirety, the first page of the Authorization Form for Preconstruction Meeting and will initial each proceeding section. By initialing each section, the Contractor is confirming comprehension of each section.

When the Contractor has provided the Area Engineer all required submittals, unless the Contractor and Department have established an agreement in writing providing future dates of outstanding required submittal items, the Contractor will schedule a preconstruction meeting with the Area Engineer.

Within two (2) business days following the Contractor scheduling the preconstruction meeting, the Area Engineer will prepare and send the Contractor a meeting confirmation and the Preconstruction Meeting Outline (Form DOT-271) of discussion items including specific Department items.

The Contractor will complete the Contractor's portion of the Preconstruction Meeting Outline and will add additional discussion items as needed. The Contractor will send the meeting notice and final Preconstruction Meeting Outline to the Area Engineer, all subcontractors, utility companies, and all suppliers at least five (5) business days prior to the preconstruction meeting.

The Area Engineer will send the notice of the meeting and the final Preconstruction Meeting Outline of discussion items to any other government entities and other principle stakeholders involved in the project at least three (3) business days prior to the preconstruction meeting.

At the discretion of the Area Engineer, the preconstruction meeting may be held in person, videoconference, or over the phone. The Contractor's competent superintendent, as required by Section 5.5, who will be working on this project, is required to attend the preconstruction meeting.

The Contractor will lead the meeting discussion as described in the Preconstruction Meeting Outline. The Area Engineer will prepare the meeting minutes including any unresolved items and distribute them to all attendees and principle stakeholders within five (5) business days following the preconstruction meeting.

**IV. METHOD OF MEASUREMENT**

The Department will not make a separate measurement for the preconstruction meeting.

**V. BASIS OF PAYMENT**

The Department will not make a separate payment for the preconstruction meeting. All costs associated with the preconstruction meeting will be incidental to other contract items.

\* \* \* \* \*



**STATE OF SOUTH DAKOTA  
DEPARTMENT OF TRANSPORTATION**

**SPECIAL PROVISION  
FOR  
ELECTRONIC BIDDING REQUIREMENTS**

**DECEMBER 18, 2013**

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The South Dakota Department of Transportation requires all bid proposals submitted for this project be prepared and submitted using the latest version of the South Dakota Electronic Bidding System (SDEBS).

A prospective bidder may obtain the latest version of the SDEBS software from the SDDOT Website:

<http://apps.sd.gov/hc65bidletting/ebsInstall.aspx>

**MAKE THE INDICATED CHANGES TO THE FOLLOWING SPECIFIED SECTIONS OF THE STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES:**

**Delete Section 2.1 and replace with the following:**

**2.1**

- A. PREQUALIFICATION OF BIDDERS** - Prequalification on state highway construction contracts is required unless the amount being bid is less than \$200,000.

A prospective bidder must be prequalified prior to the time and date specified for bid opening. A prospective bidder may apply for prequalification by completing and executing a Contractor's prequalification statement on a form approved by the Department. This application must be received by the Department's classification and rating committee at least 14 calendar days prior to the letting date.

Once prequalified, the Department will issue a notice to the prospective bidder stating the prospective bidder's approved work classification or work classifications, the prospective bidder's bidding capacity, and the prospective bidder's expiration date for prequalification status.

A prospective bidder may obtain the prequalification requirements contained in South Dakota Administrative Rules from the website:

<http://legis.sd.gov/rules/DisplayRule.aspx?Rule=70:07>

**B. ELECTRONIC IDENTIFICATION** – A prospective bidder must register as a new user on the Department’s website to obtain a company identification and password. Certain bidding documents will only be available for download with proper company identification and password. Each company will receive one company identification and password.

In addition to the company identification and password, a prospective bidder must obtain a bidder identification and password for each individual who will be authorized to submit a bid proposal on behalf of the company. To authorize an individual to submit a bid proposal on behalf of the company, and obtain the bidder identification(s) and password(s), the company must complete a Bidding Authorization Form (available on the Department’s website), furnishing all required information and all appropriate notarized signatures, and submit the form to the Department no later than 48 hours prior to the bid opening.

The individual receiving this bidder identification and password must be an authorized agent of the company having legal authority to do business for the company.

**Delete Section 2.2 and replace with the following:**

**2.2 CONTENTS OF BIDDING PACKAGE** - The bidding package consists of the proposal booklet, plans, electronic design files, specifications, special provisions, supplemental specifications, addenda, project question and answer (Q&A) forum, and electronic bid files. The bidding package will state the location and description of the contemplated construction, show the estimate of the various quantities and type of work to be performed or materials to be furnished, and will have a schedule of items for which unit bid prices are invited. The bidding package will state the time in which the contract work must be completed, the time and date deadline for submitting the required bid proposals, and prequalification requirements.

Prospective bidders must refer to the SDDOT Website to acquire the bidding package. The prospective bidder will be responsible for all costs associated with utilizing the SDEBS and electronic bonds through the bond management company.

The Department will open the project Q&A forum when the project is advertised for letting. Prospective bidders are responsible for periodically checking the project Q&A forum for new questions and answers. The Department will post questions and answers, but will provide no additional notification of posted questions and answers. Prospective bidders may post new questions to the project Q&A forum until 10:00 AM CT on the Friday prior to the letting, at which time prospective bidders will be locked from further posting. The Department may post new questions and answers to the project Q&A forum up until 10:00 AM CT

on the Tuesday prior to the letting, at which time the project Q&A forum will be final and locked from all editing. In submitting a complete and final bid, a prospective bidder must account for any and all information posted to the final project Q&A forum regardless of when the prospective bidder submits a bid proposal.

**Delete Section 2.3 and replace with the following:**

**2.3 ISSUANCE OF BIDDING PACKAGE** - The Department will not place restrictions on who may download the bidding package from the website, except that certain documents will require the company identification described in Section 2.1 B. The bidder must verify the bidder's prequalification status prior to bidding. The Department will verify bidder status in accordance with Section 3.1 prior to opening bids.

**Delete Section 2.5 and replace with the following:**

**2.5 EXAMINATION OF PLANS, SPECIFICATIONS, SPECIAL PROVISIONS, PROJECT Q&A FORUM, AND SITE OF WORK** - The bidder must examine the project site, and the entire bidding package for the work contemplated. The submission of a bid proposal will be considered conclusive evidence the bidder has investigated and is satisfied as to the conditions to be encountered, the character, quality, and quantities of work to be performed, and materials to be furnished, according to all contract documents.

Boring logs and other records of subsurface investigations are available for inspection by prospective bidders. Prospective bidders must understand this information was obtained and is intended for Department design and estimating purposes and the Department cannot guarantee the accuracy of this information. This information is made available so all prospective bidders have access to the same subsurface information available to the Department. The furnishing of this information is not intended as a substitute for the prospective bidder's personal investigation, interpretation, and judgment.

The Department will not be bound by any statement or representation made by any Department employee or agent prior to the execution of the contract, unless included in the bidding package.

A prospective bidder must request any explanation regarding the meaning or interpretation of the bidding package in adequate time to allow a Department reply to reach all prospective bidders before submission of final bid proposals. The bidder will contact the Department by submitting a request for explanation to the project Q&A forum. If the deadline for submitting questions to the project Q&A forum has passed, the bidder will submit the request for explanation to the Department Bid Letting office. The Department may answer the request for explanation on the project Q&A forum or issue an addendum to all prospective

bidders, as appropriate, in the Department's sole discretion. The Department will furnish any addendum to all prospective bidders by electronic addendum before the time specified for opening of bid proposals.

The bidder will not take advantage of any apparent error, omission, or ambiguity in the bidding package. If the bidder discovers an error, omission, or ambiguity, the bidder will immediately notify the Department of the apparent error, omission, or ambiguity and its perceived consequences. The bidder will notify the Department by submitting a question to the project Q&A forum. If the deadline for submitting questions to the project Q&A forum has passed, the bidder will notify the Department Bid Letting office. The Department may certify the error, omission, or ambiguity and may answer the question on the project Q&A forum or issue an addendum to all prospective bidders, as appropriate, in the Department's sole discretion. The Department will furnish any addendum to all prospective bidders by electronic addendum before the time specified for opening of bid proposals.

The Contractor will not take advantage of any apparent error, omission, or ambiguity in the contract. If the Contractor discovers an error, omission, or ambiguity, the Contractor will immediately notify the Department of the apparent error, omission, or ambiguity and its perceived consequences. The Contractor will notify the Engineer. The Engineer will make corrections and interpretations as necessary to fulfill the intent of the Contract.

**Delete Section 2.6 and replace with the following:**

**2.6 PREPARATION OF PROPOSAL** - The bidder must submit the proposal using the SDEBS.

The bidder must specify a unit price, in numerals, for each bid item for which a quantity is given. A unit price cannot be "\$0.00."

When the bidding package contains an alternate bid item or group(s) of alternate bid items, the bidder must indicate a choice for each available group by entering unit prices for all bid items within the alternate chosen.

The bidder must complete all required fields in the SDEBS. If the bidder does not completely fill out all required fields the Department may consider the bid irregular and reject the bid proposal in accordance with Section 2.7.

For bidding purposes, in case of a discrepancy between the line number, bid item description, or quantity shown in the SDEBS and the corresponding item shown in the plans, the bid item description and the quantity shown in the SDEBS will govern.

**2.7 IRREGULAR BID PROPOSALS** – The Department will consider a bid proposal irregular and may reject the bid proposal for any of the following reasons:

- A. The bid proposal is incomplete, or is submitted on a form other than the Department’s latest version of the SDEBS;
- B. The bid proposal contains unauthorized additions, conditional or alternate bids, or other irregularities, which may tend to make the bid proposal incomplete, indefinite, or ambiguous as to its meaning;
- C. The bid proposal contains provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award (this is not intended to exclude a bid proposal limiting the maximum gross amount of awards acceptable to a bidder at one bid letting. The Department will select awards in its sole discretion.);
- D. The bid proposal does not contain a unit price in numerals for each pay item listed, except in the case of authorized alternate pay items;
- E. The bid proposal is signed with an invalid bidder identification;
- F. The Department determines, in its sole discretion, that any of the unit bid prices are significantly unbalanced to the potential detriment of the Department; or,
- G. Confirmation of receipt of all addenda issued by the Department is not included in the bid proposal.

**Delete Section 2.8 and replace with the following:**

**2.8 PROPOSAL GUARANTY** - The Department will not consider any bid proposal unless the bidder has furnished the Department a guaranty in the amount of five percent of the total amount of the bid prior to opening of the bids. Satisfactory forms of proposal guaranties are certified checks, cashier’s checks, bank drafts issued upon a national or state bank, and bid bonds issued in accordance with South Dakota law. If the bidder uses an electronic bid bond, the bidder must submit the bid bond identification number with the bid proposal. Unless otherwise specified in the bidding package, the proposal guaranty must be made payable at sight to the “South Dakota Department of Transportation.”

**Delete Section 2.9 and replace with the following:**

**2.9 SUBMISSION OF BID PROPOSALS** – A bidder must submit a bid proposal electronically using the SDEBS to the Department’s secure bid submission site prior to the time and date specified by the Notice to Contractors in the bidding

package. The Department will not accept any bid proposal received after the time specified for opening of bids.

**Delete Section 2.10 and replace with the following:**

**2.10 WITHDRAWAL OR REVISION OF PROPOSALS** - A bidder may withdraw a proposal after it has been submitted, if the withdrawal is made before the time set for opening the proposals.

A bidder may revise and resubmit a bid proposal any time prior to the time set for opening the proposals. The Department will consider only the last bid proposal submitted as a valid bid proposal for that project. A bidder may revise a bid only through the SDEBS.

**Delete Section 3.1 and replace with the following:**

**3.1 CONSIDERATION OF BID PROPOSALS** - After the bids are received, but prior to opening, the Department will verify the bidder is prequalified for the specified work type. After the bids are opened, the Department will verify the bidder's status at that time is sufficient to handle the work for which the bidder submitted a bid. The Department reserves the right to refuse to accept a bid proposal for any of the following reasons:

- A.** Lack of competency or adequate machinery, plant, and other equipment, as shown by the Contractor's Prequalification Statement;
- B.** Uncompleted work which the Department determines, in its sole discretion, may hinder or prevent the prompt completion of additional work;
- C.** Failure to pay or satisfactorily settle any legal obligation due for labor or material on any contract at the time of issuance of proposals;
- D.** Failure to comply with the Department's prequalification regulations;
- E.** Default under any previous contract or contracts;
- F.** Debarment by the Department or the federal government;
- G.** Lack of bidding capacity as established by the Contractor's prequalification statement, considering the uncompleted work currently under contract; or,
- H.** Unsatisfactory performance on previous work or any current contract or contracts consisting of, but not limited to:
  - 1.** Noncompliance with contract specifications, contract requirements, or Engineer's directives;

2. Failure to complete work on time;
3. Instances of substantial corrective work prior to acceptance;
4. Instances of completed work that requires acceptance at reduced pay;
5. Production of work or materials not meeting required specifications, and when applicable, requiring price reductions or corrective work;
6. Failure to provide adequate safety measures or appropriate traffic control that endangers the safety of the work force and public;
7. Questionable moral integrity as determined by the Attorney General of the State, or the Department; or,
8. Failure to reimburse the State for monies owed on any previously awarded contract including any contract where the prospective bidder is a party to a joint venture and the joint venture has failed to reimburse the State for monies owed.

After the bid proposals are opened, the Department will compare the bids on the basis of the summation of the products of the quantities shown in the bid proposal by the unit bid prices. The results of such comparisons will be available to the public via the Department's Internet Website.

The Department reserves the right to reject any bid proposal, the right to waive technicalities, and the right to reject all bid proposals and advertise for new bid proposals, if in the sole judgment of the Department the rejection or waiver will promote the best interest of the Department.

**Delete Section 3.4 and replace with the following:**

- 3.4 PROPOSAL GUARANTY** - The Department will retain the proposal guaranties of the two lowest responsible and competent bidders. The Department will release the remaining proposal guaranties following opening and checking of bid proposals. The Department will release the proposal guaranties of the two low bidders when the contract has been executed.

**Delete Section 5.4 and replace with the following:**

- 5.4 COORDINATION OF CONTRACT DOCUMENTS** – The contents of the bidding package are essential parts of the contract. A requirement occurring in one is as binding as though occurring in all. The contents of the bidding package are intended to be complimentary and to describe and provide for a complete work.

If any discrepancy exists, the governing ranking is:

1. Addenda
2. Project Q&A forum
3. Special provisions
4. Plans
5. Supplemental specifications
6. Standard specifications
7. Electronic design files

Notwithstanding the above governing ranking, addenda will govern over the project Q&A forum unless specifically addressed by a Department response in the project Q&A forum.

In case of a discrepancy between questions on the project Q&A forum regarding the same topic, the most recent question and answer will govern over previous questions and answers. Questions will be numbered on the project Q&A forum in order of date and time posted.

In addition, calculated dimensions will govern over scaled dimensions.

**Delete Section 570**

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**STATE OF SOUTH DAKOTA  
DEPARTMENT OF TRANSPORTATION**

**SPECIAL PROVISION  
FOR  
DIFFERING SITE CONDITIONS**

**DECEMBER 19, 2013**

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During the progress of the work, if subsurface or latent physical conditions are encountered at the site differing materially from those indicated in the contract or if unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the contract, are encountered at the site, the party discovering such conditions shall promptly notify the other party in writing of the specific differing conditions before the site is disturbed and before the affected work is performed.

Upon written notification, the Engineer will investigate the conditions, and if it is determined that the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any work under the contract, an adjustment, excluding anticipated profits, will be made and the contract modified in writing accordingly. The Engineer will notify the Contractor of the determination whether or not an adjustment of the contract is warranted.

No contract adjustment which results in a benefit to the Contractor will be allowed unless the Contractor has provided the required written notice.

No contract adjustment will be allowed under this clause for any effects caused on unchanged work.

This section does not apply to material sources shown on the plans and as defined in Section 6.

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**STATE OF SOUTH DAKOTA  
DEPARTMENT OF TRANSPORTATION**

**SPECIAL PROVISION  
FOR  
SUSPENSION OF WORK**

**FEBRUARY 13, 2004**

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The following shall apply when suspension of the work is ordered by the Engineer.

If the performance of all or any portion of the work is suspended or delayed by the Engineer in writing for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry) and the Contractor believes that additional compensation and/ or contract time is due as a result of such suspension or delay, the Contractor shall submit to the Engineer in writing a request for adjustment within 7 calendar days of receipt of the notice to resume work. The request shall set forth the reasons and support for such adjustment.

Upon receipt, the Engineer will evaluate the contractor's request in accordance with Section 5.17 and/or Section 8.6 of the Standard Specifications. If the Engineer agrees that the cost and/or time required for the performance of the contract has increased as a result of such suspension and the suspension was caused by conditions beyond the control of and not the fault of the Contractor, its suppliers, or subcontractors at any approved tier, and not caused by weather, the Engineer will make an adjustment (excluding profit) and modify the contract in writing accordingly. The Contractor will be notified of the Engineer's determination whether or not an adjustment of the contract is warranted.

No contract adjustment will be allowed unless the Contractor has submitted the request for adjustment within the time prescribed.

No contract adjustment will be allowed under this clause to the extent that performance would have been suspended or delayed by any other cause, or for which an adjustment is provided or excluded under any other term or condition of this contract.

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**STATE OF SOUTH DAKOTA  
DEPARTMENT OF TRANSPORTATION**

**SPECIAL PROVISION  
FOR  
STANDARD TITLE VI ASSURANCE**

**JANUARY 15, 2004**

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**TITLE VI – NONDISCRIMINATION:**

During the performance of this contract, the contractor, for itself, its assignees and successors in interest (hereinafter referred to as the “Contractor”) agrees as follows:

- (1) Compliance with Regulations: The contractor shall comply with the Regulations relative to nondiscrimination in Federally or State assisted programs of the South Dakota Department of Transportation, Title 49, Code of Federal Regulations, Part 21, as they may be amended (hereinafter referred to as the “Regulations”), incorporated by reference and made a part of this contract.
- (2) Nondiscrimination: The contractor, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, religion, national origin, sex, age or disability in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor shall not participate either directly or indirectly in the discrimination prohibited by section 21.5 of the Regulations, including employment practices when the contract covers a program set forth in Appendix B of the Regulations.
- (3) Solicitations for Subcontracts, Including Procurements of Materials and Equipment: In all solicitations either by competitive bidding or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the contractor of the contractor’s obligations under this contract and the Regulations relative to nondiscrimination on the grounds of race, color, religion, national origin, sex, age or disability.
- (4) Information and Reports: The contractor shall provide all information and reports required by the Regulations, or directives issued pursuant thereto, and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the South Dakota Department of Transportation or the Federal Highway Administration to be pertinent to ascertain compliance with such Regulations or directives. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish this information, the contractor shall so certify to the South Dakota Department of Transportation, or the Federal Highway Administration as appropriate, and shall set forth what efforts it has made to obtain this information.
- (5) Sanctions for Noncompliance: In the event of the contractor’s noncompliance with the nondiscrimination provisions of this contract, the South Dakota Department of Transportation shall impose such contract sanctions as it or the Federal Highway Administration may determine to be appropriate, including but not limited to:
  - (a) withholding of payments to the contractor under the contract until the contractor complies, and/or
  - (b) cancellation, termination or suspension of the contract, in whole or in part.
- (6) Incorporation of Provisions: The contractor shall include the provisions of paragraphs (1) through (6) in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Regulations, or directives pursuant thereto. The contractor shall take such action with respect to any subcontract or procurement as the South Dakota Department of Transportation or the Federal Highway Administration may direct as a means of enforcing such provisions including sanctions for non-compliance. Provided, however, that, in the event of a contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, the contractor may request the South Dakota Department of Transportation to enter into such litigation to protect the interest of the State, and, in addition, the contractor may request the United States to enter such litigation to protect the interests of the United States.

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**STATE OF SOUTH DAKOTA  
DEPARTMENT OF TRANSPORTATION**

**SPECIAL PROVISION FOR  
IMPLEMENTATION OF CLEAN AIR ACT  
AND  
FEDERAL WATER POLLUTION CONTROL ACT**

**SEPTEMBER 1, 1997**

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By signing this bid, the bidder will be deemed to have stipulated as follows:

- a) That any facility to be utilized in the performance of this contract, unless such contract is exempt under the Clean Air Act, as amended (42 U.S.C. 1857 et seq., as amended by Pub. L. 91-604), and under the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq., as amended by Pub. L. 92-500), Executive Order 11738, and regulations in implementation thereof (40 CFR, Part 15), is not listed on the U.S. Environmental Protection Agency (EPA) List of Violating Facilities pursuant to 40 CFR 15.20.
- b) That the State Transportation Department shall be promptly notified prior to contract award of the receipt by the bidder of any communication from the Director, Office of Federal Activities, EPA, indicating that a facility to be utilized for the contract is under consideration to be listed on the EPA List of Violating Facilities.

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**STATE OF SOUTH DAKOTA  
DEPARTMENT OF TRANSPORTATION  
SUPPLEMENTAL SPECIFICATION FOR  
ERRATA**

**MARCH 3, 2010**

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**MAKE THE INDICATED CORRECTIONS TO THE FOLLOWING SPECIFIED SECTIONS:**

**Section 491.5 A, B, C, D, E – Page 290 – Add the following to the end of the first sentence of each of these sections:**

(square meter).

**Section 629.4 C – Page 351 – Replace the first sentence with the following:**

Remove Three Cable Guardrail will be measured to the nearest foot (0.1 meter) along the centerline of the cable.

**Section 629.4 D – Page 351 – Replace the first sentence with the following:**

Removal of Anchor Assembly will be measured by the each.

**Section 630.3 D – Page 354 – Replace the fourth sentence with the following:**

The drawings shall contain all components of the W beam end terminal.

**Section 634.2 – Page 371 – Replace the second paragraph with the following:**

Traffic control devices shall meet the crashworthy requirements of the National Cooperative Highway Research Program Report 350 (NCHRP 350) for Category I, II and III devices.

**Section 635.3 L – Page 383 – Delete and replace with the following:**

**L. Luminaires:** Luminaires shall be adjusted on the support so the lamina sets level as indicated by a small bubble level. Bolts shall be firmly tightened.

**Section 635.4 K – Page 385 – Delete and replace with the following:**

**K. Luminaires:** Measurement will be by the actual count of the various types and sizes of luminaires furnished and installed.

**Section 635.5 K – Page 387 – Delete and replace with the following:**

**K. Luminaires:** Payment for luminaires of the various types and sizes will be at their respective contract unit prices per each. Payment will be full compensation for furnishing and installing luminaires.

**Section 984.3 H – Page 504 – Replace the first paragraph with the following:**

Temporary road markers shall consist of a yellow or white plastic body providing a horizontal width and length of approximately 3 ½ inches (90 mm) in both dimensions and approximately ¾ inches (20

mm) high. If flexible vertical markers are used they shall be approximately 4 inches (100 mm) wide and approximately 2 inches (50 mm) high.

**Index – Page 532 – Under Portland Cement Concrete Pavement – Delete “Dowel and Tie Bars...517” and replace with the following:**

Dowel and Tie Bars..... 519

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**STATE OF SOUTH DAKOTA  
DEPARTMENT OF TRANSPORTATION**

**SUPPLEMENTAL SPECIFICATION TO  
STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES**

**MARCH 3, 2010**

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All items included in this supplemental specification will govern over the Errata.

**MAKE THE INDICATED CHANGES TO THE FOLLOWING SPECIFIED SECTIONS:**

**Section 2.6 D – Page 11 – Delete and replace with the following:**

D. PCN

**Section 3.6 – Page 15 – Delete and replace with the following:**

**3.6 EXECUTION AND APPROVAL OF CONTRACT** - The contract shall be signed and returned by the successful bidder, together with the contract bond, within 20 calendar days after the receipt of the Notice of Award. If the contract is not executed by the Department within 15 calendar days following the receipt from the bidder of the signed contract and related documents, the bidder shall have the right to withdraw the bid without penalty. A contract will not be considered in effect until it has been executed by all parties to the contract.

**Section 3.7 – Page 15 – Delete the first sentence and replace with the following:**

Failure to execute the contract and file acceptable bonds within 20 calendar days after bidder's receipt of the Notice of Award shall be just cause for the cancellation of the award and the forfeiture of the proposal guaranty which shall become the property of the Department, for liquidation of damages sustained.

**Section 4.6 – Page 19 – Delete and replace with the following:**

**4.6 FINAL CLEANING UP** - Before Acceptance of Field Work is made by the Area Office, the highway and areas occupied by the Contractor in connection with the work shall be cleaned of rubbish, excess materials, temporary structures, and equipment; and the work left in an acceptable condition, unless otherwise approved by the Engineer.

**Section 5.6 – Page 24 – Delete the last sentence of the seventh paragraph and replace with the following:**

The depth applies to the existing grade or ditch flowline within the right-of-way.

**Section 5.6 – Page 24 – Delete the last two sentences of the eighth paragraph and replace with the following:**

Contractors shall give at least 48 hour notice prior to commencement of excavation, excluding Saturdays, Sundays, and legal holidays of the state. South Dakota One Call phone number is **1-800-781-7474** or **811** within the State of South Dakota.

**Section 5.6 – Page 24 – Add the following to the list of items on page 25:**

Tunneling or Boring  
Duration of Excavation  
Nearest Cross Street

**Section 5.6 – Page 24 – Delete the third sentence of the last paragraph on page 25 and replace with the following:**

The utility shall as soon as possible but not longer than two hours from the notification time during the business day and not longer than four hours from the notification time outside of the business day or by the start time on the ticket, whichever is later provide all reasonably available practical information to the Contractor.

**Section 5.10 – Page 27 – Add the following sentence to this section:**

Neither the Department's authority to inspect all work nor any actual inspections performed by the Department during the course of construction shall constitute an acceptance of work performed, or operate to relieve the Contractor of its obligation to construct the project in compliance with the plans and specifications.

**Section 5.14 – Page 28 – Delete the first sentence of the first paragraph and replace with the following:**

The Contractor shall maintain the work during construction and until the Area Office issues the Acceptance of Field Work.

**Section 5.14 – Page 28 – Delete the last paragraph and replace with the following:**

Cost of maintenance work during construction and before the Area Office issues the Acceptance of Field Work shall be included in the unit price bid on the various pay items and the Contractor will not be paid an additional amount for such work.

**Section 5.16 – Page 29 – Delete and replace with the following:**

**5.16 ACCEPTANCE OF FIELD WORK** - When the contract work, including authorized modifications and final cleanup has been completed, the Area Engineer or his designee will, within fourteen days, make a final inspection of the work. When provided in the Contract, the Area Engineer or his designee may make inspections following completion of portions of the contract. If the work is found to conform with the requirements of the Contract, the Area Engineer or his designee will issue written notification to the Contractor of Acceptance of Field Work. Such notice is not to be construed as an acceptance by the Area Engineer or his designee of previously noted defective or unauthorized work, or of unauthorized work subsequently determined during the final computations of field measurements. Should the work fail to conform with requirements of the Contract, a written statement of the features to be remedied will be given the Contractor. Final Acceptance will not be made until the Contractor advises the Engineer that the corrections have been made and the requirements have been met.

**Section 5.17 – Page 29 – Delete the first paragraph and replace with the following:**

**5.17 CLAIMS FOR ADJUSTMENT AND DISPUTES** - If the Contractor deems that additional compensation is warranted for work or materials not covered in the Contract and not ordered as extra work as defined herein, the Contractor shall give the Area Engineer written notice of the claim for additional compensation.

**Section 5.17 – Page 29 – Delete the fourth paragraph and replace with the following:**

Under no circumstances will a claim be considered if written notification is made more than 30 days after the final payment is made.

**Section 5.17 – Page 30 – Delete the sixth and seventh paragraphs and replace with the following two paragraphs:**

The Contractor hereby agrees to waive any claim for additional compensation if timely written notification is not furnished and the Area Engineer is not provided the opportunity to keep account of or determine costs, to incorporate alternate methods of accomplishing the disputed work or to otherwise resolve the claim.

A Claims Documentation Form, furnished by the Department, shall be completed by the Contractor and submitted to the Area Engineer after completion of the work on which the claim is based. The Claims Documentation Form shall be completed within 120 calendar days after completion of the work unless an extension is granted, in writing, by the Area Engineer.

**Section 5.17 – Page 30 – Delete the last three paragraphs of this section and replace with the following five paragraphs:**

Claims which are properly submitted, but which are not approved, will be automatically escalated to the next higher authority level within the Department for review. The Secretary of Transportation has final resolution authority on all submitted claims.

Claims may be submitted by the Department to a third-party claim investigator for further review and investigation. The report prepared by the claim investigator shall not be shared with the Contractor, nor shall the report be used in subsequent administrative or legal proceedings. Failure to fully cooperate with the third-party investigator may result in

denial of the claim. After the Secretary of Transportation receives the report, the parties, by mutual agreement, may initiate a non-binding mediation to attempt to resolve the claim.

If the claim is determined completely or partially valid, those portions determined valid, plus interest computed at the rate of 4.25% per annum for the time period between the date shown on the Region Engineer's letter of Final Acceptance and the date the claim was resolved, will be paid.

If a claim is determined completely or partially valid in a subsequent proceeding in circuit court and pre-judgment interest is awarded by the court on all or a portion of the judgment, that interest shall be computed at the rate of 4.25% per annum.

Nothing in this section shall be construed as establishing any claim contrary to the terms of Section 4.2.

**Section 7.6 – Page 37 – Add the following paragraph to this section:**

All workers within the right of way who are exposed either to traffic (vehicles using the highway for purposes of travel) or to construction equipment within the work area shall wear high-visibility safety apparel intended to provide conspicuity during both daytime and nighttime usage, and meeting the Performance Class 2 or 3 requirements of the ANSI/ISEA 107-2004 publication entitled "American National Standard for High-Visibility Safety Apparel and Headwear".

**Section 7.12 – Page 39 – Delete the last sentence of the second paragraph and replace with the following:**

The Contractor's responsibility will not be released until completion of the project and Final Acceptance is made, as noted by the date shown on the Region Engineer's letter of Final Acceptance.

**Section 7.14 – Page 39 – Delete this section and replace with the following:**

**7.14 RESPONSIBILITY FOR DAMAGE CLAIMS** - The Contractor shall hold harmless and indemnify the Department, its officers and employees, from all suits, actions, or claims of any character brought because of any injuries or damages received or sustained by any person, persons or property arising from the operations of the said Contractor; or on account of or in consequence of any neglect in safeguarding the work; or through use of unacceptable materials in constructing the work; or because of any act or omission, neglect, or misconduct of said Contractor; or because of any claims or amounts recovered from any infringements of patent, trademark, or copyright; or from any claims or amounts arising or recovered under the "Workmen's Compensation Act", or any other law, ordinance, order, or decree; and so much of the money due the said Contractor under and by virtue of his contract as may be considered necessary by the Department for such purpose may be retained for the use of the State; or in case no money is due, his surety may be held until such suit or suits, action or actions, claim or claims for injuries or damages as aforesaid shall have been settled and suitable evidence to that effect furnished to the Department; money due the Contractor will not be withheld when the Contractor produces satisfactory written confirmation from its insurer that adequate public liability insurance and property damage insurance providing coverage for such particular claims as may be made is in force; a copy of a certificate of insurance, without further confirmation of coverage for the particular claim being made, will not be sufficient to satisfy the requirement of written confirmation.

**Section 7.15 – Page 40 – Delete the first sentence and replace with the following:**

**7.15 LIABILITY INSURANCE** - The Contractor shall procure and maintain at the Contractor's expense, during duration of the Contract, liability insurance with an insurance company authorized to do business in the state of South Dakota, for damages imposed by law.

**Section 7.16 – Page 40 – Delete the second sentence of the last paragraph and replace with the following:**

In such event, the Contractor shall not be relieved of liability or responsibility during the period the work is so opened and prior to Acceptance of Field Work.

**Section 7.17 – Page 40 – Delete the first paragraph and replace with the following two paragraphs:**

**CONTRACTOR'S RESPONSIBILITY FOR WORK** - The Contractor is responsible for the work until the Acceptance of Field Work is made by the Area Office, except as set forth in Section 4.4 B.1. The Contractor shall protect the work against injury or damage from all causes, whether arising from the execution or from the non-execution of the work. The Contractor shall rebuild, repair, restore, and replace all work that is injured or damaged prior to the Acceptance of Field Work, at no additional cost to the Department. Damage to work due to unforeseeable

causes beyond the control of and without the fault or negligence of the Contractor, including but not restricted to acts of God, acts of the public enemy, or acts of governmental authorities shall be restored by the Contractor at the Department's expense according to subsection 4.2 or 4.3, as applicable.

Following the Acceptance of Field Work, but prior to Final Acceptance as described in Section 9.9, the Contractor shall be responsible for damage to work resulting from an act, omission, neglect, or misconduct in the Contractor's manner or method of executing the work, or due to defective work or materials at no additional cost to the Department.

**Section 8.1 – Page 45 – Delete and replace with the following:**

**8.1 SUBLETTING OF CONTRACT** - The Contractor shall not sublet, sell, transfer, assign, or dispose of the contract or contracts or any portion of them, without written consent of the Engineer. Each request to sublet shall be submitted on the form provided by the Engineer. The Contractor shall submit a request to sublet for any contracting firms a subcontractor proposes to use as a lower tier subcontractor. The Contractor shall obtain approval of each subcontractor before the start of the work performed by the subcontractor.

The Contractor will be permitted to sublet up to 50 percent of the contract amount, based on the contract unit prices, but shall perform work amounting to not less than 50 percent of the total contract amount with his own organization.

The Department will consider the Contractor's own organization to include only workers employed and paid directly by the Contractor, equipment owned or rented by the Contractor, and materials purchased by the Contractor for its use in performing Contract work. This does not include employees, equipment, or materials purchased by or incorporated into work of any subcontractor, assignee, or agent of the Contractor.

The Department will not consider as subcontracting the following; 1) any material produced outside the project limits including but not limited to the production of sand, gravel, crushed stone, batched concrete aggregates, ready mix concrete, off-site fabricated structural steel, other off-site fabricated items, and any materials delivered by established and recognized commercial plants; or 2) delivery of these materials to the work site from an off-site location in vehicles owned or operated by such plants or by recognized independent or commercial hauling companies. Project limits is defined as being within a 1/2 mile radius of the project proper.

Any items designated in the contract as "specialty items" may be performed by subcontract and the cost of designated specialty items performed by subcontract will be deducted from the total contract amount before computing the amount of work required to be performed by the Contractor's own organization.

The Contractor shall give assurance to the Engineer that all pertinent provisions of the prime contract including minimum wage for labor shall apply to the work sublet. Subcontract, or transfer of contract, shall not relieve the Contractor of his responsibilities and liability under the contract and bonds.

**Section 8.2 – Page 45 – Delete and replace with the following:**

**8.2 NOTICE TO PROCEED** - The Notice to Proceed shall consist of written notification to the Contractor to proceed with the work. Such notification will be issued within 15 calendar days following the receipt from the bidder of the signed contract and related documents. The contract time will start on the date the Contractor actually starts construction work or 30 calendar days after the date of the Notice to Proceed, whichever date is earlier. The Contractor shall not begin work prior to the date of the Notice to Proceed.

**Section 8.6 A – Page 48 – Delete the first paragraph on page 48 and replace with the following:**

If for reasons beyond the Contractor's control the work cannot be completed within the contract time as specified or as extended according to the provisions of this section, the Contractor may make a written request for an extension of contract time. The written request shall be made at any time prior to the expiration of the contract time as extended. The Contractor's time extension request shall set forth the reasons which will justify an extension of time.

A Time Extension Request Form, furnished by the Department, shall be completed by the Contractor and submitted to the Area Engineer. If the written request was properly filed in accordance with the requirements of this section, the time extension request will be forwarded through the proper channels, to the Secretary of Transportation for final resolution.

The Time Extension Request Form shall be fully completed and will contain the following:

1. A narrative justification citing the basis for the time extension.
2. A statement of the amount of extra compensation, including liquidated damages, incentive, or disincentive associated with the time extension.
3. A signed and notarized statement that the information furnished is true and fully documented.
4. Permission for the Department or its authorized representative to examine all Contractor records concerning this time extension request.

The Secretary of Transportation may submit the time extension request to a third-party investigator for further review and investigation. The report prepared by the investigator shall not be shared with the Contractor, nor shall the report be used in subsequent administrative or legal proceedings. Failure to fully cooperate with the third-party investigator may result in denial of the time extension request. After the Secretary of Transportation receives the report, the parties, by mutual agreement, may initiate a non-binding mediation to attempt to resolve the time extension request.

**Section 8.6 A – Page 48 – Delete the first sentence of the second to last paragraph and replace with the following:**

If the Secretary of Transportation finds that the work was delayed because of conditions beyond the control and without the fault of the Contractor, the Secretary may extend the time for completion in such amount as the conditions justify.

**Section 8.6 A – Page 48 – Delete the last paragraph and replace with the following:**

When Acceptance of Field Work has been duly made as prescribed in Section 5.16, the daily time count/assessment will cease. The daily time count/assessment may resume if the Contractor fails to provide, in a timely manner, required project documentation as ordered by the Area Engineer. The daily time count/assessment may also resume when in accordance with Section 7.17, repairs, rework, or other activities are ordered for work that the Contractor is responsible for.

**Section 8.6 B – Page 50 – Delete the second paragraph on page 50 and replace with the following:**

If for reasons beyond the Contractor's control the work cannot be completed within the contract time as specified or as extended according to the provisions of this section, the Contractor may make a written request for an extension of contract time. The written request shall be made at any time prior to the expiration of the contract time as extended. The Contractor's time extension request shall set forth the reasons which will justify an extension of time.

A Time Extension Request Form, furnished by the Department, shall be completed by the Contractor and submitted to the Area Engineer. If the written request was properly filed in accordance with the requirements of this section, the time extension request will be forwarded through the proper channels, to the Secretary of Transportation for final resolution.

The Time Extension Request Form shall be fully completed and will contain the following:

1. A narrative justification citing the basis for the time extension.
2. A statement of the amount of extra compensation, including liquidated damages, incentive, or disincentive associated with the time extension.
3. A signed and notarized statement that the information furnished is true and fully documented.
4. Permission for the Department or its authorized representative to examine all Contractor records concerning this time extension request.

The Secretary of Transportation may submit the time extension request to a third-party investigator for further review and investigation. The report prepared by the investigator shall not be shared with the Contractor, nor shall the report be used in subsequent administrative or legal proceedings. Failure to fully cooperate with the third-party investigator may result in denial of the time extension request. After the Secretary of Transportation receives the report, the parties, by mutual agreement, may initiate a non-binding mediation to attempt to resolve the time extension request.

**Section 8.6 B – Page 51 – Delete the last sentence of the second to last paragraph and replace with the following:**

If the Secretary of Transportation finds that the work was delayed because of conditions beyond the control and without the fault of the Contractor, the Secretary may extend the time for completion in such amount as the conditions justify. The extended time for completion shall then be in full force and effect the same as though it were the original time for completion.

**Section 8.6 B – Page 51 – Delete the last paragraph and replace with the following:**

When Acceptance of Field Work has been duly made as prescribed in Section 5.16, the daily time count/assessment will cease. The daily time count/assessment may resume if the Contractor fails to provide, in a timely manner, required project documentation as ordered by the Area Engineer. The daily time count/assessment may also resume when in accordance with Section 7.17, repairs, rework, or other activities are ordered for work that the Contractor is responsible for.

**Section 8.7 – Page 51 – Delete the last sentence of the second paragraph and replace with the following:**

This sum shall be considered and treated not as a penalty but as liquidated damages due the Department from the Contractor by reason of added cost of engineering and supervision resulting from failure to complete the work within the time specified in the contract.

**Section 9.1 B – Page 56 – Delete the fourth paragraph on page 57 and replace with the following:**

Loader Scales - Loader scales will be allowed to be used on contracts when the quantity per line item of granular material to be weighed for payment is less than 10,000 tons (10,000 metric tons).

**Section 9.1 B – Page 56 – Add the following sentence to the end of the sixth paragraph on page 57:**

The accuracy check shall be performed prior to weighing the material for payment and then once per week thereafter.

**Section 9.4 – Page 61 – Delete and replace with the following:**

**9.4 COMPENSATION FOR ALTERED QUANTITIES** - When the accepted quantities of work vary from the estimated quantities in the Contract, the Contractor shall accept as payment in full, payment at the original contract unit prices for the accepted quantities of work. Allowance will not be made for increased expense, except as provided in Section 4.2. Allowance will also not be made for loss of expected reimbursement or loss of anticipated profits.

**Section 9.5 D – Page 62 – Delete the first paragraph of this section and replace with the following:**

**D. Equipment:** For machinery or special equipment including fuel and lubricants, plus transportation costs, authorized by the Engineer, the Contractor shall be paid in accordance with the provisions and rates set forth in the South Dakota Equipment Rental Rates Book which is currently established as the “Rental Rate Blue Book” published by EquipmentWatch, a division of Penton Media, Inc. For purposes of determining an hourly rate, the monthly rate divided by 176 shall be used. This rate will be adjusted for regional factors, age and operating expenses as set forth in the “Rental Rate Blue Book”.

**Section 9.7 – Page 64 – Add the following sentence to the end of the second to last paragraph:**

Progress payments shall not constitute acceptance of the work.

**Section 9.9 - Page 65 - Delete this section and replace with the following:**

**9.9 FINAL ACCEPTANCE AND FINAL PAYMENT** - When Acceptance of Field Work has been made as prescribed in Section 5.16, and all project documentation has been provided, the Engineer will prepare the final estimate of the quantities of the various classes of work performed. After the Engineer determines the final estimate, the Contractor will be paid the entire sum found to be due after deducting previous payments and amounts to be retained or deducted under the provisions of the contract.

Prior partial estimates and payments shall be subject to correction in the final estimate of payment. Final payment will be due 120 days after the date shown on the Region Engineer’s letter of Final Acceptance.

Interest will be added to payments in excess of \$2000 which are due the Contractor and remain unpaid 120 days after the date shown on the Region Engineer's letter of Final Acceptance. Interest will accrue at a rate of 4.25% per annum for the time period after the noted 120 days until final payment is made.

**Section 9.12 – Page 66 – Delete and replace with the following:**

**9.12 THIS SECTION INTENTIONALLY LEFT BLANK**

**Section 120.2 A – Page 73 – Delete and replace with the following:**

- A. Unclassified Excavation:** All materials except those classified as rock excavation, unclassified/rock excavation, muck excavation, option borrow excavation, contractor furnished borrow, or borrow unclassified excavation encountered during the construction of the work, regardless of their nature or manner in which they are removed, will be considered unclassified excavation.

**Section 120.2 – Page 73 – Add the following to the end of this Section:**

- I. Option Borrow Excavation:** Material, furnished by the State, from a pit or other source. The Contractor may use this material at his option.
- J. Contractor Furnished Borrow:** Material, furnished by the Contractor, from a pit or other source.
- K. Borrow Unclassified Excavation:** Material, furnished by the State, from a pit or other source. The Contractor must use this material.

**Section 120.3 – Page 74 – Delete the fifth paragraph and replace with the following:**

The subgrade shall be finished to within minus 0.04 feet (13 mm) to plus 0.08 feet (25 mm) from the design grade and typical section shown in the plans and to within  $\pm 0.5$  percent of the typical section cross slope. The quarter crown within any 12 foot (3.6 m) transverse length shall not exceed 0.04 feet (13 mm) when measured with a straight edge, stringline, or by other suitable equipment.

**Section 120.3 B.3.a – Page 77 – Delete the fifth paragraph and replace with the following:**

Density shall be determined in accordance with SD 105 (AASHTO T 191), SD 106, or SD 114 (AASHTO T 310).

**Section 120.3 B.3.a – Page 78 – Add the following sentence to the end of the second to last paragraph:**

If the material does not contain enough fines to allow for conventional density testing (SD 105 or SD 106), the material shall be compacted as specified for A-2-4(0) and A-3 soils.

**Section 120.4 – Page 79 – Add the following to the end of this Section:**

- I. Borrow Unclassified Excavation:** Borrow unclassified excavation will be measured in its original position by cross sectioning. Volumes will be computed in cubic yards (cubic meters) by the average end area method.

Original cross sections will be taken prior to removal of any material and final sections will be taken following replacement of topsoil. Salvaged topsoil which is stockpiled from the borrow sources will be included as borrow unclassified excavation.

The quantity of topsoil stockpiled and respread on borrow sources will be determined by measuring the stockpiles prior to removal of the material from the stockpiles.

**Section 120.5 – Page 81 – Add the following to the end of this Section:**

- I. Borrow Unclassified Excavation:** Borrow unclassified excavation will be paid for at the contract unit price per cubic yard (cubic meter). Payment will be full compensation for excavation and furnishing the material on the project, construction and compaction of embankments, shaping of slopes, finishing of surface, completion of subgrade, shoulders, and roadway, and maintenance, and for furnishing materials (except topsoil), labor, and incidentals required for restoration of the pit.

Topsoil which is stockpiled from the borrow source will be respread and paid for at the contract unit price per cubic yard (cubic meter) of borrow unclassified excavation and placing topsoil.

**Section 120.5 F – Page 82 – Delete the last sentence and replace with the following:**

Topsoil, seed, fertilizer and mulch for the restoration of the pit shall be incidental to the unit price per cubic yard (cubic meter) of contractor furnished borrow.

**Section 210.3 – Page 85 – Delete the second to last paragraph and replace with the following:**

The subgrade shall be finished to within minus 0.04 feet (13 mm) to plus 0.08 feet (25 mm) from the design grade and typical section shown in the plans and to within  $\pm 0.5$  percent of the typical section cross slope. The quarter crown within any 12 foot (3.6 m) transverse length shall not exceed 0.04 feet (13 mm) when measured with a straight edge, stringline, or by other suitable equipment.

**Section 260.3 A – Page 93 - Delete the first paragraph and replace with the following:**

**A. Subbase and Base Course:** Roadway shaping shall be performed in accordance with Section 210.3 B prior to placement of the material.

**Section 260.3 A – Page 94 - Delete the last paragraph and replace with the following:**

Recycled Portland cement concrete pavement used as a granular base material shall not be used for Base Course, Salvaged Base Course, or in areas where drainage fabric, edge drains, or other similar drainage systems are present.

**Section 270.1 – Page 97 – Delete and replace with the following:**

**270.1 DESCRIPTION**

This work consists of salvaging, processing or crushing, and stockpiling salvaged material from the existing roadway. Salvaged material shall consist of granular material, asphalt concrete mix material, or asphalt mix and granular base material.

**Section 270.2 – Page 97 – Delete this section and replace with the following:**

**270.2 MATERIALS**

The salvaged material shall be processed or crushed to provide material meeting the following gradation.

<u>Sieve Size</u>	<u>% Passing</u>
1 ½ inch (37.5 mm)	100
1 inch (25.0 mm)	95-100

**Section 270.3 – Page 97 – Delete and replace with the following:**

**270.3 CONSTRUCTION REQUIREMENTS**

**A. Salvage and Stockpile Granular Material or Asphalt Mix and Granular Base Material:**

- 1. Salvaging:** The salvaged material shall be moved and loaded in a manner that minimizes waste and avoids contamination of the salvage material with underlying subgrade soil. Scrapers shall not be used for the removing or loading operations, but may be used to haul the material. Salvaging of material shall not exceed two miles (3.2 kilometers) in advance of the grading operation, unless otherwise directed. The material shall be moved toward the center of the road, to the extent necessary to ensure that salvage material is not lost down inslopes.
- 2. Processing:** Processing and blending may be accomplished in place, provided the Contractor's method meets the blending and gradation requirements and has positive depth control.

3. **Stockpiling:** Asphalt concrete mix and granular material shall be processed or crushed and stockpiled together so that a uniform blend is obtained. The salvaged material may be stockpiled at contractor provided sites. Prior to stockpiling, the stockpile site shall be prepared by removal of the top six inches (150 mm) of topsoil and the area bladed smooth.

**B. Salvage and Stockpile Asphalt Mix Material:**

1. **Salvaging:** The salvaged material shall be moved and loaded in a manner that minimizes waste and avoids contamination of the salvage material. Scrapers shall not be used for the removing or loading operations, but may be used to haul the material. Salvaging of material shall not exceed two miles (3.2 kilometers) in advance of the grading operation, unless otherwise directed. The material shall be moved toward the center of the road, to the extent necessary to ensure that salvage material is not lost down inslopes.
2. **Stockpiling:** Salvaged asphalt mix material shall be processed or crushed and stockpiled so that a uniform blend is obtained. Prior to stockpiling, the stockpile site shall be prepared by removal of the top six inches (150 mm) of topsoil and the area bladed smooth. Stockpiles shall be constructed in accordance with Section 320. The stockpiles shall not contain dirt, grease, oil, brick, paving fabric, clay balls, organic debris, and other foreign material.

**Section 270.4 – Page 97 – Delete and replace with the following:**

**270.4 METHOD OF MEASUREMENT**

Salvage and stockpile granular material, salvage and stockpile asphalt mix and granular base material, and salvage and stockpile asphalt mix material will be measured to the nearest 0.1 ton (0.1 metric ton) or 0.1 cubic yard (0.1 cubic meter) at the time it is hauled to the road.

When less than 5000 tons (4500 metric tons) of salvaged material is generated on a project, the material may be measured in a stockpile and converted to tons (metric tons) using a factor of 1.5 tons per Cu. Yd. (1.78 metric tons per cubic meter), in lieu of weighing the material.

Alternate measurement techniques may be allowed if agreed upon by the Contractor and Engineer prior to salvaging operations commencing.

Material stockpiled for future use will be measured in the stockpile and converted to tons (metric tons) using a factor of 1.50 tons per Cu. Yd. (1.78 metric tons per cubic meter).

The unclassified excavation quantities will not be increased or decreased to reflect whether salvaged material was taken from cut or fill sections.

**Section 270.5 – Page 97 – Delete and replace with the following:**

**270.5 BASIS OF PAYMENT**

Salvage and stockpile granular material, salvage and stockpile asphalt mix and granular base material, and salvage and stockpile asphalt mix material will be paid for at the contract unit price per ton (metric ton) or cubic yard (cubic meter). Payment will be full compensation for work required to salvage, haul, process or crush, and stockpile the material.

Removal of this material is included in and paid for under the item of unclassified excavation.

**Section 280.2 – Page 99 – Delete this section and replace with the following:**

**280.2 MATERIALS**

The asphalt mix and granular material shall be processed to provide material meeting the following gradation.

<u>Sieve Size</u>	<u>% Passing</u>
1 ½ inch (37.5 mm)	100
1 inch (25.0 mm)	95-100

**Section 320.3 B.1 – Page 103 – Delete the first sentence of the fourth paragraph and replace with the following:**

Burner fuel used for production of asphalt concrete shall be propane, butane, natural gas, Grade 1 fuel oil, Grade 2 fuel oil, Grade 4 fuel oil, Grade 4 (light) fuel oil, Grade 5 (light or heavy) fuel oil, or Grade 6 fuel oil.

**Section 320.3 B.1 – Page 103 – Add the following to the end of the seventh paragraph:**

An accurate thermometer must be installed in the tank so the temperature can be monitored.

**Section 320.3 B.4 – Page 104 – Delete the third sentence of the first paragraph.**

**Section 320.3 B.4 – Page 105 – Delete the last sentence of the third paragraph and replace with the following:**

The system shall be capable of manually controlling the transverse slope and the screed height.

**Section 320.3 B.5 – Page 105 – Delete the last sentence of the first paragraph and replace with the following:**

The rollers shall be capable of being reversed smoothly, without shoving or tearing the asphalt concrete.

**Section 320.3 C.3.d – Page 106 – Delete and replace with the following:**

- d. A one-gallon (four liter) sample of asphalt binder intended for use shall be obtained from the designated supplier for the project.

**Section 320.3 D – Page 107 – Delete the last sentence of the fifth paragraph and replace with the following:**

A water spray system must be installed at the discharge end of the pug mill. This water system must be used when directed by the Engineer to prevent fugitive lime dust from being released into the air.

**Section 320.3 E – Page 107 – Add the following after the fourth sentence in the first paragraph:**

No material shall be used which could adversely affect the asphalt concrete.

**Section 320.3 F – Page 107 – Add the following new paragraph after the first paragraph:**

Surfaces which have been primed with cutback asphalt shall be allowed to cure for a minimum of 72 hours prior to being covered.

**Section 320.3 F – Page 107 – Add the following to the end of the third paragraph:**

In lieu of a self-propelled paver, asphalt concrete may be placed by a shouldering machine on shoulders less than 6 feet (2 m) in width.

**Section 320.3 F – Page 110 – Delete the first paragraph at the top of Page 110 and replace with the following:**

Irregularities shall be corrected before the temperature of the asphalt mix drops below 175° F (80° C). The longitudinal profile can only be improved by using a grinder with diamond blades mounted on a horizontal shaft and when approved by the Engineer. Areas that have been ground shall not be left smooth or polished, but shall have a uniform texture equal in roughness to the surrounding unground asphalt concrete. Grinding shall be daylighted to the outside edge of the pavement. Ground surfaces shall be flushed sealed. Under no circumstances shall operations continue when it becomes evident final rolling is not producing a smooth, uniform, compacted surface free from roller marks and other irregularities.

**Section 320.4 A – Page 111 – Add the following after the first sentence:**

Quantities of asphalt binder in excess of the asphalt content listed on the job mix formula plus 0.3% tolerance will not be accepted for payment.

**Section 320.4 B – Page 111 – Delete the last two sentences of the first paragraph and replace with the following:**

The mixture of mineral aggregate, asphalt binder, and hydrated lime, when required, will be weighed after mixing. No deduction will be made for the weight of the asphalt binder or hydrated lime, when required, included in the mixture.

**Section 320.4 E – Page 112 – Add the following after the first sentence:**

Quantities of hydrated lime in excess of the lime content listed on the job mix formula plus 0.1% tolerance will not be accepted for payment.

**Section 320.5 C – Page 112 – Add the following sentence to the end of the paragraph:**

Payment will be full compensation for all labor, equipment, materials, and all other items incidental to sampling and repair of the sample locations to the satisfaction of the Engineer.

**Section 321.3 B – Page 113 – Delete and replace with the following:**

**B. Density:** The minimum density requirement shall be 92 percent of the maximum specific gravity of the test specimens prepared in the field in accordance with SD 312. The compacted density of asphalt concrete shall be determined according to SD 311.

**Section 324.5 – Page 115 and 116 – Delete the last sentence and replace with the following:**

When required, the following shall also be included in the contract unit price per ton (metric ton) for Asphalt Concrete Composite: Asphalt for Prime MC-70, Blotting Sand for Prime, Asphalt for Flush Seal SS-1h or CSS-1h, Sand for Flush seal, Hydrated Lime, equipment, labor and incidentals necessary.

**Section 330.2 – Page 121 – Add the following to the end of this section:**

**D. Sand for Fog Seal:** Section 879

**Section 330.3 A.2.b – Page 121 – Add the following paragraph after the second paragraph:**

Surfaces primed with cutback asphalt shall be allowed to cure for a minimum of 72 hours prior to being overlaid with asphalt concrete.

**Section 330.3 F – Page 123 – Delete the first sentence of the fourth paragraph and replace with the following:**

When applying fog seal coats, a light application of sand may be ordered by the Engineer to prevent material pickup.

**Section 330.4 – Page 124 – Add the following to the end of this section:**

**D. Sand for Fog Seal:** Sand for fog seal will be measured to the nearest 0.1 ton (0.1 metric ton).

**Section 330.5 – Page 124 – Add the following to the end of this section:**

**D. Sand for Fog Seal:** Sand for fog seal will be paid for at the contract unit price per ton (metric ton) complete in place. Payment will be full compensation for furnishing, installing, and all incidentals required to complete the work.

**Section 332.2 – Page 125 – Delete this section and replace with the following:**

**332.2 MATERIALS**

The material produced by cold milling shall be processed or crushed to provide material meeting the following requirements.

<u>Sieve Size</u>	<u>% Passing</u>
1 ½ inch (37.5 mm)	100
1 inch (25.0 mm)	95-100

Cold milled asphalt concrete material used in hot mixed asphalt as recycled asphalt pavement (RAP) shall have the 1 inch sieve size requirement waived.

**Section 332.3 B – Page 125 – Delete the first paragraph and replace with the following:**

- B. Equipment:** The equipment for cold milling shall consist of a rotating drum equipped with teeth capable of removing material to a depth of up to three inches (75 mm) in one pass, producing a uniform surface finish.

**Section 332.3 C – Page 125 – Delete the last paragraph of this section on page 126 and replace with the following:**

When traffic will be exposed to the milled surface, all cold milling asphalt concrete shall be accomplished on one-half of the roadway at a time. The Contractor shall schedule the cold milling asphalt concrete operations so that there are no drop offs, uneven lanes, or windrows of milled material remaining on the roadway overnight. At the end of the day the Contractor shall place cold milled asphalt concrete material to provide temporary ramps as a transition onto or off of the milled surface and the project limits, bridge approaches, and intersecting roads. The resultant transition shall be of sufficient length to provide a slope no steeper than 20:1.

- 1. Cold Milling Asphalt Concrete and Placing Cold Milled Material:** Some areas of the shoulder may require the movement of cold milled asphalt concrete material either ahead or back to achieve the required cross section. No separate payment will be made for the movement of this material.

Material placed on the shoulders shall be compacted according to Section 260.3 B of the Standard Specifications except that a pneumatic tired roller with an effective roller weight of at least 250 pounds per inch (4.5 kilograms per mm) of roller width will be required.

- 2. Cold Milling Asphalt Concrete:** Loose material resulting from the milling shall be immediately picked up, hauled to the stockpile site(s), and stockpiled. Prior to allowing traffic on the milled surface, the surface shall be thoroughly broomed free of remaining loose material.

Cold milled asphalt concrete material shall be processed or crushed and stockpiled so that a uniform blend is obtained. Prior to stockpiling, the stockpile site shall be prepared by removal of the top six inches (150 mm) of topsoil and the area bladed smooth. Stockpiles shall be constructed in accordance with Section 320. The stockpiles shall not contain dirt, grease, oil, brick, paving fabric, clay balls, organic debris, and other foreign material

**Section 332.4 – Page 126 – Delete and replace with the following:**

**332.4 METHOD OF MEASUREMENT**

- A. Cold Milling Asphalt Concrete and Placing Cold Milled Material:** Cold Milling Asphalt Concrete and Placing Cold Milled Material will not be measured. Plans quantity will be used. If changes from the plans quantity are ordered these areas will be measured and the plans quantity will be appropriately adjusted.
- B. Cold Milling Asphalt Concrete:** Cold milling Asphalt Concrete will not be measured. Plans quantity will be used. If changes from the plans quantity are ordered these areas will be measured and the plans quantity will be appropriately adjusted.

**Section 332.5 – Page 126 – Delete and replace with the following:**

**332.5 BASIS OF PAYMENT**

- A. Cold Milling Asphalt Concrete and Placing Cold Milled Material:** Cold Milling Asphalt Concrete and Placing Cold Milled Material will be paid for at the contract unit price per square yard (square meter) or as indicated in the plans. Payment will be full compensation for the removal of grass, weeds, topsoil, etc. from the placement location, milling, removing, placing, and compaction of the cold milled material and the brooming, equipment, labor, and all incidentals required.
- B. Cold Milling Asphalt Concrete:** Cold Milling Asphalt Concrete will be paid for at the contract unit price per square yard (square meter) or as indicated in the plans. Payment will be full compensation for milling, removing, hauling, stockpiling, processing or crushing the cold milled material, brooming, equipment, labor, and all incidentals required.

**Section 350.2 – Page 127 – Delete this section and replace with the following:**

The sealant shall conform to the requirements of ASTM D-6690 Type IV.

The sealant material shall have a unit weight no greater than 9.35 lbs./gal (1124 kilograms per cubic meter).

Only products that meet the above requirements and have performed satisfactorily based on Department analysis may be used. A listing of acceptable products meeting ASTM D-6690 Type IV requirements may be obtained from the Department's Approved Products List. Products on the Approved Products list for Joint Sealant for Asphalt Over Long Jointed Concrete Pavement may also be used.

The blocking medium shall be an inert, compressible material, which is compatible with the sealant.

**Section 350.4 – Page 129 – Add the following sentence to this section:**

Quantities of asphalt concrete crack sealing with a manufacturer's unit weight in excess of the specified unit weight will be reduced to the specified maximum unit weight prior to measurement for payment.

**Section 360.3 A – Page 131 – Delete the minimum temperature and seasonal limitations table and replace with the following:**

Minimum temperatures and seasonal limitations are as follows:

Cover Aggregates	Air and Surface Temp. (In the Shade and Rising)	Seasonal Limitations (Dates are Inclusive)
Type 1	70° F (21° C)	May 15 - Aug. 31
Type 2	70° F (21° C)	May 15 - Aug. 31
Type 3	70° F (21° C)	May 15 - Sept. 15

**Section 360.3 B.3 – Page 131 – Delete the last sentence of this section:**

**Section 370.2 – Page 135 – Delete the first paragraph of this section and replace with the following:**

The RAP material, after processing, shall meet the following gradation.

<u>Sieve Size</u>	<u>% Passing</u>
1 ¼ inch (31.5 mm)	100
1 inch (25.0 mm)	95-100

**Section 380.2 – Page 139 – Add the following to the end of this section:**

- L. Epoxy Resin Adhesive:** Epoxy resin adhesive shall be of the type intended for horizontal applications, and shall conform to the requirements of ASTM C 881, Type IV, Grade 3 (equivalent to AASHTO M235, Type IV, Grade 3).

**Section 380.3 B.1 – Page 140 – Delete the first paragraph on page 141 and replace with the following:**

When automatic moisture sensing equipment is used for an aggregate component, the batch ticket shall show the percent of moisture for the aggregate component with moisture sensing equipment. The results of the most recent two hour moisture test shall be shown for aggregate components without moisture sensing equipment.

The W/C ratio shall be calculated using the following formula and rounded to the nearest 0.01:

$$W / C \text{ ratio} = \left[ \frac{\text{weight of free water} + \text{weight of batch water}}{\text{weight of cement} + \text{weight of supplementary cementitious material}} \right]$$

weight of free water = (% total moisture in aggregate - % absorption of aggregate) x weight of aggregate

weight of batch water = total weight of water added to the batch of concrete either at the plant or in the truck

The weight of free water shall be calculated for both the fine aggregate and the coarse aggregate.

**Section 380.3 D – Page 146 – Add the following paragraph to the end of this section:**

The amount of batch water and aggregates added to the mix shall be adjusted accordingly using the results of the most recent two hour moisture tests. If automatic moisture sensing equipment is used, the Engineer may allow the use of the automatic moisture sensing results to make adjustments.

**Section 380.3 E – Page 146 – Delete the second sentence and replace with the following:**

Truck mixing will be permitted only when approved by the Engineer.

**Section 380.3 E – Page 146 – Delete the fifth paragraph and replace with the following:**

When a concrete batch is transported in a truck mixer or agitator and the batch is smaller than 60 percent of the rated capacity of the truck mixer or agitator, the following percentage of additional cementitious material at the same proportions as listed on the mix design shall be added to the batch:

**Section 380.3 E – Page 146 – Delete the paragraph below the table at the top of page 147 and replace with the following:**

The above provisions regarding additional cementitious material shall also apply to the mixing of small batches in central plants. Additional cementitious material will not be required when the small batch is mixed in a drum that is sufficiently coated with mortar to withstand the loss of cementitious material. Sufficient mortar coating, as determined by the Engineer, may include mortar coating the drum from a previously mixed batch during continuous mixing operations. Additional cementitious material will be required if more than 30 minutes has passed from the mixing of the previous batch, if the drum has been cleaned following the previous batch, or if the mortar coating the drum has been disturbed following the previous batch.

**Section 380.3 E.2 – Page 147 – Delete the second sentence of the second paragraph and replace with the following:**

When approved by the Engineer, additional water or cement may be added to the batch after completion of the original mixing, in which case the batch shall be mixed an additional 30 revolutions at mixing speed.

**Section 380.3 L – Page 149 – Add the following sentence to the end of this section:**

Epoxy coated dowel bars and tie bars shall meet the requirements of Section 480.3 A.

**Section 380.3 M.2 – Page 151 – Delete the first sentence of the last paragraph and replace with the following:**

The Contractor shall load test five percent of the first 500 tie bars that are drilled and epoxied in place.

**Section 380.3 M.3 – Page 151 – Add the following paragraph to this section:**

If a soft cut style saw is used, the soft cut shall remain approximately 1” (25mm) from the edges of the concrete slab to control spalling at the edge. Additionally if a soft cut is used, the Contractor shall complete the initial saw cut for the entire width and to the required depth before the end of the 72 hour curing period.

**Section 380.3 M.4 – Page 151 – Delete the first sentence of the fourth paragraph and replace with the following:**

If an uncontrolled crack develops within six feet (1.8 m) of the contraction joint, a minimum of six feet (1.8 m) of pavement removal and replacement will be required.

**Section 380.3 N.6 – Page 153 – Delete this section and replace with the following:**

6. **Final Finish:** Before the concrete has attained its initial set, the surface shall be given a final finish with a carpet drag drawn over the surface in a longitudinal direction. The drag shall be mounted on a bridge and shall be sized so that a strip of the carpet approximately two feet (600 mm) wide is in contact with the pavement surface while the drag is operated.

The condition of the drag shall be maintained so the resultant surface is of uniform appearance with corrugations approximately 1/16 inch (2 mm) in depth. Drags shall be maintained clean and free of encrusted mortar. Drags that cannot be cleaned shall be discarded and replaced.

The carpet shall meet the following requirements:

- Facing Material - Molded polyethylene pile face
- Blade Length - 7/8", ±1/8" (22 mm, ±3 mm)
- Total Fabric Weight - 70 oz. per square yard min.  
(2.37 kg per square meter min.)

The backing shall be of a strong, durable material, not subject to rot, which is adequately bonded to the facing.

Plain Jointed concrete pavement shall be either longitudinally or transversely tined as specified in the plans.

Continuously reinforced concrete pavement shall be longitudinally tined.

Tining depth and spacing shall be determined according to SD 418.

- a. Transverse Tining:** Immediately following the carpet drag, the surface of the concrete pavement shall be given a transverse metal-tine finish with a separate self-propelled mechanical device. The metal-tine finish shall provide a groove width of 1/8" and a groove depth of 6/32 inch (5 mm) ± 2/32 inch (2 mm). The spacing between the individual tines shall meet the following:

Inches (ten foot tining rake)

2-5/16, 2-15/16, 1-1/4, 2-7/16, 2-1/16, 1-1/4, 13/16, 1, 1-5/16, 1-1/8, 2-5/16  
 2-1/2, 2-7/8, 2-3/4, 1-1/8, 2-3/4, 2-1/8, 1-15/16, 13/16, 7/8, 2-5/8, 3-1/16  
 3-1/16, 7/8, 9/16, 9/16, 1-5/8, 2-3/8, 1, 1-1/4, 1-9/16, 2-15/16, 1-1/8  
 1-15/16, 2-3/16, 2, 2-13/16, 1, 2-11/16, 13/16, 1-7/8, 9/16, 2-5/16, 1-7/8  
 2-1/2, 1-5/16, 3-3/16, 1-3/8, 15/16, 7/8, 1-5/8, 9/16, 1-3/4, 2-7/8, 3  
 1-5/8, 1-5/8, 7/8, 9/16, 5/8, 2-13/16, 1-5/8, 2-7/16, 13/16, 1-1/4, 11/16  
 2-3/4, 2-5/16, 1-1/8

Millimeters (3 meter tining rake)

58, 74, 31, 62, 53, 32, 21, 26, 33, 28, 59  
 64, 73, 70, 29, 70, 54, 49, 20, 22, 67, 78  
 77, 23, 15, 15, 41, 60, 25, 32, 39, 75, 28  
 50, 55, 51, 72, 25, 69, 21, 47, 15, 59, 47  
 64, 34, 55, 35, 24, 22, 42, 14, 45, 73, 76  
 41, 41, 22, 15, 16, 71, 41, 62, 21, 31, 17  
 70, 58, 29

Successive passes of the tining shall not overlap.

Each location, where transverse joint saw cuts are to be made, shall be protected from tining by covering with a metal strip from four inches (100 mm) to six inches (150 mm) or by other methods that produce acceptable results.

Brooming may be used on irregular areas in lieu of the carpet drag and tine finish. The broom shall be drawn transversely across the pavement with adjacent strokes slightly overlapping.

Brooming shall be uniform in appearance and shall produce grooves 1/16 inch (2 mm) deep. Texturing shall be completed while the concrete surface can be broomed without being torn or unduly roughened by the operation.

The finished surface shall be free from rough and porous areas, irregularities, and depressions resulting from improper handling of the broom.

- b. Longitudinal Tining:** Immediately following the carpet drag, the surface of the concrete pavement shall be given a longitudinal metal-tine finish with a wire broom or comb attached to a separate self-propelled mechanical device.

Transverse joints shall not be protected from longitudinal tining, the tining shall be continuous across the joints.

The slab shall not be tined within 3 inches of the edge of the slab, centerline, or rumblestrip.

The longitudinal tining equipment shall have the ability to be raised and lowered, and shall have vertical and horizontal string line controls to ensure straight grooves that are parallel to the longitudinal joint.

The curing unit shall be separate from the tining unit when longitudinal tining is used unless the tining and curing can be accomplished simultaneously with the same piece of equipment at the specified rate to the satisfaction of the Engineer.

The tine bar shall have a single row of tines and shall provide a groove width of 1/8 inch (3 mm)  $\pm$  1/64 inch (0.4 mm) and a groove depth of 6/32 inch (5 mm)  $\pm$  2/32 inch (2 mm). The spacing between the individual tines shall be uniformly spaced at 3/4 inch (20 mm) intervals.

**Section 380.3 N.7 – Page 155 – Delete the first sentence of the first paragraph and replace with the following:**

After the final finish, and while the concrete is still plastic, the edges of the pavement along each side of the slab, and on each side of transverse construction joints, shall be worked with an approved tool and rounded to the specified radius.

**Section 380.3 O – Page 155 – Add the following two sentences to the beginning of this section:**

The pavement surface shall be checked for deviations using either a ten foot (3 meter) straightedge or a profilograph (when specified). When the use of a profilograph is specified, the ten foot (3 meter) straightedge check may also be required in locations determined by the Engineer.

**Section 380.3 O.2.c.2 – Page 157 – Delete the first paragraph and replace with the following:**

Areas excluded from profilograph testing shall be shoulders, transitions, area within 50 feet (15 m) of existing pavement and bridges, existing curb and gutter sections, ramps, pavements on horizontal curves having a centerline radius less than 1,000 feet (300 m) and the superelevation transitions. Pavement sections not subject to profilograph testing shall meet the 10 foot (3 m) straight edge test requirements in Section 380.3 O.1.

**Section 380.3 O.2.c.2 – Page 157 – Add the following to the end of the last paragraph:**

Grinding shall be day lighted to the outside edge of the pavement.

**Section 380.3 O.2.f.1 – Page 158 – Delete this section and replace with the following:**

- 1) Satisfactorily correct deficient area by grinding with equipment meeting the requirements of Section 380.3 O.2.c.2.

**Section 380.3 O.2.h – Page 158 – Delete the last paragraph of this section.**

**Section 380.3 R.2 – Page 161 – Delete the first sentence of the third paragraph and replace with the following:**

The sealant surface shall be tooled to produce a slightly concave surface below the pavement surface.

**Section 380.3 T – Page 162 – Add the following sentence after the first sentence in the second paragraph:**

Equipment operated on a previously constructed pavement that has attained a compressive strength of at least 3000 psi (21 Mpa) but less than 4000 psi (28 Mpa) shall be tracked type equipment.

**Section 390.2 B – Page 167 – Delete and replace with the following:**

**B. Concrete Patches:** Concrete patching material shall be one of the following:

1. A packaged, dry, rapid-hardening cementitious mortar conforming to the requirements of ASTM C 928, Type R-3 containing no chloride ions.
2. A packaged, dry, rapid-hardening concrete materials conforming to the requirements of ASTM C 928, Type R-3 containing no chloride ions.
3. A patching material meeting the following requirements:
  - a. **Cement:** Cement shall be Type III conforming to Section 750.
  - b. **Air Entraining Admixtures:** Air entraining admixtures shall conform to Section 751.
  - c. **Water:** Water shall conform to Section 790.
  - d. **Fine Aggregate:** Fine aggregate shall conform to Section 800.
  - e. **Coarse Aggregate:** Coarse aggregate shall be crushed quarry stone, size five, conforming to Section 820.
  - f. **Curing Compound:** Curing compound shall conform to Section 821.
  - g. **Proportioning:** Materials for concrete patches shall be mixed at the following proportions:

Fine Aggregate.....165 lbs./bag (75 kg/bag) cement  
 Coarse Aggregate.....165 lbs./bag (75 kg/bag) cement  
 Cement (min)..... 8.0 bags/c. y.(10.5 bags/cubic meter) concrete  
 Water (maximum).....5.0 gallon/bag (19 L/bag) cement

- h. **Air and Slump:** The slump and air shall conform to the following:

Air.....7% ± 2%  
 Slump.....1-1/2" (40 mm) maximum

**Section 391.2 A – Page 171 – Add the following paragraph to the end of this Section:**

Alternate design mixes for the grout may be submitted to the Engineer for approval.

**Section 392.2 A – Page 177 – Add the following paragraph to the end of this section:**

Alternate jacking slurry design mixes may be submitted to the Engineer for approval.

**Section 410.3 G.6 – Page 195 – Add the following section to the end of this section:**

- g. The turn-of-nut method for bolt tightening may be used when specified in the plans. When the turn-of-nut installation method is specified, hardened washers are not required except as specified in Section 410.3 G.6.d.

A sufficient number of bolts shall first be placed in the joint and snugged to insure that all faying surfaces are in firm contact, prior to tightening. Snug tight is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary wrench. Bolts shall be placed in any remaining holes and snugged tight as erection bolts or pins are removed. All bolts in the joint shall then be tightened the amount shown in Table 2 progressing systematically from the center most rigid part of the joint to its free edges. When tightening, the element not turned shall be held with a hand wrench to prevent rotation.

<b>Table 2 Nut Rotation from Snugged Condition<sup>a,b</sup></b>			
<b>Geometry of Outer Faces of Bolted Parts</b>			
Bolt Length Measured From Underside of Head to End of Bolt	Both Faces Normal to Bolt Axis	One Face Normal to Bolt Axis and Other Face Sloped Not More Than 1:20, Bevel	Both Faces Sloped Not More Than 1:20 From Normal to Bolt Axis, Bevel Washers Not

		Washer Not Used	Used
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters <sup>c</sup>	2/3 turn	5/6 turn	1 turn

<sup>a</sup> Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, the tolerance should be plus or minus 30 degrees; for bolts installed by 2/3 turn and more, the tolerance should be plus or minus 45 degrees.

<sup>b</sup> Applicable only to connections in which all material within grip of the bolt is steel.

<sup>c</sup> No research work has been performed by the Research Council Riveted and Bolted Structural Joints to establish the turn-of-nut procedure when bolt lengths exceed 12 diameters. Therefore, the required rotation must be determined by actual tests in a suitable tension device simulating the actual conditions.

**Section 421.3 A – Page 213 – Delete the second sentence of the second paragraph and replace with the following:**

Backfill shall be compacted to 95% or greater of Maximum Dry Density in horizontal layers not to exceed six inches (150 mm) loose depth.

**Section 423.1 – Page 219 – Delete this section and replace with the following:**

**423.1 DESCRIPTION**

This work consists of the design, construction, and subsequent removal of all temporary works including, but not limited to; falsework, formwork, cofferdams, work berms and platforms, temporary traffic and stream diversions, and temporary retaining structures.

**Section 421.2 A – Page 213 – Delete the sieve analysis specification for the No. 200 (75 µm) sieve and replace with the following:**

No. 200 (75 µm) 0 - 18.0

**Section 421.2 B – Page 213 – Delete the sieve analysis specification for the No. 200 (75 µm) sieve and replace with the following:**

No. 200 (75 µm) 0 - 10.0

**Section 421.3 – Page 213 – Add the following to this section:**

**D. Extruded Insulation Board (Polystyrene):** No equipment will be allowed on the uncovered insulation board. The backfill covering the insulation board shall be spread and compacted in such a manner that the equipment used shall be operated on a minimum of 6 inches (150 mm) of backfill material at all times.

**Section 421.4 – Page 214 – Add the following to this section:**

**C. Extruded Insulation Board (Polystyrene):** Extruded insulation board (polystyrene) will be measured to the nearest square yard (square meter).

**Section 421.5 – Page 214 – Add the following to this section:**

**C. Extruded Insulation Board (Polystyrene):** Extruded insulation board (polystyrene) will be paid for at the contract unit price per square yard (square meter). Payment shall be full compensation for labor, equipment, and incidentals to furnish and install the extruded insulation board (polystyrene).

**Section 423.3 A – Page 219 – Add the following to the end of this section:**

All temporary works in streams or wetlands are required to be covered in the Corp of Engineers 404 Permit. At the time of the preconstruction meeting, the Contractor shall submit documentation for all temporary works for the purpose of complying with the 404 Permit requirements. The documentation shall include at a minimum:

1. A written description of the proposed temporary works including types of materials to be used, how the temporary works will be installed, removed, and what portion, if any, will remain in place after construction.
2. Details showing approximate size and location of the temporary works. Details shall include at a minimum, a Plan View and a Cross-Section View of the temporary works. Details shall provide sufficient dimensions such that the approximate size of the temporary works and location of the temporary works from a known point is shown.
3. Estimated quantities of all temporary fill material below the ordinary high water elevation. If the temporary fill is to be placed in a wetland, the estimated quantity shall be the amount of wetland loss, (in acres).

If during the course of construction there is a need for additional temporary works, the documentation shall be submitted to the Engineer at that time.

The Engineer will submit the documentation to the Corp of Engineers for approval. No construction of temporary works below the ordinary high water mark or in wetlands may begin until Corp of Engineer approval is attained by the Engineer.

**Section 423.3 B – Page 219 – Delete the first sentence and replace with the following two sentences:**

Falsework plans and design calculations for bridges shall be prepared by an Engineer registered in the State of South Dakota. Three (3) copies of the falsework plans and design calculations shall be submitted to the Bridge Construction Engineer for review at least 30 days prior to construction of falsework.

**Section 423.5 – Page 221 – Delete this section and replace with the following:**

**423.5 BASIS OF PAYMENT**

No payment will be made for temporary works. All costs involved in designing, constructing, and removing temporary works shall be incidental to the other contract items.

**Section 430.2 A. – Page 223 – Delete the last sentence of the second paragraph and replace with the following:**

The percentage of material passing a No. 200 (75µm) sieve shall not exceed 2.0 percent.

**Section 430.2 B – Page 223 – Delete this section and replace with the following:**

**B. Granular Bridge End Backfill:** The granular bridge end backfill material shall conform to Section 882.

**Section 430.3 C – Page 225 – Delete the second and third paragraphs and replace with the following:**

Granular bridge end backfill shall not be placed until at least 24 hours after completion of the deck pour. In addition, granular bridge end backfill shall not be placed until the abutments and sills, including wingwalls, have attained full design strength.

Granular bridge end backfill shall be placed in loose lifts not to exceed eight inches (200 mm) and compacted to 97% of maximum dry density. The moisture at the time of compaction shall be within  $\pm 4\%$  of optimum moisture. Maximum dry density and optimum moisture will be determined in accordance with SD 104.

**Section 430.3 C.1 through 6 – Page 225 and 226 – Delete and replace with the following:**

1. Each layer of granular bridge end backfill shall be placed in loose lifts not to exceed eight inches (200 mm). The placement and compaction of each layer must be inspected and approved by the Engineer prior to placement of the next layer.
2. Any equipment used to install the bridge end backfill over the geotextile fabric shall be operated in such a manner that the geotextile fabric is not damaged. To avoid damage to the geotextile fabric, the equipment used to place, spread, and compact the granular bridge end backfill over the geotextile fabric shall not be operated on less than six inches (150 mm) of material.

3. The geotextile fabric may be oriented in any direction. To minimize the horizontal deflection of the mechanically stabilized vertical face, it is extremely important to make sure that the geotextile fabric is taut and free of wrinkles during placement of the granular bridge end backfill.
4. Any geotextile fabric that is torn or punctured shall be repaired or replaced by the Contractor at no additional cost to the Department. The repair shall consist of a patch of the same type of geotextile fabric being placed over the ruptured area such that it overlaps the damaged area a minimum of 3 ft. (1 m) from any damaged edge. A sewn patch meeting the same requirements for seam strength as that of the fabric being repaired is allowed.
5. Seams that are perpendicular to face of the mechanically stabilized backfill may be constructed by overlapping the fabric a minimum of two feet (0.6 m). All other seams, as well as those in which the two foot (0.6 m) minimum overlap cannot be accomplished, shall be sewn. All seams shall be inspected by the Engineer and any deficient seams repaired by the Contractor prior to placement of the next layer of granular bridge end backfill. Geotextile fabric that is joined by sewn seams shall have strength properties at the seam equal to the specified strength requirements of the geotextile fabric. High strength polyester, polypropylene, or kevlar thread shall be used for sewn seams. Nylon threads shall not be used. The edges of the fabric shall be even and shall be completely penetrated by the stitch.
6. During periods of shipment and storage, the geotextile fabric shall be enclosed in a heavy duty opaque wrapping such that the fabric is protected from direct sunlight, ultraviolet rays, dirt or debris. The fabric shall not be subjected to temperatures greater than 140°F (60°C).

**Section 430.5 B – Page 227 – Delete the second sentence and replace with the following:**

Payment will be full compensation for all labor, equipment, materials, water, and all other items incidental to scarifying, reshaping and recompacting the area to be backfilled, furnishing and installing the polyethylene sheeting, drainage fabric, geotextile fabric, and furnishing, placing, and compacting the porous backfill and granular bridge end backfill to the limits shown on the plans.

**Section 450.2 – Page 231 – Add the following to this section:**

**F. High Density Polyethylene Pipe:** Section 990.

**Section 450.3 C – Page 231 – Delete and replace with the following:**

**C. Polyethylene Pipe Culverts:** Corrugated polyethylene pipe culverts and high density polyethylene pipe culverts shall be installed according to manufacturer instructions.

**Section 450.3 G – Page 232 – Delete and replace with the following:**

**G. Backfill Above Bedding Grade:** Moisture and density requirements for backfill shall be as specified in the plans and shall meet the requirements of Section 120. The backfill material shall be pre-moistened if necessary to obtain uniform moisture.

Selected embankment material shall be placed along the pipe in layers not exceeding six inches (150 mm) in depth and thoroughly compacted by mechanical compactors to the specified density before successive layers are placed. The width of the berms on each side of the pipe shall be twice as wide as the external diameter of the pipe or 12 feet (four meters), whichever is less. This method of backfilling shall be continued until the embankment is at least two feet (600 mm) over the top of the pipe.

In trench installations, backfill width shall be equal to trench width. The backfill shall be brought up evenly on both sides of the pipe for its full length. This method of backfilling shall be continued until the embankment is at least two feet (600 mm) over the top of the pipe.

**Section 460.3 A – Page 235 – Delete the first paragraph of this section and replace with the following:**

**Concrete Quality and Proportion:** The Contractor shall design and be responsible for the performance of all concrete mixes used in structures.

All mix designs and any modifications thereto, including changes in admixtures, shall be approved by the Concrete Engineer prior to use. Mix design data and test results shall be recorded on a DOT-24 and submitted to the Engineer.

The mix proportioning selected shall conform to the following requirements:

**Section 460.3 A – Page 236 – Delete the second sentence in Note 1 under Table 1.**

**Section 460.3 A – Page 235 – Delete the second sentence of the first paragraph on page 236 and replace with the following:**

The mix design shall be based upon obtaining an average concrete compressive strength 1200 psi above the specified minimum 28 day compressive strength.

**Section 460.3 A – Page 235 – Delete the last sentence of the second paragraph on page 236 and replace with the following:**

Trial batches shall be conducted in accordance with the American Concrete Institute Publication ACI 211.1, ACI 318, ASTM C192 and the following:

**Section 460.3 A – Page 235 – Delete the first paragraph on page 237 and replace with the following:**

Concrete mix designs previously used will be considered in compliance with the mix design requirements provided all of the following conditions are met:

**Section 460.3 A – Page 235 – Delete the second sentence of item 3 on page 237 and replace with the following:**

These test results and associated batch tickets shall be submitted to the Engineer.

**Section 460.3 A – Page 235 – Add the following to the list of items on page 237:**

4. All supporting information for the mix design including but not limited to, fresh concrete tests and material properties.

**Section 460.3 A – Page 235 – Delete the last two paragraphs of this section on page 237:**

**Section 460.3 B.2 – Page 237 – Delete the last paragraph of this section on page 238 and replace with the following:**

If the average compressive strength of the 28 day and the backup cylinder compressive strength is more than 500 psi (3.5 Mpa) below the specified 28 day compressive strength, the concrete represented by the cylinders shall be removed and replaced.

**Section 460.3 B.3 – Page 238 – Delete the last paragraph of this section and replace with the following:**

If the average core compressive strength is more than 500 psi (3.5 Mpa) below the specified 28 day compressive strength, the concrete represented by the cylinders shall be removed and replaced.

**Section 460.3 B.4 – Page 238 – Delete the last paragraph of this section on page 239 and replace with the following:**

If the average core compressive strength is more than 500 psi (3.5 Mpa) below the specified 28 day compressive strength, the concrete represented by the cylinders shall be removed and replaced.

**Section 460.3 B.5 – Page 239 – Delete the first sentence and replace with the following:**

If the Contractor utilizes the option to core as specified in Section 460.3 B.4, the Contractor shall arrange for an independent testing laboratory to perform the coring and compressive testing within 14 calendar days of notification of the failing compressive strength of the backup cylinder.

**Section 460.3 B.5 – Page 239 – Delete the last sentence of the second paragraph.**

**Section 460.3 B.5.a – Page 239 – Delete this section and replace with the following.**

- a. Include DOT project number, county, & PCN.

**Section 460.3 C.1 – Page 240 – Add the following to the list of items to be included on the printed ticket on page 241:**

W/C ratio

Aggregate Moistures (total moisture & absorption)

**Section 460.3 C.1 – Page 240 – Add the following after the last paragraph of this section on page 241:**

The W/C ratio shall be calculated using the following formula and rounded to the nearest 0.01:

$$W / C \text{ ratio} = \left[ \frac{\text{weight of free water} + \text{weight of batch water}}{\text{weight of cement} + \text{weight of supplementary cementitious material}} \right]$$

weight of free water = (% total moisture in aggregate - % absorption of aggregate) x weight of aggregate

weight of batch water = total weight of water added to the batch of concrete either at the plant or in the truck

The weight of free water shall be calculated for both the fine aggregate and the coarse aggregate.

**Section 460.3 D – Page 242 – Add the following to this section:**

6. The amount of batch water and aggregates added to the mix shall be adjusted accordingly using the results of the most recent two hour moisture tests. If automatic moisture sensing equipment is used, the Engineer may allow the use of the automatic moisture sensing results to make adjustments.

**Section 460.3 E – Page 243 – Delete the third paragraph and replace with the following:**

When a concrete batch is transported in a truck mixer or agitator and the batch is smaller than 60 percent of the rated capacity of the truck mixer or agitator, the following percentage of additional cementitious material at the same proportions as listed on the mix design shall be added to the batch:

**Section 460.3 E – Page 243 – Delete the paragraph below the table on the middle of page 243 and replace with the following:**

The above provisions regarding additional cementitious material shall also apply to the mixing of small batches in central plants. Additional cementitious material will not be required when the small batch is mixed in a drum that is sufficiently coated with mortar to withstand the loss of cementitious material. Sufficient mortar coating, as determined by the Engineer, may include mortar coating the drum from a previously mixed batch during continuous mixing operations. Additional cementitious material will be required if more than 30 minutes has passed from the mixing of the previous batch, if the drum has been cleaned following the previous batch, or if the mortar coating the drum has been disturbed following the previous batch.

**Section 460.3 K.1 – Page 247 – Delete and replace with the following:**

1. The coarse aggregate piles must be flushed with water for a minimum of 24 hours.

**Section 460.3 K – Page 248 – Delete the twelfth paragraph and replace with the following:**

Barrier curbs will not be allowed to be placed with slipform paving equipment.

**Section 460.3 M.4.c – Page 251 – Delete the second sentence of the first paragraph and replace with the following:**

Tining depth and spacing shall be measured according to SD 418. The metal-tine finish shall provide a groove width of 1/8" and a groove depth of 6/32 inch (5 mm) ±2/32 inch (3 mm).

**Section 465.2 A.3 – Page 265 – Add the following sentence to the end of the paragraph:**

Slump loss shall be tested in accordance with SD 423.

**Section 465.2 A.6 – Page 265 – Delete this section and replace with the following:**

6. The mix design shall establish a maximum water cementitious material ratio for the concrete mix (never to exceed 0.44)

The use of a water reducer will be required to achieve the above properties. Water reducers conforming to AASHTO M194 Type C (Accelerating) and Type E (Water-Reducing and Accelerating) will not be permitted.

**Section 480.3 C.1 – Page 280 – Delete the fifth paragraph and replace with the following:**

Welding of reinforcing steel shall not be allowed without written approval of the Bridge Construction Engineer. The request for approval shall list the bars to be welded, welding procedure, type of electrode, joint detail, and mill certificate of the reinforcing steel to be welded.

**Section 480.4 – Page 281 and 282 – Delete the English and Metric Bar Designation tables and replace with the following:**

**Bar Designation**

Size (English)	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 14	No. 18
Weight (lb/ft)	0.376	0.668	1.043	1.502	2.044	2.670	3.400	4.303	5.313	7.65	13.60
Size (Metric)	10	13	16	19	22	25	29	32	36	43	57
Weight (kg/m)	0.560	0.994	1.552	2.235	3.042	3.973	5.060	6.404	7.907	11.38	20.24

**Section 550.3 A.2 – Page 303 – Delete the second sentence of the last paragraph and replace with the following:**

When backfilling extra depth holes in accordance with Section 550.3 C.1.f.2, a grout admixture shall be added to the grout mixture in accordance with the manufacturer’s recommendations.

**Section 550.3 C.1.b – Page 305 – Delete the third sentence of the first paragraph and replace with the following:**

After completion of the Type 1A removal, the Engineer will inspect the deck and mark remaining areas of unsound existing overlay.

**Section 550.3 C.1.c – Page 306 – Delete and replace with the following:**

- c. Type 1B Removal areas will be determined after Type 1A Removal (or Type 2A Removal if specified) has been accomplished. Type 1B Removal shall consist of removing delaminated or unsound concrete by chipping below the Type 1A Removal (or Type 2A Removal if specified) and extending down to the top of the top bar in the top mat of reinforcing steel. Concrete removed below the top of the top bar incidental to Type 1B Removal will be considered a part of the Type 1B Removal.

**Section 550.3 C.1.f.2 – Page 306 – Delete the first sentence and replace with the following:**

**Backfill of Extra Depth Holes:** When Type 1D removal is necessary, or when holes deeper than 4” (100mm) below the top of the scarified surface are encountered, they shall be backfilled as follows:

**Section 550.3 D.2 – Page 309 – Delete the fourth paragraph and replace with the following:**

Concrete placement will not be permitted after October 1 or before May 1 or when the air temperature is above 85°F (29°C) in the shade. It may be necessary to place concrete during evening or early morning hours and not during periods of low humidity and high wind to comply with this requirement.

**Section 550.3 E – Page 310 – Delete and replace with the following:**

- E. **Proportioning and Mixing Concrete Materials:** Proportioning and mixing shall conform to Section 460.3 F.

**Section 560.2 A – Page 317 – Add the following:**

- 6. **Cement:** Section 750. Type II cement shall be used, unless otherwise specified.

**Section 560.3 A – Page 317 – Add the following paragraph after the first paragraph:**

Precast concrete drop inlets shall conform to the requirements of Section 670.

**Section 560.3 A.1 – Page 317 – Delete and replace with the following:**

1. **Fabrication:** The Fabricator shall notify the Area Engineer prior to the fabrication of precast and prestressed concrete items.

**Section 560.3 A.2 – Page 317 – Delete the last sentence of the first paragraph and replace with the following:**

When a plant has been in operation and satisfactorily producing material, the Contractor will not be required to submit a concrete mix design for precast concrete, unless changes have been made to the pre-approved mix design or the material used in the mix design. Concrete mix designs shall be submitted for each project on all prestressed concrete products.

**Section 560.3 B.1 – Page 319 – Delete the second sentence of the fifth paragraph and replace with the following:**

A checked design includes the design calculations and check design calculations performed by an independent Engineer registered in the State of South Dakota.

**Section 560.3 B.2.b – Page 321 – Delete the second paragraph and replace with the following:**

Acceptance of the precast units shall be in accordance with Section 460.3 B except that the fabricator shall be responsible for the sampling, preparing, and properly curing of all concrete cylinders for concrete compressive strength in accordance with the Materials Manual. The precast units will be accepted when the minimum design concrete compressive strength requirements have been met. Accepted precast units represented by that test group of cylinders may be delivered to the project and will not require the 28 day cylinder test.

**Section 600.2 A.17 – Page 333 – Add the following sentence at the end of the paragraph:**

The concrete pad must be securely mounted and solidly supported under the laboratory to minimize vibration while operating the Marshall compactor.

**Section 600.3 – Page 336 – Delete the fourth and fifth sentence and replace with the following:**

On projects that a Type III lab is required, the Engineer may allow a Type I or II lab to be supplied until such a time the Engineer determines the Type III lab is required. If the Engineer allows a temporary Type I or II lab to be furnished, no additional payment for that lab will be made.

**Section 605.3 C – Page 339 – Delete the third sentence of the first paragraph and replace with the following:**

If fly ash is used, the minimum amount of cement to be replaced is 15 percent and the maximum amount is 20 percent at a 1:1 ratio by weight.

**Section 630.4 A – Page 355 – Delete this section and replace with the following:**

- A. **Beam Guardrail:** Each class and type will be measured to the nearest 0.1 foot (0.1 meter) along the centerline of the rail. The length in feet (meters) shall be the overall length center to center of end posts or to connections with bridges.

**Section 630.4 C – Page 355 – Delete this section and replace with the following:**

- C. **Remove Beam Guardrail:** Remove Beam Guardrail will be measured to the nearest 0.1 foot (0.1 meter) along the centerline of the rail.

**Section 630.5 A – Page 355 – Delete this section and replace with the following:**

- A. **Beam Guardrail:** Beam guardrail will be paid for at the contract unit price per 0.1 foot (0.1 meter) for each class and type installed. Payment will be full compensation for labor, materials, equipment, and incidentals required.

**Section 630.5 C – Page 356 – Delete this section and replace with the following:**

- C. **Remove Beam Guardrail:** Remove Beam Guardrail will be paid for at the contract unit price per 0.1 foot (0.1 meter). Payment will be full compensation for the backfill of holes and the removal of the guardrail including end terminals, beam guardrail, posts, blocks, and hardware from the project limits.

**Section 632.3 H.2.c – Page 361 – Delete and replace with the following:**

- c. Anchor bolts shall be provided with leveling nuts, top nuts, and jam nuts. Anchor bolts shall be tightened in accordance with Section 635.3 F.

**Section 633.3 D – Page 368 – In the grooving tolerance tables, replace “Depth of Groove” with the following:**

Depth of Groove	(English) 80 mils	+ 10 mils
Depth of Groove	(Metric) 2.032 mm	+ 0.25 mm

**Section 634.3 A – Page 372 – Delete the first sentence of the fourth paragraph and replace with the following:**

All workers within the right of way who are exposed either to traffic (vehicles using the highway for purposes of travel) or to construction equipment within the work area shall wear high-visibility safety apparel intended to provide conspicuity during both daytime and nighttime usage, and meeting the Performance Class 2 or 3 requirements of the ANSI/ISEA 107-2004 publication entitled “American National Standard for High-Visibility Safety Apparel and Headwear”.

**Section 634.3 A – Page 372 – Delete the first sentence of the fifth paragraph.**

**Section 634.3 C – Page 374 – Add the following paragraph after the first paragraph:**

For 2 lane roadways with average daily traffic volumes of 2500 or less, no passing zones may be identified using DO NOT PASS, PASS WITH CARE, and NO PASSING ZONE signs rather than pavement markings. The DO NOT PASS and NO PASSING ZONE signs shall be used to mark the beginning of each no passing zone, and the PASS WITH CARE signs to mark the end of each zone. These may be utilized in place of the pavement markings normally used to identify no passing zones for no longer than 2 weeks. The placement of the dashed centerline marking and these signs shall be required prior to nightfall.

**Section 635.3 C.3 – Page 380 – Add the following sentence at the end of the first paragraph:**

The contractor shall not use a machine requiring flowing water for installation of conduit under streets or roadways unless approved by the Engineer.

**Section 635.3 F – Page 381 – Delete and replace with the following:**

- F. **Anchor Bolts:** Anchor bolts shall be installed in accordance with the following requirements.
  - 1. **General:** Anchor bolts shall be provided with leveling nuts and top nuts. Anchor bolts for light towers shall be provided with leveling nuts, top nuts, and jam nuts.
  - 2. **Anchor Bolt Installation:** A steel template shall be used to accurately locate and hold the anchor bolts plumb and in proper alignment. This template shall be in place during placement of the concrete base and shall remain in place a minimum of 24 hours after the concrete placement has been completed. Out of position anchor bolts and anchor bolts greater than 1:40 out-of-plumb are cause for rejection of the base. Bending of the anchor bolts to straighten or move into position, or alterations of the pole base plate will not be permitted.
  - 3. **Anchor Bolt Tightening:**
    - a. All leveling nuts (bottom nuts) shall be brought to full bearing on the bottom of the base plate. The bottom of the leveling nuts must be kept as close to the concrete base as practical, and shall not be more than one inch above the top of the concrete base. Leveling nuts must be threaded onto the anchor bolt to provide at least ¼ inch (6 mm) projection of the bolt above the top nut or jam nut if required when in its tightened position.
    - b. A softened beeswax or equivalent shall be applied to the top nut bearing face and top nut internal threads prior to placement on the anchor bolt. All top nuts shall be tightened to a snug tight condition. Snug tight

is defined as the tightness attained by the full effort of a person using a wrench with a length equal to 14 times the diameter of the anchor bolt, except the minimum length shall be 18 inches. The use of adjustable wrenches will not be allowed. The full effort required to achieve a snug tight condition, shall be applied as close to the end of the wrench as possible. Pull firmly by leaning back and using full body weight (brace feet to prevent slipping) on the end of the wrench until the nut stops rotating. This snug tightening shall be accomplished in a minimum of two separate passes of tightening. The sequence of tightening in each pass shall be such that the opposite side nut, to the extent possible, shall be subsequently tightened until all the nuts in that pass have been snugged.

Snug tightness of both the top and leveling nuts shall be checked in the presence of Department personnel after the Contractor has completed nut snugging as described above, but prior to final tightening. Snug tightness of the nuts (top and leveling) shall be checked by applying a torque in a range from 20% to 30% of the verification torque. See Table 1 for verification and snug tight torque values.

**Table 1**

**Anchor Bolt Tightening**

<b>Anchor Bolt Diameter (in)</b>	<b>Anchor Bolt Stress Area (sq in)</b>	<b>Yield Strength (ksi)</b>	<b>Minimum Tensile Strength (ksi)</b>	<b>Verification Torque (ft-lbs)</b>	<b>30% Snug Tight Torque (ft-lbs)</b>	<b>20% Snug Tight Torque (ft-lbs)</b>
1.00	0.61	36.0	58.0	177	53	35
1.25	0.97	36.0	58.0	351	105	70
1.50	1.41	36.0	58.0	613	184	123
1.75	1.90	36.0	58.0	964	289	193
2.00	2.50	36.0	58.0	1449	435	290
2.25	3.25	36.0	58.0	2120	636	424
2.50	4.00	36.0	58.0	2899	870	580
2.75	4.93	36.0	58.0	3930	1179	786
3.00	5.97	36.0	58.0	5192	1558	1038
1.00	0.61	55.0	75.0	274	82	55
1.25	0.97	55.0	75.0	545	163	109
1.50	1.41	55.0	75.0	951	285	190
1.75	1.90	55.0	75.0	1496	449	299
2.00	2.50	55.0	75.0	2249	675	450
2.25	3.25	55.0	75.0	3289	987	658
2.50	4.00	55.0	75.0	4498	1349	900
2.75	4.93	55.0	75.0	6098	1830	1220
3.00	5.97	55.0	75.0	8056	2417	1611
1.00	0.61	75.0	100.0	366	110	73
1.25	0.97	75.0	100.0	726	218	145
1.50	1.41	75.0	100.0	1268	381	254
1.75	1.90	75.0	100.0	1994	598	399
2.00	2.50	75.0	100.0	2999	900	600
2.25	3.25	75.0	100.0	4386	1316	877
2.50	4.00	75.0	100.0	5998	1799	1200
2.75	4.93	75.0	100.0	8131	2439	1626
3.00	5.97	75.0	100.0	10742	3223	2148
1.00	0.61	105.0	125.0	457	137	91
1.25	0.97	105.0	125.0	908	272	182
1.50	1.41	105.0	125.0	1586	476	317
1.75	1.90	105.0	125.0	2493	748	499
2.00	2.50	105.0	125.0	3749	1125	750
2.25	3.25	105.0	125.0	5482	1645	1096
2.50	4.00	105.0	125.0	7497	2249	1499
2.75	4.93	105.0	125.0	10164	3049	2033

3.00	5.97	105.0	125.0	13427	4028	2685
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- c. At this point, the top nut and leveling nut must be in full bearing on the base plate. If any gap exists between either nut (top or leveling) and the base plate, a beveled washer shall be added between the nut washer and the base plate to eliminate the gap. The beveled washer shall be stainless steel Type 304, the same diameter as the hardened washer, and beveled as required to eliminate the gap between the nut and the base plate. All nuts shall be retightened according to steps (a) and (b) above if beveled washers are added. All costs required to remove and re-erect the structure to install beveled stainless steel washers shall be at the Contractor's expense.
- d. Using a hydraulic wrench rotate all top nuts as indicated in Table 2. The additional turn of the nuts shall be accomplished by tightening all the nuts in two separate passes of equal incremental turns (i.e., for 1/3 turn use 1/6 turn each pass). The sequence of nut tightening in each pass shall be such that the opposite side nut, to the extent possible, shall be subsequently tightened until all the nuts in that pass have been turned. There shall be no rotation of the leveling nut during top nut tightening.

In lieu of a hydraulic wrench, torque wrenches and multipliers may be used to achieve the desired nut rotations and tightness.

- e. Tightness of the nuts shall be checked in the presence of Department personnel. Tightness of the nuts shall be checked within a minimum of 48 hours and a maximum of 96 hours after the nuts have been rotated as indicated in Section 635.3 F.3.d above. Tightness of the top nuts shall be checked by applying the verification torque to the nut. See Table 1 for verification torque.

**Table 2**

**Nut Rotation for Turn-Of-Nut Pretensioning**

Anchor Rod Diameter (in)*	Nut Rotation from Snug-Tight Condition a, b	
	F1554 Grade 36, A307	F1554 Grade 55 and 105, A449
< 1 ½	1/6 Turn	1/3 Turn
≥ 1 ½	1/12 Turn	1/6 Turn
a. Nut rotation is relative to anchor rod. The tolerance is plus 20 degrees		
b. Applicable only to double-nut-movement joints.		

Bottom leveling nuts shall be in contact with the base prior to applying the torque. An inability to achieve the verification torque indicates that the threads have stripped and the anchor bolt must be replaced. All costs for replacing anchor bolts shall be at the Contractor's expense.

- f. Install jam nut after verification torque has been applied to top nut. Lubricate threads of jam nut with beeswax or equivalent and tighten to a torque of 100 ft-lb (approximated without the use of a torque wrench).

**Section 635.3 H – Page 382 – Delete the first paragraph and replace with the following:**

Traffic signal conductors shall be continuous from the controller cabinets to the pole bases. Splicing of conductors will not be allowed in the junction boxes.

**Section 635.3 Q.3 – Page 384 – Delete and replace with the following:**

- 3. **Preformed Loops:** Each set of loop wires shall be tagged to identify loop. If installation of the loop is for future use the loop wires in the same lane shall be taped together. If installation is on a signal project, tagging shall be done and wires connected in series.

In new roadways, the preformed loops and lead-in conduits shall be placed in the base course, with the top of the conduit flush with the top of the base, and then covered with hot mix asphalt or Portland cement concrete pavement. Preformed loops and lead-in conduits shall be protected from damage prior to and during pavement placement.

In new reinforced concrete structure decks, the preformed loops shall be secured to the top of the uppermost layer of reinforcing steel using nylon wire ties. The loop shall be held parallel to the structure deck by using PVC or polypropylene spacers where necessary. Conduit for lead-in conductors shall be placed below the upper mat of reinforcing steel.

In existing pavement, the preformed loops shall be placed in a saw slot, 1-1/4 inches minimum width, cut into the existing pavement. The top of the conduit shall be 2 inches, minimum, below the top of existing surface. Sawed Slots shall be filled with an approved loop sealant.

On asphalt or concrete resurfacing projects, the preformed loops shall be placed in a saw slot, 1-1/4 inches minimum width, cut into the existing pavement. The top of the conduit shall be 2 inches, minimum, below the top of existing surface after any required surface removal is completed and prior to the placing of the new surface. Sawed Slots shall be filled with an approved loop sealant.

**Section 635.3 R.3 – Page 384 – Delete the first sentence in the first paragraph and replace with the following:**

All circular red, red arrow, circular yellow, yellow arrow, circular green, green arrow, and pedestrian indications shall be light emitting diode (LED) signal modules.

**Section 635.5 E – Page 386 – Delete and replace with the following:**

**D. Anchor Bolts:** Cost for anchor bolts shall be included in the contract unit price for the concrete for which they are incorporated with.

**Section 651.2 C – Page 391 – Delete the last sentence of this section and replace with the following:**

Not more than 25.0 percent by weight shall pass a No. 200 (75µm) sieve.

**Section 670.3 – Page 393 – Delete and replace with the following:**

**A. General Requirements:** Concrete for drop inlets shall be proportioned, mixed, hauled, and placed in accordance with Section 462.

When the foundation for a drop inlet is in new embankment, the embankment shall be constructed to an elevation at least one foot (300 mm) above the footing before the foundation for the drop inlet is prepared. The foundation shall be compacted as specified for the adjacent embankment.

Castings shall be set in full mortar beds or secured as specified. Castings shall be set accurately to the correct elevation so subsequent adjustment will not be necessary.

Inlet and outlet pipe connections shall be of the same size and kind and shall meet the same requirements as the pipe they connect. Pipe sections shall be flush on the inside of the structure wall and project outside sufficiently for proper connection with the next pipe section. Masonry shall fit neatly and tightly around the pipe. Grouting of the pipe connection may be required as directed by the Engineer if voids exist after form removal.

Drop inlets shall be either cast in place or precast. Precast drop inlets shall be defined as those drop inlets cast outside of the project limits. Drop inlets cast within the project limits will be considered cast in place.

**B. Cast in Place Drop Inlets:** The foundation excavated for drop inlets shall be thoroughly moistened immediately prior to placing concrete.

Steel reinforcement shall be placed in accordance with Section 480.

The finished surface of the concrete shall present a neat and smooth appearance. Concrete shall be protected and cured in accordance with Section 460.3, except the minimum curing time shall be 72 hours.

Upon completion and curing of the unit, the sheeting, bracing, forms, and falsework shall be removed and the excavation backfilled. The unit shall not be backfilled until the completion of the 72 hour curing period, or until the concrete reaches a minimum compressive strength of 3000 psi (21 MPa). Backfill shall be placed in layers not

exceeding six inches (150 mm) thick and compacted to the same degree as specified for the adjacent embankment. Installations shall be finished completed and left in a neat appearing condition.

**C. Precast Drop Inlets:** Precast drop inlets shall conform to the following requirements:

- 1. Notification:** The Contractor shall notify the Engineer 24 hours in advance of all concrete pours for inspection and observation of Contractor testing:
- 2. Design:** Precast drop inlets shall conform to the configurations of the standard plates. Variations from the standard plates may be accepted provided the AASHTO materials, design, fabrication specifications, and the requirements of this section are complied with.

Precast drop inlets shall be designed to specified load conditions. The Design Engineer of the drop inlets must be registered in the State of South Dakota. The design shall conform to the AASHTO design requirements for the depth of fill, including surfacing, etc., as well as live load or specified loading.

The Contractor shall furnish a checked design with the shop drawings. A checked design shall include the design calculations, and check design calculations performed by an independent Engineer registered in the State of South Dakota.

- 3. Shop Drawings:** Fifteen days prior to fabrication, the Contractor shall furnish shop drawings for Department review. The shop drawings shall consist of fabrication details including reinforcing steel and spacer placement and configurations, total quantities for the complete item, and all information for fabrication and erection.
- 4. Forms:** The forms shall be designed to withstand the fluid pressure of the concrete and the added forces due to vibration and impact without distortion. The forms shall be mortar tight and free from warp.

The form surface area in contact with the concrete shall be treated with an approved form oil or wax before the form is set in position. The forms shall be thoroughly cleaned of all other substances.

- 5. Concrete Cure:** The concrete shall be cured by low pressure steam, radiant heat, or as specified in Section 460.3 N. When curing in accordance with Section 460.3 N., the concrete temperature requirements of Section 460.3 O. shall apply.

Low pressure steam or radiant heat curing shall be done under an enclosure to contain the live steam or the heat and prevent heat and moisture loss. The concrete shall be allowed to attain initial set before application of the steam or heat. The initial application of the steam or heat shall be three hours after the final placement of concrete to allow the initial set to occur. When retarders are used, the waiting period before application of the steam or radiant heat shall be five hours. When the time of initial set is determined by ASTM C 403, the time limits described above may be waived.

During the waiting period, the minimum temperature within the curing chamber shall not be less than 50° F (10° C) and live steam or radiant heat may be used to maintain the curing chamber between 50° F (10° C) and 80° F (27° C). During the waiting period the concrete shall be kept moist.

Application of live steam shall not be directed on the concrete forms causing localized high temperatures. Radiant heat may be applied by pipes circulating steam, hot oil, hot water, or by electric heating elements. Moisture loss shall be minimized by covering exposed concrete surfaces with a plastic sheeting or by applying an approved liquid membrane curing compound to exposed concrete surfaces. The top surface of concrete members for use in composite construction shall be free of membrane curing compound residue unless suitable mechanical means for full bond development are provided.

During the initial application of live steam or radiant heat, the concrete temperature shall increase at an average rate not exceeding 40° F (22° C) per hour until the curing temperature is reached. The maximum concrete temperature shall not exceed 160° F (71° C). The maximum temperature shall be held until the concrete has reached the desired strength. After discontinuing the steam or radiant heat application, the temperature of the concrete shall decrease at a rate not to exceed 40° F (22° C) per hour until the concrete temperature is within 20° F (11° C) of the ambient air temperature. The Contractor will not be required to monitor this cool down temperature when the ambient air temperature is 20° F (11° C) or above.

The test cylinders shall be cured with the unit, or in a similar manner (similar curing method and concrete curing temperature, as approved by the Concrete Engineer) as the unit, until minimum compressive strength has been obtained.

- 6. Surface Finish and Patching:** If a precast or prestressed item shows stone pockets, honeycomb, delamination or other defects which may be detrimental to the structural capacity of the item, it will be subject to rejection at the discretion of the Engineer. Minor surface irregularities or cavities, which do not impair the service of the item, and which are satisfactorily repaired will not constitute cause for rejection. Repairs shall not be made until the Engineer has inspected the extent of the irregularities and has determined whether the item can be satisfactorily repaired. If the item is deemed to be repairable, the repair method and procedures shall be agreed upon by the Department and fabricator prior to the work commencing.

Depressions resulting from the removal of metal ties or other causes shall be carefully poointed with a mortar of sand and cement in the proportions, which are similar to the specific class of concrete in the unit. A sack rub finish is required on prestressed beams except for the bottom of the bottom flange and the top of the top flange. A sack rub finish is also required on sloped surfaces of box culvert end sections.

- 7. Fresh Concrete Testing:** The Contractor shall be responsible for performing all fresh concrete testing in accordance with the materials manual Materials Manual. Tests shall be documented on a DOT-54 form and submitted to the Engineer.
- 8. Concrete Compressive Strength:** The Contractor shall make a minimum of one group of test cylinders for each class of concrete for each day's production, not to exceed 150 cubic yard (125 cubic meters) per group of cylinders.

At a minimum, a group of test cylinders shall consist of the following:

- a. Two test cylinders are required for the 28 day compression test.
- b. Two additional cylinders will be required for determining concrete strength, when the Contractor desires to make delivery and obtain acceptance by the Department prior to the 28 day compression test.

Acceptance of the precast units shall be in accordance with Section 460.3 B. The precast units will be accepted when the minimum design concrete compressive strength requirements have been met. Accepted precast units represented by that test group of cylinders may be delivered to the project and will not require the 28 day cylinder test.

The Engineer will be responsible for breaking of all concrete cylinders for concrete compressive strength in accordance with the Materials Manual.

**Section 670.5 – Page 394 – Add the following paragraph after the first paragraph:**

Unless otherwise specified in the plans the cost for removal of existing pipe, if necessary, to facilitate the installation of new drop inlets shall be incidental to the associated drop inlet contract unit prices.

**Section 671.5 – Page 397 – Add the following paragraph to this section:**

Unless otherwise specified in the plans the cost for removal of existing pipe, if necessary, to facilitate the installation of new manholes shall be incidental to the associated manhole contract unit prices.

**Section 680.2 A – Page 399 – Delete the last sentence of the second paragraph and replace with the following:**

The percentage of material passing a No. 200 (75µm) sieve shall not exceed 2.0 percent.

**Section 720.4 – Page 405 – Delete this section and replace with the following:**

- A. Bank and Channel Protection Gabions:** Bank and channel protection gabions will be measured to the nearest 0.1 cubic yard (0.1 cubic meter). If a substitution is made, the dimensions of the bank and channel protection installed shall be equal to or greater than the dimensions specified. Payment will be based on plans quantity, unless changes are ordered in writing by the Engineer.

**B. Drainage Fabric:** Drainage fabric will be measured to the nearest square yard (square meter). The lap at joints will not be included in the measurement.

**Section 720.5 – Page 405 – Delete this section and replace with the following:**

**A. Bank and Channel Protection Gabions:** Bank and channel protection gabions will be paid for at the contract unit price per cubic yard (cubic meter). Payment will be full compensation for materials, equipment, labor, excavating, shaping and incidentals required.

**B. Drainage Fabric:** Drainage fabric will be paid for at the contract unit price per square yard (square meter). Payment will be full compensation for furnishing and installing the drainage fabric as specified. Payment will be for plan quantity unless changes are ordered in writing.

**Section 730.2 C – Page 407 – Delete the fourth sentence and replace with the following:**

If the seed is not planted within the 9 month period, the Contractor shall have the seed retested for germination, as described above, and a new certified test report shall be furnished prior to starting seeding operations.

**Section 734.3 – Page 423 – Add the following paragraph before the first paragraph:**

The Contractor shall designate an employee as Erosion Control Supervisor whose responsibility is the construction and maintenance of erosion and sediment control. This person shall be available to be reached by phone 24 hours a day, 7 days a week, and must be able to respond to emergency situations at the job site within 12 hours. The person so designated must have training and be certified by the South Dakota Department of Transportation in the area of erosion and sediment control. The name, phone number, and location of the person shall be provided to the Department at the preconstruction meeting.

**Section 734.3 B.2 – Page 424 – Delete the second sentence and replace with the following:**

The muck will be removed when the surface of the muck is at approximately one-third the height of the silt fence.

**Section 750 – Page 431 – Add the following after the second paragraph:**

In addition to the certification requirement specified in SD 416, when limestone is used, the manufacturer shall state in writing the amount thereof, the percentage of Calcium Carbonate in the limestone, and shall supply comparative test data on chemical and physical properties of the cement with and without the limestone. The comparative tests do not supersede the normal testing to confirm that the cement meets chemical and physical requirements.

**Section 800.2 D – Page 436 – Add the following sentence to the end of the fourth paragraph:**

Fine aggregate with a 14 day expansion value of 0.400 or greater shall not be used.

**Section 800.2 D – Page 436 – Add the following sentence to the end of the last paragraph:**

The expansion value of the blended sources will be used to determine the type of cement required.

**Section 800.2 F – Page 437 – Delete the last three sentences of the first paragraph and replace with the following:**

If the fineness modulus falls outside this limit the Concrete Engineer shall be notified. A new or adjusted mix design may be provided or approved. The uniformity of grading requirements do not apply to fine aggregate for Low slump Dense Concrete and Class M (I) concrete.

**Section 800.2 F – Page 437 – Delete the first sentence of the second paragraph and replace with the following:**

For determining the FM deviation from the design mix FM, the average of the five most recent FM test shall be used.

**Section 800.2 F – Page 437 – Delete the first sentence of the last paragraph and replace with the following:**

Additionally for Portland Cement Concrete Paving conforming to Section 380; the FM of the fine aggregate, as established by the mix design, will be from 2.40 to 3.10 (wide band).



**TABLE 1**

REQUIREMENTS	CLASS D		CLASS E		CLASS G		CLASS S	
	TYPE 1	TYPE 2	TYPE 1	TYPE 2	TYPE 1	TYPE 2	TYPE 1	TYPE 2
SIEVE	PERCENT PASSING							
1" (25.0 mm)	100		100		100			
3/4" (19.0 mm)	97-100	100	97-100	100	97-100	100		
1/2" (12.5 mm)	75-95	97-100	75-95	97-100	75-95	97-100	86-100	100
3/8" (9.50 mm)							66-80	80-100
No. 4 (4.75 mm)	45-75	60-80	45-75	60-80	45-75	60-80	24-34	24-45
No. 8 (2.36 mm)	30-55	40-60	30-55	40-60	30-55	40-60	10-20	10-22
No. 16 (1.18 mm)	20-45	25-50	20-45	25-50	20-45	25-50		
No. 40 (425 µm)	10-30	15-35	10-30	15-35	10-30	15-35		
No. 200 (75 µm)	3.0-7.0	4.0-8.0	3.0-7.0	4.0-8.0	3.0-7.0	4.0-8.0	4.0-8.0	2.0-5.0
Processing Required	Crushed		Crushed		Crushed		Crushed	
Liquid Limit (max)	25		25		25		25	
Plasticity Index, (max)	3		Non-Plastic		Non-Plastic		Non-Plastic	
L.A. Abra. Loss. (max)	45%		40%		35%		40%	
Sodium Sulfate (Soundness) (Max.)								
+4 (4.75 mm) sieve	15%		15%		12%		12%	
-4 (4.75 mm) sieve	15%		15%		12%		12%	
Lightweight Particles (Max.)								
+4 (4.75 mm) sieve	4.5%		3.0%		1.0%		1.0%	
-4 (4.75 mm) sieve	4.5%		3.0%		1.0%		1.0%	
Crushed Particles (Min.)								
+4 (4.75 mm) sieve	50% 1-FF		70% 2-FF		90% 2-FF		90% 2-FF	
* - 4 Manufactured Fines	NA		20% Min.		70% Min.		95% Min.	

\* - Manufactured fines shall be manufactured solely from material retained on the 3/4 inch (19mm) sieve, unless the aggregate material is produced from a ledge rock source.

**Section 880.2 B.1 – Page 456 – Delete the second sentence and replace with the following:**

The material shall be fine enough that when pulverized for testing, 90 percent by dry weight will pass a No. 40 (425 µm) sieve and 60.0 percent by dry weight will pass a No. 200 (75µm) sieve.

**Section 880.2 B.2 – Page 456 – Delete the sieve analysis specification for the No. 200 (75 µm) sieve and replace with the following:**

Passing a No. 200 (75 µm) sieve ..... 65.0-100%

**Section 882.2 – Page 459 – Delete Table 1 and replace with the following:**

Table 1

REQUIREMENT	Subbase	Gravel Cushion	Granular Bridge End Backfill	Aggregate Base Course	Limestone Ledge Rock		Gravel Surfacing
					Base Course	Gravel Cushion	
SIEVE	PERCENT PASSING						
2" (50 mm)	100						
1" (25.0 mm)	70-100		100	100	100		
3/4" (19.0 mm)		100	80-100	80-100	80-100	100	100
½" (12.5 mm)			68-91	68-91	68-90		
No. 4 (4.75 mm)	30-70	50-75	42-70	46-70	42-70	46-70	50-78
No. 8 (2.36 mm)	22-62	38-64	29-58	34-58	29-53	29-53	37-67
No. 40 (425 µm)	10-35	15-35	10-35	13-35	10-28	10-28	13-35
No. 200 (75 µm)	0.0-15.0	3.0-12.0	0.0-5.0	3.0-12.0	3.0-12.0	3.0-12.0	4.0-15.0
Liquid Limit Max		25	25	25	25	25	
Plasticity Index	0-6	0-6	0-6	0-6	0-3	0-3	4-12
L.A. Abra. Loss, max.	50	40	40	40	40	40	40
Foot Notes		2	1,2	1,2			
Processing Required	crushed	crushed	crushed	crushed	crushed	crushed	crushed

**Section 890.2 G – Page 465 – In the table, under TESTS ON RESIDUE FROM DISTILLATION TESTS, add the following after Elastic Recovery @ 50°F (10°C):**

(see Note 4)

**Section 890.2 G – Page 465 – Add the following after Note 3:**

Note 4: The Elastic Recovery test shall be in accordance with AASHTO T301, except that the residue will be obtained by distillation, not oven evaporation. The distillation temperature shall be as recommended by the emulsion manufacturer.

**Section 972.2 B – Page 479 – Delete the second paragraph and replace with the following:**

For bolts that are 1" (M24) (incl.) in diameter and less, the maximum hardness for AASHTO M164 (ASTM A325) bolts shall be 33 Rc.

**Section 972.2 C – Page 483 – Add the following paragraph before the second to last paragraph:**

Jam nuts shall conform to ASTM A563 Grade A.

**Section 972.2 C – Page 483 – Delete the first sentence of the last paragraph and replace with the following:**

Bolts and nuts shall be hot dipped galvanized in accordance with ASTM F2329 or mechanically galvanized in accordance with ASTM B695. Washers shall be hot dipped galvanized in accordance with ASTM F2329 or mechanically galvanized in accordance with ASTM B695.

**Section 972.2 D – Page 484 – Delete the fourth note under the table as denoted by “\*\*\*\*” and replace with the following:**

\*\*\*\* Anchor bolts conforming to ASTM F1554 Grade 55 (380) shall satisfy Supplemental Requirement S4. Anchor bolts conforming to ASTM F1554 Grade 105 (725) shall satisfy Supplemental Requirement S5.

**Section 980.1 A.1 – Page 485 – Delete this section and replace with the following:**

**1. Quantitative Requirements:** The finished paint shall meet the following quantitative requirements:

	<u>WHITE</u>	<u>YELLOW</u>
<u>Lead</u> , parts per million max. ASTM D 3335 or X-ray fluorescence	100	100
<u>Pigment</u> , percent by weight	60.0 - 62.5	58.5 – 61.0
<u>Pigment</u> , percent by weight; when tested in accordance with ASTM D 3723 (See Note 1)	60.0 - 62.5	56.1 - 58.6
Note 1: The residual extracted pigment upon analysis shall conform to the following quantitative compositional requirements when tested in accordance with ASTM D 1394 or ASTM D 4764.		
Titanium Dioxide ASTM D 476 Type II Rutile 92% min. TiO <sub>2</sub> tested in accordance with ASTM D 1394 or ASTM D 4764	1.00 lb/gal min.	0.20 lb/gal min.
<u>Total Solids</u> , percent by weight; min. when tested in accordance with ASTM D 3723	77.0	76.1
<u>Non-volatile Vehicle</u> , percent by weight vehicle; min. when tested in accordance with FTMS 141c (Method 4051.1)	42.5	42.5
<u>Consistency</u> . Krebs-Stormer Shearing rate 200 r.p.m. Grams	190 to 300	190 to 300
Equivalent K.U. when tested in accordance with ASTM D 562 (See Note 2)	80 to 95	80 to 95
Note 2: The consistency of the paint shall be within the stated specification when determined a minimum 48 hours after packaging the material.		
<u>Weight per Gallon</u> , pounds minimum when tested in accordance with ASTM D 1475 (See Note 3)	Rohm & Haas 13.85 Dow DT 250NA 13.75	13.30 13.20
Note 3: In addition to compliance with the minimum, the weight per gallon shall not vary more than $\pm 0.3$ lbs / gal. between batches.		
<u>Fineness of Dispersion</u> Hegman Scale, min. when tested in accordance with ASTM D 1210	2 min. "B" Cleanliness"	2 min B" Cleanliness
<u>Drying Time</u> , No Pick-Up, Minutes, max. when tested in accordance with ASTM D711, except the wet film thickness shall be $12.5 \pm 0.5$ mils. The applied film shall be immediately placed in a laboratory drying chamber maintaining the relative humidity of $65 \pm 3\%$ , the temperature $73.5 \pm 3.5^\circ\text{F}$ ( $23 \pm 2^\circ\text{C}$ ), and air flow less than one foot (1') per minute.	12max.	12max.
<u>Drying Time</u> , Dry-through, Minutes	120max.	120max.

max. when tested in accordance with ASTM 1640, except the wet film thickness shall be  $12.5 \pm 0.5$  mils. The applied film shall be immediately placed in a laboratory drying chamber maintaining the relative humidity at  $90 \pm 3\%$ , and the temperature  $23 \pm 2^\circ\text{C}$ . The pressure exerted will be the minimum needed to maintain contact between the thumb and film. A reference-control paint will be run in conjunction with the candidate paint. Rohm and Haas formulation will be referenced-control paint.

Note 4: If either the candidate or reference-control paint exceeds the 120 minute maximum, then the candidate paint shall not exceed the dry time of the reference-control paint by more than 15 minutes.

<u>Field Drying Time</u> , Track-Free, minutes max.	2	2
When applied under the following conditions, the line shall show no visual tracking when viewed from 50 feet after driving a passenger vehicle over the line at a speed of 25-35 mph: Fifteen mils wet film thickness Six lbs. of glass beads per gal. of paint Paint temperature at nozzle between 70 to 120°F Pavement dry, pavement temperature 50 to 120°F Relative humidity of 85% maximum		
<u>Directional Reflectance</u> , minimum.	85	50
when applied at a wet film thickness of 15 mils and when tested in accordance with ASTM E 1347 (Illuminate C 2°)		
<u>pH</u> , minimum.	9.80	9.80
when tested in accordance with ASTM E70		
<u>Dry Opacity</u> , Contrast ratio, min.	0.955	0.880
when applied at a wet film thickness of 6 to 7 mils and when tested in accordance with FTMS 141c (Method 4121 Illuminate C 2°)		
<u>Volatile Organic Content (VOC)</u> , max.	115 g/liter	115 g/liter
in accordance with ASTM D 3960		
<u>Flash Point</u> , closed cup, min.	115°F	115°F

Color: The paint shall meet the color specification limits and luminance factors listed in Tables 1 & 2 when tested in accordance with ASTM E1347 or ASTM E1349. The paint shall not discolor in sunlight and shall maintain the colors and luminance factors throughout the life of the paint. No Bayferrox 3950, iron oxides or other color enhancers will be permitted to achieve the color chromaticity coordinates.

Table 1\*

Color	Chromaticity Coordinates (corner points)								Min. Luminance Factor (Y %)
	X	Y	X	Y	X	Y	X	Y	
White	0.355	0.355	0.305	0.305	0.285	0.325	0.335	0.375	35
Yellow	0.560	0.440	0.490	0.510	0.420	0.440	0.460	0.400	25

\* Daytime Color Specification Limits and Luminance Factors for Pavement Markings Material with CIE 2° Standard Observer and 45/0 (0/45) Geometry and CIE Standard Illuminant D65

Table 2\*\*

Color	Chromaticity Coordinates (corner points)							
	1		2		3		4	
	X	Y	X	Y	X	Y	X	Y
White	0.480	0.410	0.430	0.380	0.405	0.405	0.455	0.435
Yellow	0.575	0.425	0.508	0.415	0.473	0.453	0.510	0.490

\*\* Nighttime Color Specification Limits for Pavement Marking Retroreflective Material With CIE 2° Standard Observer, Observation Angle = 1.05°, Entrance Angle + 88.76° and CIE Standard Illuminant A.

**Section 981.1 – Page 489 – Delete this section and replace with the following:**

Glass beads for use with pavement marking paint shall be moisture resistant and shall meet the requirements of AASHTO M 247, Type I. The glass beads shall be without floatation properties. The glass beads shall have dual surface treatment consisting of a moisture resistant silicone treatment, and silane adherence surface treatment. The glass beads shall have a minimum of 80% true spheres. Roundness shall be tested in accordance with SD 510.

**Section 983.1 – Page 499 – Delete the third sentence of the first paragraph:**

**Section 983.1 B – Page 499 – Delete this section in it's entirety.**

**Section 983.2 B – Page 500 – Delete this section in it's entirety.**

**Section 985.1 D – Page 506 – Delete the last two sentences of the first paragraph and replace with the following:**

Vertical reinforcement shall be deformed unless otherwise noted and shall conform to the requirements of ASTM A 615/AASHTO M 31 Grade 60 (400). Circular ties, stirrups, and spiral reinforcing may be fabricated from deformed bars conforming to the requirements of ASTM A 615/AASHTO M31 Grade 60 (400). Spiral reinforcing may also be fabricated from cold drawn wire conforming to ASTM A 82 or hot rolled plain bars conforming to ASTM A 615/AASHTO M 31 Grade 60 (400).

**Section 985.1 G.4 – Page 508 – Delete the first sentence and replace with the following:**

Conductor insulation shall be colored in accordance with ICEA S-95-658, Method 1, Table K-2.

**Section 985.1 G.5 – Page 508 – Delete the first sentence and replace with the following:**

Jackets shall be polyvinyl chloride meeting UL requirements for Class 12 jackets and ICEA S-95-658, Section 4.

**Section 985.1 I.1.b – Page 508-509 – Delete the last sentence in the paragraph:**

**Section 985.1 N – Page 514 – Delete the second sentence in the fifth paragraph and replace with the following:**

The flash control circuit shall ensure that remote transfer to flashing from normal stop and go operations occurs during the end of the mainline green interval in the cycle.

**Section 985.1 N.1 and 2 – Page 515 – Delete these two sections and replace with the following sentence:**

The controller furnished shall meet current NEMA TS2 standards for controllers.

**Section 985.1 Q.7 – Page 516 – Delete and replace with the following:**

7. Backplates for Signal Heads: Unless otherwise stated on the plans, backplates may be either 0.050 inch (1.27 mm) thick aluminum or 0.125 inch (3.18 mm) thick polycarbonate. The polycarbonate backplates must be made up from no more than two pieces.

**Section 990.1 – Page 517 – Add the following to this section:**

**G. High Density Polyethylene Pipe:** High Density Polyethylene pipe, couplings, and fittings shall conform to the requirements of AASHTO M 294.

**Section 990.1 A.2.a – Page 517 – Delete and replace with the following:**

- a. Portland cement shall conform to Section 750.

**Section 990.1 A.2.h – Page 517 – Delete and replace with the following:**

- h. Flexible watertight gaskets shall conform to AASHTO M 198.

**Section 990.1 A.3 – Page 517 – Delete and replace with the following:**

3. **Concrete:** The concrete in special sections shall have a minimum compressive strength of 4000 psi (28 MPa). Special sections are those sections of concrete pipe not covered by the class requirement of AASHTO M 170, M 206, or M 207. The strength shall be determined by test cylinders or by cores.

**Section 1010.1 A – Page 519 – Add the following to the end of the first paragraph:**

Bar reinforcement shall be deformed, unless otherwise noted.

**Section 1010.1 C – Page 519 – Delete the second paragraph and replace with the following:**

Dowel bars for concrete pavements shall be epoxy coated and shall conform to AASHTO M 254 Type B except the film thickness shall be from 5 to 12 mils (0.13 to 0.30 mm) after cure. The steel cores shall be plain round bars conforming to AASHTO M 31 Grade 40 or 60, M 227 Grade 70 minimum, or M 255 Grade 75 minimum. The bars shall be the diameter shown in the plans, free from burring or other deformation restricting slippage in the concrete.

**Section 1010.1 C – Page 519 – Add the following sentence after the first sentence of the third paragraph:**

The cut ends do not have to be coated.

\* \* \* \* \*



