

## **3801 RIGID STEEL CONDUIT**

### **3801.1 SCOPE**

Provide rigid steel conduit and fittings for electrical systems.

### **3801.2 REQUIREMENTS**

Use rigid steel conduit listed and labeled by an NRTL, as defined by the U.S. Department of Labor, and meeting the requirements of UL 6 and UL 514B. Use an NRTL listed by OSHA in its scope of recognition for the tests required by this specification.

Hot-dip galvanize the inside and outside surfaces of rigid steel conduit and fittings.

### **3801.3 SAMPLING AND TESTING**

Label each conduit length with the relevant NRTL label.

The Department reserves the right to sample, test, inspect, and accept or reject conduit or fittings based on its own tests.

## **3802 INTERMEDIATE METAL CONDUIT**

### **3802.1 SCOPE**

Provide intermediate metal conduit and fittings for electrical systems.

### **3802.2 REQUIREMENTS**

Use intermediate metal conduit listed and labeled by a National Recognized Testing Laboratory (NRTL), as defined by the U.S. Department of Labor, and meeting the requirements of UL 6 and UL 514B. Use an NRTL listed by OSHA in its scope of recognition for the tests required by this specification.

Hot-dip galvanize the inside and outside surfaces of intermediate metal conduit and fittings.

### **3802.3 SAMPLING AND TESTING ..... 3801**

## **3803 NON-METALLIC RIGID PVC AND HDPE CONDUIT**

### **3803.1 SCOPE**

Provide rigid polyvinyl chloride (PVC) and high density polyethylene (HDPE) conduit and fittings for electrical systems.

### **3803.2 REQUIREMENTS**

#### **A Rigid PVC Conduit**

Use rigid PVC conduit and fittings meeting the following requirements:

- (1) Listed by an NRTL as meeting the requirements of UL 514B and UL 651 for underground use,
- (2) Gray in color,
- (3) Smooth interior and exterior surfaces, and
- (4) Schedule 80 conduit and conduit fittings.

#### **B High Density Polyethylene (HDPE) Conduit**

Use HDPE continuous-type conduit and fittings meeting the following requirements:

- (1) In compliance with ASTM F 2160,
- (2) Listed by NRTL as meeting the requirements of UL 651B,
- (3) Schedule 80 conduit and conduit fittings,
- (4) Red or gray in color, and
- (5) Smooth interior and exterior surfaces.

### **3803.3 SAMPLING AND TESTING ..... 3801**

## **3810 LIGHTING LUMINAIRES**

### **3810.1 SCOPE**

Provide lighting luminaires with associated components.

### **3810.2 REQUIREMENTS**

#### **A General**

Use a complete and operational lighting luminaire of the type and capacity required by the contract.

Use lighting luminaires with a warranty of at least of five years.

Mark the month and year of installation inside the luminaire housing using a black, oil-based paint marker.

Mark the month and year of installation on the lamp socket base by etching or using a black, oil-based paint marker.

#### **B Roadway Lighting Luminaire**

Use roadway lighting luminaires listed on the Approved/Qualified Products List under "Lighting."

#### **C Sign Lighting Luminaire**

Use sign lighting luminaires listed on the Approved/Qualified Products List under "Lighting."

#### **D Underpass Lighting Luminaire**

Use underpass lighting luminaires listed on the Approved/Qualified Products List under "Lighting."

#### **E High Pressure Sodium Lamps**

Use high-pressure sodium lamps listed on the Approved/Qualified Products List under "Lighting."

#### **F High Pressure Sodium Self-Starting Extended Life Lamps**

Use high-pressure sodium, self-starting, extended-life lamps listed on the Approved/Qualified Products List under "Lighting."

#### **G Luminaire Wire Holders**

Use luminaire wire holders listed on the Approved/Qualified Products List under "Lighting."

### **3810.3 SAMPLING AND TESTING**

Submit five complete sets of manufacturer's drawings and specifications for proposed lighting luminaires, in accordance with 2471.3.B.1, "Shop Detail Drawings, General Requirements," and 2471.3.B.3, "Submittal for Engineer's Review and Approval," to the Engineer, for approval by the District Traffic Engineer or Signing Engineer. Include verification with the drawings that luminaires or lamps are listed on the Approved/Qualified Products List. After approval, the Engineer will distribute the drawings to the following:

- (1) Contractor,

- (2) Contractor's fabricator,
- (3) Engineer,
- (4) Signing Engineer, and
- (5) District Traffic Engineer

Do not install luminaires until approved by the District Traffic Engineer or Signing Engineer.

## **3811 LIGHT STANDARDS**

### **3811.1 SCOPE**

Design and provide light standards including poles, mast arms, and base anchorages.

### **3811.2 REQUIREMENTS**

#### **A General**

Provide a complete light standard and hardware required for a complete light standard installation as required by the contract and in accordance with AASHTO *Standard Specifications of Structural Supports for Highway Signs, Luminaires, and Traffic Signals*. Provide light standards designed with a service life of at least 20 years and capable of withstanding a wind velocity of 80 mph [130 km/h] with a 1.3 gust factor.

Provide breakaway light standards with certification from the manufacturer that the light standard meets the breakaway specifications as specified in the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*.

#### **B Light Standard**

Provide mast arm standards designed for a 75 lb [34 kg] luminaire with a projected area of 3.2 sq. ft [0.3 sq. m]. For twin mast arm standards, design each mast arm for a 75 lb [34 kg] luminaire with the projected area of 3.2 sq. ft [0.3 sq. m].

Provide truss arm type standards with a removable, rainproof, ornamental cap for the top of shaft and with a smooth opening in the shaft for cable entry into the mast arm. Provide mast arms fabricated from pipe or tubing, without intermediate splices or couplings, as shown on the plans. Ensure the mast arm to shaft bracket provides a watertight connection.

Unless the contract requires otherwise, provide transformer base type standards. Design and construct the base to provide internal space to accommodate a waterproof frame and a mount for transformers, fuses, and ballasts. Provide an access hole, with an opening of at least 100 sq in [0.06 sq. m] on one side of the base. Provide the access hole with a waterproof cover with positive closure. Place the access hole 180° from the mast arm unless otherwise required by the contract.

Finish exposed edges and corners of the light standard base assembly smooth and round the corners so no burrs remain.

Provide breakaway or non-breakaway light standards in accordance with the contract.

Provide each light standard with an electrical grounding lug or nut. Design and fabricate each light standard to provide electrical continuity to the grounding lug.

Design each standard to stand plumb with the design dead loads in place under a no-wind condition.

Provide light standards with at least the shell thicknesses and shaft diameters required by the contract or the design analysis for the following material types:

### **B.1 Coated Steel Standards**

Provide shafts and transformer bases fabricated from steel meeting the requirements of 3309, "High-Strength Low-Alloy Structural Steel." If the plans show a galvanized coating, the Engineer may approve the use of another weldable steel with a yield point of at least 40,000 psi [276 MPa] after fabrication. Fabricate shafts with only one longitudinal seam unless otherwise allowed.

Provide mast arms made of Schedule 40 pipe meeting the requirements of ASTM A 53, Grade A.

Paint or galvanize component parts of the standard, including hardware and fittings as required by the contract.

Clean, paint, and galvanize in accordance with 2471.3.L, "Coating," and 2478, "Organic Zinc-Rich Paint System."

### **B.2 Aluminum Alloy Standards**

Provide shafts fabricated from seamless 6063-T6 or 6061 T6 aluminum alloy tapered tubing. Provide mast arms fabricated from 6063-T6 or 6061-T6 seamless tubing.

Provide aluminum alloy standards with a factory installed vibration dampener and an aluminum wall thickness of 0.188 in [4.78 mm].

Provide transformer bases for breakaway designs fabricated from cast aluminum alloy 356-T6.

Provide stainless steel screws, nuts, bolts, washers, and other miscellaneous hardware, except for the anchor rod assemblies, meeting the requirements of 3391.2, "Fasteners, Requirements," for stainless steel fasteners.

Provide aluminum alloy standards with a nonspecular, natural or sand belted (satin) finish.

### **B.3 Stainless Steel Standards**

Provide shafts, mast arms, transformer bases, and base slip fitters fabricated from material meeting the requirements of ASTM A 240, UNS Designation S20103, or an approved equal, as required by the contract, with a yield strength of at least 50,000 psi [345 MPa]. Provide a slip fitter accommodating the luminaire fabricated from material meeting the requirements of ASTM A 511, Grade MT 304L, Grade MT 316L, or an approved equal, as required by the contract. The Engineer will reject light standards that do not meet these requirements.

Attach the transformer base to the shaft using a slip fitter at least 1½ times the length of the major shaft diameter. Accurately size the slip fitter. Rivet the stainless steel base to the transformer base. Design the light standard so the base to slip fitter circumferential weld and heat affected zone are visible after assembling the shaft and slip fitter.

The Engineer will approve the number and size of the base plate rivets before fabrication. Provide annealed and waxed Type 316 rivets or an approved equal.

Clean the complete standard with a cleaning agent that will not damage the original mill finish.

### **3811.3 SAMPLING AND TESTING**

Within 30 days after contract award, submit the following information to the Engineer as a basis for testing and acceptance:

- (1) Material specifications with chemical compositions and mechanical properties for lighting standard and anchorage assembly components,
- (2) Dimensioned drawings of the standard and component details,
- (3) Manufacturing and assembly data for the standard and the components,
- (4) Data supporting the breakaway design features of the standard,
- (5) Anchor bolt test specimen that are representative of the designs,

- (6) Structural design computations for the lighting standard and components, including design criteria, allowable stresses, fatigue stresses, loading, and designed unit stresses, and
- (7) A certification from a registered professional engineer competent in structural design certifying the structural adequacy of the proposed lighting standard.

If the Department previously approved the manufacturer's design and if the manufacturer certifies, in writing that the material, design, structural analysis, manufacturing procedure, and workmanship are the same as previous standards on the project, the Department will not require the data, computations, and certificates for items 3, 4, 6, and 7.

The Engineer will perform final inspection and acceptance at the project, including identification and documentation of the item, type, size, and manufacturer's marking, of the light standards. The Engineer will select random samples from the material delivered to the project or at the source before delivery.

Submit five complete sets of shop detail drawings of the light standards and anchor rods in accordance with 2471.3.B.1, "Shop Detail Drawings, General Requirements," and 2471.3.B.3, "Submittal for Engineer's Review and Approval," to the Engineer for approval by the District Traffic Engineer. Submit final reproducible drawings in accordance with 2471.3.B, "Shop Detail Drawings," for high mast lighting installations. After approval, the Engineer will distribute the drawings to the following:

- (1) Contractor,
- (2) Contractor's fabricator,
- (3) Engineer,
- (4) Traffic Electrical Systems Engineer, and
- (5) District Traffic Engineer

Obtain the Engineer's approval before installing light standards.

## **3812 PHOTOELECTRIC CONTROL**

### **3812.1 SCOPE**

Provide photoelectric control devices for turning on and off roadway luminaires, sign lights, or dimming flasher beacons.

### **3812.2 REQUIREMENTS**

Use photoelectric controls listed on the Approved/Qualified Products List under "Lighting."

### **3812.3 SAMPLING AND TESTING**

The Engineer may perform final inspection and acceptance of the photoelectric control devices on the project. Final inspection includes documentation identifying the item, type, size, and manufacturer's marking, and documentation verifying photoelectric control devices are listed on the Approved/Qualified Products List under "Lighting."

Submit five complete sets of shop detail drawings of the photoelectric control devices to the Engineer for approval by the District Traffic Engineer in accordance with 2471.3.B.1, "Shop Detail Drawings, General Requirements," and 2471.3.B.3, "Submittal for Engineer's Review and Approval." After approval, the Engineer will distribute the drawings to the following:

- (1) Contractor,
- (2) Contractor's Fabricator,
- (3) Engineer,
- (4) Traffic Electrical Systems Engineer, and
- (5) District Traffic Engineer

Do not install photoelectric control devices until approved by the District Traffic Engineer.

## **3814 EMERGENCY VEHICLE PRE-EMPTION (EVP) EQUIPMENT**

### **3814.1 SCOPE**

Provide Emergency Vehicle Preemption (EVP) equipment for traffic control signal systems.

### **3814.2 REQUIREMENTS**

Use EVP systems and confirmatory indicator lights mounted on traffic signal mast arms and traffic signal pedestals as required by the contract. Use mounting hardware and attach to mast arms and pedestals in accordance with the contract and as approved by the Engineer.



## **A EVP Detectors**

Use EVP systems listed on the Approved/Qualified Products List under “Signals.”

Deliver EVP phase selectors to the Department’s Central Electrical Services Unit at least 30 working days before the traffic signal cabinet is required on the project. The Department’s Central Electrical Services Unit will approve and install the EVP phase selectors into the Department-provided traffic signal cabinet.

## **B EVP Confirmatory Indicator Lights**

Use 75 W, halogen, PAR 38 white flood type lamps for EVP confirmatory indicator lights mounted within an outdoor-type flood lamp housing. Verify that the solid white indication is visible from at least 500 ft [150 m].

## **C EVP Round Outlet Box**

Use an EVP round outlet box for wire splicing with the following characteristics:

- (1) Nominal 4 in [100 mm] diameter by 1½ in [38 mm] deep;
- (2) Cast aluminum;
- (3) NRTL listed, for use in wet locations;
- (4) Threaded openings at the top, bottom, and two sides, with threaded caps, to support ¾ in [20 mm] conduit;
- (5) One threaded opening with threaded cap to support a ¾ in [20 mm] conduit on the back of outlet box;
- (6) Galvanized or zinc-plated screw-on cover for wet locations with weather seal; and
- (7) Threaded nipples with locking washers sized to fit the round outlet box for attached appurtenances.

## **D EVP Condulet Outlet Body**

Use an EVP condulet outlet body for mounting the EVP detector unit to the EVP round outlet box with the following characteristics:

- (1) 90° up from horizontal,
- (2) Screw-on cover with weather tight seal,
- (3) Male threaded end and female threaded end,
- (4) NRTL listed, and
- (5) For use in wet locations.

## **E EVP Confirmatory Indicator Lamp Holder**

Use EVP confirmatory indicator lamp holders listed on the Approved/Qualified Products List under “Signals.”

### **3814.3 SAMPLING AND TESTING**

Confirm and document the listing of the EVP systems and the EVP confirmatory indicator lamp holders in the Approved/Qualified Products List under "Signals." Provide this documentation to the Engineer. Obtain the Engineer's approval of the EVP round outlet box or the EVP conduit outlet body before installation.

## **3815 ELECTRICAL CABLES AND CONDUCTORS**

### **3815.1 SCOPE**

Provide electrical cables and individual conductors for use in traffic control signal systems, roadway lighting systems, traffic management systems, sign control systems, automatic traffic recorder systems, and other electrical systems.

### **3815.2 REQUIREMENTS**

#### **A General**

Provide electrical cables and conductors meeting the following requirements, unless otherwise required by the contract:

- (1) Signal control cable listed by a NRTL as defined by the U.S. Department of Labor and tested in a laboratory listed by OSHA in its scope of recognition for the tests specified in this section. The Department will not require NRTL listing of Loop Detector Lead-in cable and EVP cable.
- (2) Single stranded copper, 600 V electrical conductors meeting the requirements of ANSI and NEC.
- (3) Electrical cable meeting the requirements of ANSI, NEC, ASTM, and ICEA/NEMA Standards Publications.
- (4) Wire sizes for electrical conductors based on the American Wire Gauge (AWG).
- (5) Electrical cables, except loop detector lead-in cables – IMSA 50-2 and 3/C # 20 EVP Cable, with the following information ink printed on the jacket:
  - (5.1) Manufacturer name,
  - (5.2) Year of manufacture (date code),
  - (5.3) Type of wire or cable,
  - (5.4) Size and number of conductors,
  - (5.5) Voltage rating,
  - (5.6) Conductor insulation rating,
  - (5.7) NRTL certification mark indicating that the cable is listed, and

(5.8) Labeled as sunlight resistant (Sun Res), direct burial (Dir Bur) and oil resistant 1 (Oil Res 1).

Provide signal control cable with the following additional markings:

- (1) Traffic signal cable,
- (2) Foot markers, and
- (3) -31 °F [-35 °C] cold bend.

Provide loop detector lead-in cable – IMSA – 50-2 meeting IMSA marking requirements.

Provide EVP detector cable (3/C #20) surface marked in accordance with NEC and with the following additional markings:

- (1) Labeled as sunlight resistant (Sun Res),
- (2) Labeled as direct burial (Dir Bur),
- (3) Year of manufacture (date code),
- (4) Conductor insulation rating, and
- (5) Foot markers.

Repeat cable markings at intervals no greater than 24 in [609 mm] on the jacket surface.

## **B Individual Electrical Conductors**

### **B.1 Power Conductors**

Provide Type THW, Type THWN, or Type XHHW insulation power conductors as required by the contract.

### **B.2 Roadway Loop Detector Conductors**

Provide roadway loop detector conductors in rigid polyvinyl chloride (PVC) conduit meeting the following requirements:

- (1) No. 14,
- (2) Stranded copper,
- (3) Insulated with Type XLPE, or Type XHHW insulation in accordance with UL 44, and
- (4) Marked with “XLPE,” “XLP,” or “XHHW” on the conductor.

Provide conductors for roadway embedded saw-cut loop detectors meeting the following requirements:

- (1) No. 14,
- (2) Stranded copper,

- (3) Insulated with filled chemically XLPE, or XHHW insulation in accordance with UL 44, and
- (4) Contained in a black polyethylene tubing with a nominal outside diameter of 0.250 in [6.35 mm] and a nominal wall thickness of 40 mils [1 mm], and
- (5) Marked with "XLPE," "XLP," or "XHHW" on the conductor.

### **B.3 Bridge Deck Loop Detector Conductors**

Provide conductors for bridge deck embedded saw-cut loop detectors meeting the following requirements:

- (1) No. 16,
- (2) Stranded nickel or silver plated copper conductors, and
- (3) Insulated with at least 0.010 in [0.25 mm] extruded Teflon meeting the requirements of MIL-W-16878D (Type E).

### **B.4 (Blank)**

### **B.5 Grounding Conductors**

Provide equipment grounding conductors or grounding electrode conductors installed as individual conductors in conduit meeting the following requirements:

- (1) Type THW, Type THWN, or Type XHHW,
- (2) Green-colored insulated wire,
- (3) No. 6,
- (4) Stranded (7 strands, Class B Stranding), and
- (5) Meeting the requirements of ASTM B 8 for stranded wires.

For equipment grounding conductors or grounding electrode conductors not installed in conduit, provide equipment meeting the following requirements:

- (1) Bare,
- (2) Uninsulated solid copper wire,
- (3) No. 6, and
- (4) Meeting the requirements of ASTM B 3, "Soft Annealed Copper."

## **C Electrical Cables**

### **C.1 Direct Buried Lighting Cable**

Provide shielded underground cable meeting the following requirements or characteristics:

- (1) Listed by a NRTL as defined by the U.S. Department of Labor and tested in a testing laboratory listed by OSHA in its scope of recognition for the tests

specified in this section. Provide shielded cable tested by an NRTL and meeting the requirements of UL 44 and UL 1277,

- (2) Four conductors No. 4 AWG,
- (3) Class C (19 Strand) soft drawn, bare copper wire conductors meeting the requirements of ASTM B 3 and ASTM B 8,
- (4) Suitable for use in cable trays, aerial, or direct buried installations,
- (5) Rated for 600 volts,
- (6) Heat resistant,
- (7) Moisture resistant,
- (8) Sunlight resistant,
- (9) Insulation acceptable for use in wet and dry locations at 194 °F [90 °C],
- (10) Insulated conductors with chemically XLPE insulation,
- (11) Individual conductors constructed with circuit identification in accordance with Method 1 of ICEA S-73-532 (NEMA WC-57) Table E-1 (Black, White, Red and Green),
- (12) Single thickness copper tape shielding meeting the requirements of ASTM B 152 with a thickness of at least 0.01 in [254 µm] and a spiral overlap of at least 0.25 in [6.35 mm] wrapped around the binder tape and under the outer jacket,
- (13) PVC outer jacket with an average thickness at least 80 mils [2.03 mm] and a thickness at any point at least 64 mils [1.62 mm],
- (14) Constructed using a tape binder,
- (15) Containing non-hygroscopic fillers used in the interstices of the cable where necessary to give the completed cable assembly a circular cross-section. Do not use fillers made of jute or paper.
- (16) Shall have a rip cord between the copper tape shield and the outer jacket
- (17) Containing an outer cable jacket having a substantially circular cross-section as specified in ANSI/ICEA S-73-532 NEMA WC 57 and not convoluted or having a ropey appearance,
- (18) Outer jacket surface ink printed with the following information:
  - (18.1) Manufacturer name,
  - (18.2) Year of manufacture (date code),
  - (18.3) Type of cable,
  - (18.4) Size and number of conductors,
  - (18.5) Voltage rating,
  - (18.6) Conductor insulation rating,
  - (18.7) Labeled NRTL listed,
  - (18.8) Labeled as sunlight resistant (Sun Res) and direct burial (Dir Bur), and
  - (18.9) Foot markers.

## C.2 Overhead Light Cable

Provide quadplex cables for the overhead distribution circuits of electrical systems meeting the following requirements:

- (1) Thermoplastic-insulated 4 conductor No. 4,
- (2) Self supporting aluminum cable, and
- (3) The fourth conductor that is an ACSR (aluminum conductor, steel reinforced) equipment ground messenger in accordance with the ICEA/NEMA Specification for "Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy" (ICEA publication No. S-95-658, NEMA publication No. WC70).

## C.3 Signal Control Cable

Provide signal control cable listed by an NRTL as defined by the U.S. Department of Labor and tested in a testing laboratory listed by OSHA in its scope of recognition for tests specified by this section.

Provide cables tested by an NRTL and meeting the following requirements:

- (1) UL 44,
- (2) UL 1277,
- (3) UL 1685,
- (4) ICEA T-29-520,
- (5) ICEA T-30-520,
- (6) ICEA S-73-532 (NEMA WC 57),
- (7) Suitable for use at 194 °F [90 °C] in wet or dry locations,
- (8) Suitable for direct burial,
- (9) Sunlight resistant,
- (10) Rated for 600 Volts,
- (11) Rated as a Tray Cable,
- (12) XHHW-2 cable designation,
- (13) No. 14 AWG,
- (14) Class B (7 strand) soft drawn, bare or tinned copper meeting the requirements of ASTM B 3, ASTM B 8, and ASTM B 33,
- (15) Constructed with circuit identification meeting the requirements of Method 1 of ICEA S-73-532 (NEMA WC-57) Table E-1, except as modified below:
  - (15.1) 3 Conductor:
    - (15.1.1) Black,
    - (15.1.2) White, and
    - (15.1.3) Green
  - (15.2) 4 Conductor

- (15.2.1) Black,
- (15.2.2) White,
- (15.2.3) Red, and
- (15.2.4) Black/red stripe
- (15.3) 6 Conductor:
  - (15.3.1) Black,
  - (15.3.2) White,
  - (15.3.3) Red,
  - (15.3.4) Black/red stripe,
  - (15.3.5) Orange, and
  - (15.3.6) Blue
- (15.4) 12 Conductor:
  - (15.4.1) Black,
  - (15.4.2) White,
  - (15.4.3) Red,
  - (15.4.4) Black/red stripe,
  - (15.4.5) Orange,
  - (15.4.6) Blue,
  - (15.4.7) White/Black stripe,
  - (15.4.8) Red/Black stripe,
  - (15.4.9) White/Red stripe,
  - (15.4.10) Orange/Black stripe,
  - (15.4.11) Blue/Black stripe, and
  - (15.4.12) Black/White stripe.
- (16) Average insulation thickness of at least 30 mil [0.76 mm],
- (17) Constructed using a tape binder,
- (18) Cable jacket having a substantially circular cross-section as specified in ANSI/ICEA S-73-532 NEMA WC 57, with an outer cable jacket not convoluted or having a ropy appearance,
- (19) Non-hygroscopic fillers used in the interstices of the cables where necessary to give the completed cable assembly a circular cross-section,
- (20) Fillers not made of jute or paper,
- (21) Rip cord between the outer jacket and the tape binder,
- (22) May be bare copper or tinned wires,
- (23) Outer jacket of the 4 conductor cable having a diameter no greater than 0.480 in [12.19 mm]. Outer jacket of the 6 conductor cable having a diameter no greater than 0.560 in [14.22 mm],
- (24) Carries an oil resistance level 1,
- (25) Meets a -31 °F [-35 °C] cold bend test,
- (26) Cables with a PVC jacket with a low migration grade of PVC,

- (27) Cable jacket passes the 7 day [168 h] oven age test at 249.8 °F [121 °C] meeting the requirements of UL 1581, and
- (28) Cable carries multiple ratings. If the requirements of different ratings conflict, ensure the cable meets the most stringent specification.

Submit to the Department the NRTL test qualification report, provided by the manufacturer, stating that the submitted cable meets the requirements of this section. The Department will not allow substitutions after the acceptance of a cable, unless otherwise approved by the Department in writing.

#### **C.4 Loop Detector Lead-in Cable**

Provide 14 AWG conductor loop detector lead-in cable meeting the requirements of International Municipal Signal Association, Inc. Specification No.50-2- Polyethylene insulated, Polyethylene Jacketed Loop Detector Lead-in Cable for use in traffic control signal systems and traffic management systems.

#### **C.5 Emergency Vehicle Pre-emption (EVP) Detector Cable**

Provide EVP detector cable for conduit and mast arm pull, direct burial, and exposed overhead installation in traffic control signal systems meeting the following requirements:

- (1) Consisting of twisted three-conductor shielded cable with ground drain wire,
- (2) Suitable for use at 167 °F [75 °C] in wet or dry locations,
- (3) Suitable for direct burial,
- (4) Sunlight resistant,
- (5) Rated for 600 Volts,
- (6) 3/C No. 20 (7x28) stranded, individually tinned copper, color coded yellow, blue, orange conductors,
- (7) No. 20 (7x28) stranded, individually tinned copper ground drain wire,
- (8) Aluminized polyester shield with at least 0.170 in [6.35 mm] overlap,
- (9) Black PVC jacket with a 0.04 in [1 mm] nominal wall thickness,
- (10) Cable outside diameter, nominal 0.3 in [7.62 mm],
- (11) Drain and conductor DC resistance no greater than 11.0 Ω per 1,000 ft [36 Ω per kilometer],
- (12) Capacitance from one conductor to other two conductors and shield no greater than 48 pF per foot [157.5 pF per meter], and
- (13) Cable marked with the following:
  - (13.1) Manufacturer name,
  - (13.2) Year of manufacture (date code),
  - (13.3) Type of cable,
  - (13.4) Size and number of conductors,
  - (13.5) Voltage rating,



- (13.6) Conductor Insulation rating,
- (13.7) Sunlight resistant (Sun Res) and direct burial (Dir Bur), and
- (13.8) Foot markers.

## **C.6 Telephone Cables**

Provide voice grade telephone cable for indoor installation, outdoor installation in conduit, outdoor direct buried installation, and telephone drop wire.

### **C.6.a Indoor Installation**

Provide telephone cable installed indoors in conduit or cable trays utilizing No. 22 conductors and meeting the requirements of ANSI/ICEA S-80-576.

### **C.6.b Outdoor Conduit or Direct Buried Installation**

Provide telephone cable for direct buried installation or installation in conduit meeting the following requirements:

- (1) Gopher resistant,
- (2) Grease-filled,
- (3) Using No. 19 conductors, and
- (4) Meets the requirements of RUS 7 CFR 1755.390, "RUS Specification for Filled Telephone Cables" and "REA Specification for Filled Telephone Cables" (PE-39), except do not use plastic-coated aluminum-shielded cable with plastic-coated steel-armor (CACSP).

Provide one of the following for cable shielding:

- (1) 10 mil [0.25 mm] copper,
- (2) 5 mil [0.13 mm] or 6 mil [0.15 mm] copper-clad stainless steel,
- (3) 5 mil [0.13 mm] copper-clad alloy steel, or
- (4) 6 mil [0.15 mm] or 7 mil [0.17 mm] alloy 194.

Provide cable jacket labeled as meeting the requirements of RUS 1755.390.

### **C.6.c Telephone Drop Wire**

Provide telephone drop wire from the traffic signal cabinet or other type cabinet to the point of connection with the servicing telephone company conductors meeting the following requirements:

- (1) Two-conductor parallel-type drop wire for use on telephone systems,
- (2) Meeting the requirements of RUS Bulletin 1753F-204(PE7), "RUS Specification for Aerial Service Wires," and
- (3) Approved by the local telephone company.

**C.7 (Blank)**

**C.8 (Blank)**

**C.9 (Blank)**

**C.10 (Blank)**

**C.11 (Blank)**

**C.12 (Blank)**

**C.13 Fiber Optic Cables**

Provide fiber optic cable listed on the Approved/Qualified Products List under Traffic Management Systems/ITS.

**C.13.a Armored Pigtail**

Provide armored fiber optic pigtail cables listed on the Approved/Qualified Products List under Traffic Management Systems/ITS.

**C.14 Microwave and Sonic Detector Cable**

Provide microwave and sonic detector cable and conductors meeting the following requirements:

- (1) Listed and tested by an NRTL as defined by the U.S. Department of Labor in a testing laboratory listed by OSHA in its scope of recognition for tests specified by this section and meeting the following requirements:
  - (1.1) UL44,
  - (1.2) UL1277, and
  - (1.3) UL 1685.
- (2) Suitable for use at 194 °F [90 °C] in wet or dry locations,
- (3) Sunlight resistant (Sun Res),
- (4) Rated for 600 Volts,
- (5) Rated as tray cable,
- (6) Labeled and rated as oil resistant (Oil Res 1),
- (7) Labeled and rated for direct burial (Dir Bur),
- (8) Cable designation of TC, PLTC, ITC, CL3,
- (9) No. 18 AWG conductors,
- (10) Tinned conductors,
- (11) Class B (7X26 strand) soft drawn, tinned copper meeting the requirements of ASTM B 3, ASTM B 8, and ASTM B 33,
- (12) XLPE conductor insulation,

- (13) Individual conductors constructed with circuit identification meeting the requirements of Method 1 of ICEA S-73-532 (NEMA WC-57) Table E-1 (Black, White, Red and Green),
- (14) Non-hygroscopic fillers if used,
- (15) Do not use fillers made of jute or paper,
- (16) Aluminum/mylar tape shield with an overlap of at least 0.250 in [6.35 mm],
- (17) 18 AWG, 7 strand tinned copper drain wire,
- (18) Drain wire installed on the outside of the aluminum/mylar tape shield (drain out),
- (19) Water blocking barrier tape to allow the cable to be used in underground ducts,
- (20) Jacket constructed of polyvinylchloride meeting the requirements of UL 1277,
- (21) Black jacket,
- (22) Cable jacket having a substantially circular cross-section as specified in ANSI/ICEA S-73-532 NEMA WC 57, with the outer cable jacket not convoluted and not having a ropey appearance,
- (23) Cable markings on the jacket surface ink printed with the following information:
  - (23.1) Manufacturer name,
  - (23.2) Year of manufacture (date code),
  - (23.3) Type of wire or cable,
  - (23.4) Size and number of conductors,
  - (23.5) Voltage rating,
  - (23.6) Conductor insulation rating,
  - (23.7) NRTL Certification Mark indicating the cable is listed,
  - (23.8) Labeled as sunlight resistant (Sun Res), oil resistant (Oil Res 1), direct buried (Dir Bur), and
  - (23.9) Foot markers.

Repeat cable markings at intervals no greater than 24 in [610 mm] on the jacket surface.

### **3815.3 SAMPLING AND TESTING**

The Department reserves the right to sample, test, inspect, and accept or reject all electrical conductors and cables specified in this section.

The Department may require certified test reports covering the physical and electrical properties of the signal control cable in addition to the requirements listed in the specification.

## **3831 MAST ARM POLE STANDARDS AND LUMINAIRES**

### **3831.1 SCOPE**

Provide mast arm pole standards for supporting mast arm mounted and pole mounted vehicle and pedestrian signal heads, and supporting luminaires, as part of a traffic signal system.

### **3831.2 REQUIREMENTS**

#### **A General**

Use mast arm pole standards of the type required by the contract including the following:

- (1) Transformer base,
- (2) Vertical pole shaft,
- (3) Traffic signal mast arm, and
- (4) Luminaire vertical pole shaft extension with a luminaire mast arm and luminaire, if required by the contract.

Use mast arm pole standards designed and constructed in accordance with the *AASHTO Standard Specifications for Structural Support for Highway Signs, Luminaires and Traffic Signals*.

#### **B Transformer Base**

Use square transformer-type bases with an access hole that provides an opening, as required by the contract, on one side of the base. Provide a cover for the access hole with a positive closure and locking mechanism that is an integral part of the door.

#### **C Mast Arm**

Use a  $\frac{3}{4}$  in [19 mm] half-coupling and plug on the top side of the traffic signal mast arm at the location required by the contract.

Attach the traffic signal mast arm to the vertical pole shaft using high-strength galvanized bolts and nuts.

If required by the contract, provide swing-away hinges with the traffic signal mast arm. Obtain the Engineer's approval before installation. Install the swing-away hinges so the traffic signal mast arm swings away from the intersection.

### **C.1 Mast Arm Signal Mounts**

Mount vehicle signal heads on the extended end of traffic signal mast arms using high-strength cast aluminum angle or straight plumbizer mounts.

If required by the contract, mount vehicle signal heads mid-arm on traffic signal mast arms using straight plumbizer mounts as specified in this section.

Mount vehicle signal heads on the end of the mast arm using angle mounts as specified in this section.

### **C.2 Two-way Mast Arm Signal Mounts**

Mount two-way vehicle signal heads on the extended end of traffic signal mast arms as required by the contract, using high-strength cast aluminum, two-way plumbizer mounts.

### **C.3 Access opening with Covers on Mast Arm Pole Standards**

To ensure a moisture-free seal between access openings and covers, use a clear, 100 percent silicone sealant to seal the 3 in × 5 in [76 mm × 127 mm] access opening covers on the mast arm pole standard.

## **D Luminaires on Mast Arm Pole Standards**

Provide luminaires atop mast arm pole standards if required by the contract.

### **D.1 Mast Arm and Pole Extension**

Provide mast arm and pole extension for luminaires atop mast arm pole standards as required by the contract. Use a slip fitter with a nominal diameter of 2 in [50 mm] on the extended end of the luminaire mast arm.

### **D.2 Luminaires**

Use luminaires listed on the Approved/Qualified Products List under "Lighting."

Mark the month and year of installation inside the luminaire housing using a black oil-based paint marker.

Etch or use a black oil based paint marker to mark the month and year of installation on the lamp socket base.

Include a photoelectric control mounting receptacle and photoelectric control with the luminaire, if required by the contract. Use photoelectric control mounting receptacles and photoelectric controls (photo cells) listed on the Approved/Qualified List under "Lighting."

### **D.3 Luminaire Wiring**

Wire luminaires continuously, without splices, from the source of power to the luminaire as required by the contract.

Provide and install a wire holder that supports the luminaire cable within the end of the luminaire slipfitter near the connection point of the luminaire. Use wire holders listed on the Approved/Qualified Products List under "Signals."

### **3831.3 SAMPLING AND TESTING**

Submit six complete sets of shop detail drawings of the mast arm pole standard, anchor rods, luminaires, and photoelectric control in accordance with 2471.3.B.1, "Shop Detail Drawings, General Requirements," and 2471.3.B.3, "Submittal for Engineer's Review and Approval," to the Engineer for approval. After approval, the Engineer will distribute the drawings to the following:

- (1) Contractor,
- (2) Contractor's Fabricator,
- (3) Engineer,
- (4) Traffic Electrical Systems Engineer, and
- (5) Spare or District Traffic Engineer.

## **3832 TRAFFIC SIGNAL PEDESTAL**

### **3832.1 SCOPE**

Provide 4 inch [100 mm] trade size diameter traffic signal pedestals that support vehicle signal faces, pedestrian signal faces, and warning flashers.

### **3832.2 REQUIREMENTS**

#### **A General**

Submit shop drawings of the pedestal to the Engineer for approval, before procurement. Provide traffic signal pedestals with a shaft and a base.

Provide traffic signal pedestals meeting the applicable requirements for structural supports specified in the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*.

## **B Pedestal Shaft**

### **B.1 Steel Pedestal Shafts**

Provide steel pedestal shafts as required by the contract. Clean the inner and outer surfaces of pedestal shafts. Blast clean the outer surface. Paint the inner and outer surfaces of the pedestal shafts with two coats of prime paint in accordance with 3532, "Exterior Polyurethane Paint." Ensure a total dried primer thickness of 3 mil [76 µm]. Finish paint the outside of the shaft with two coats of yellow paint in accordance with 3532, "Exterior Polyurethane Paint," unless otherwise required by the contract. Ensure a total thickness of the dried primer and finish coats at least 5½ mil [140 µm]. Do not install shafts with scratches or other damages to the paint.

Repair or replace pedestal bases scratched or damaged during installation as approved by the Engineer.

### **B.2 Aluminum Pedestal Shafts**

Provide aluminum pedestal shafts meeting the following requirements;

- (1) Made of anodized aluminum meeting the requirements of MIL-A-8625 for Type II, Class I coating, Schedule 80, 4 in [100 mm] nominal trade size;
- (2) Provided in the length required by the contract;
- (3) Made from 6061T6 aluminum alloy;
- (4) Weighing 5.18 lb per ft [7.69 kg per m] of shaft, with a shaft wall 0.337 in [8.6 mm] thick;
- (5) Threaded to meet the requirements of ANSIB2.1; and
- (6) Spun finished.

## **C Pedestal Base**

Provide pedestal square transformer bases meeting the following requirements:

- (1) Upper end threaded to receive a nominal 4 in [100 mm] pipe shaft,
- (2) Made from cast aluminum,
- (3) Meeting or exceeding the current edition of the AASHTO breakaway requirements, and
- (4) Anodized with an aluminum finish meeting the requirements of MIL-A-8625 for Type II, Class I coating.

### **C.1 Access Door**

Provide an access door with a locking mechanism on the inside top and a fixed catch on the inside bottom. Include a ¼ in × 1½ in [6.4 mm × 40 mm] diameter stainless steel hex-head threaded bolt that screws through the door into a pre-threaded aperture and is part of the molded body of the pedestal door with the locking

mechanism. Provide a pedestal base with an anodized aluminum finish meeting the requirements of MIL-A-8625 for Type II, Class I coating.

### **C.2 Ground Connector**

Mount one NRTL listed ground wire connector with a single bolt on each adjacent sidewall to the access door, 3 in [76.2 mm] in from the door and 8 in above the base bottom of each sidewall.

Use a crosslot head screw to secure the ground wire to the connector. Ensure the connector accommodates a No. 6 stranded copper wire. Install the connectors with the connector down. Ensure every device in the pedestal base is constructed from compatible materials.

### **C.3 Anchor Rods**

Provide anchor rods in the size specified on Mn/DOT Standard Plate 8112. Provide anchor rods, nuts, and washers in accordance with 3385.2.A, "Type A – Carbon Steel Anchor Rods," unless otherwise required by the contract.

Provide pedestal washers meeting the following requirements, unless otherwise required by the contract:

- (1) Round-formed, at least Grade 5, hardened steel washers as specified in 3391.2.B, "High Strength Structural Steel Bolts,"
- (2) Galvanized by the hot-dip process or by the mechanical process as specified in 3392, "Galvanized Hardware," and
- (3) Dimensions in accordance with Mn/DOT Standard Plate 8112.

### **C.4 Reinforcing Collars**

Provide reinforcing pedestal reinforcing collars, wind collars, listed on the Approved/Qualified Products List for Signals.

### **C.5 Painted Pedestal Base**

Shop paint pedestal bases on the inner and outer surfaces with two coats of prime paint meeting the requirements specified in 3532, "Exterior Polyurethane Paint," if required by the contract. Ensure the dried primer is 3 mil [76 µm] thick. Finish paint the outer surface with two coats of green paint meeting the requirements of 3532, "Exterior Polyurethane Paint," or the equivalent manufacture's shop coat paint as specified in 2565.3.T, "Painting." Ensure the combined thickness of the primer and finish coats is 5½ mil [140 µm].

Repair or replace pedestal bases scratched or damaged during installation as approved by the Engineer.



### **C.6 Pedestal Base Access Door**

Provide aluminum pedestal access doors in accordance with Mn/DOT Standard Plate 8122 and with an anodic coating meeting the requirements of MIL-A-8625 for Type II, Class I Coating.

### **C7 Pedestal Cap**

Provide aluminum pedestal caps listed on the Approved/Qualified Products List under "Signals" and with an anodic coating meeting the requirements of MIL-A-8625 for Type II, Class I Coating.

Provide pedestal caps for each pedestal shaft if using straight mount plumbizers for signal and pedestrian head mounting.

### **C.8 Pedestal Slipfitter Collar**

Provide pedestal slipfitter collars manufactured as specified in Mn/DOT Standard Plate No. 8111 and with an anodic coating meeting the requirements of MIL-A-8526 for Type II, Class I Coating.

## **3832.3 SAMPLING AND TESTING**

The Engineer will inspect and approve the pedestal shafts and pedestal bases before installation.

Provide test reports from an FHWA-approved independent laboratory certifying the tests made on pedestal bases showing results that meet AASHTO breakaway requirements.

Submit a certification from the FHWA, provided by the manufacturer, stating FHWA acceptance and approval of tests made on pedestal bases.

## **3833 ACCESSIBLE PEDESTRIAN SIGNAL (APS)**

### **3833.1 SCOPE**

Provide touch-activated Accessible Pedestrian Signals (APS) with information signs to detect and instruct pedestrians as part of a traffic control signal system.

### **3833.2 REQUIREMENTS**

Use APS listed on the Approved/Qualified List under "Signals." Locate and mount APS and information signs on vertical mast arm pole shafts, vertical light

standard shafts, traffic signal pedestal shafts, or similar equipment approved by the Engineer, or on separate mountings, as required by the contract.

### **3833.3 SAMPLING AND TESTING**

Confirm and document the listing of the APS on the Approved/Qualified Products List under "Signals." Provide this documentation to the Engineer. Obtain the Engineer's approval of the APS before installation.

## **3834 VEHICLE SIGNAL FACES**

### **3834.1 SCOPE**

Provide standard traffic signal faces to control vehicle movements as part of a traffic control signal system or freeway ramp control signal.

### **3834.2 REQUIREMENTS**

#### **A Standard ITE Vehicle Signal Faces**

##### **A.1 General**

Use standard ITE black polycarbonate vehicle signal faces listed on the Approved/Qualified Products List under "Signals," unless otherwise required by the contract. Verify that the electrical and optical system of each vehicle signal indication is designed to operate on a nominal 120 VAC, single phase power supply.

Use adjustable-type vehicle signal faces capable of 360° rotation about a vertical axis.

Use vehicle signal faces made up of at least three separate vehicle signal indications. Ensure each vehicle signal indication consists of a housing, housing door, visor, optical unit, and wiring.

Use vehicle signal indications for traffic control signal systems of the nominal size as required by the contract.

Arrange vehicle signal indications in a vehicle signal face in accordance with Part IV, "Signals" of the MN MUTCD.

For each intersection, install standard ITE vehicle signal faces from the same manufacturer.

Install and mount each vehicle signal face at the location shown on the plans.

Always provide vehicle signal faces with provisions to attach a background shield, regardless of the contract requirement for background shields.

## **A.2 Visor**

Provide each vehicle signal indication of each vehicle signal face with a removable visor. Use visors meeting the following characteristics:

- (1) Made from black carbonate material,
- (2) Designed to fit tightly against the housing door to prevent filtration of light between the visor and the housing door,
- (3) At least 9½ in [240 mm] long for a nominal 12 in [300 mm] vehicle signal indication, and
- (4) At least 7 in [180 mm] long for a nominal 8 in [200 mm] vehicle signal indication.

Mount the visor with twist-on slots and stainless steel screws positioned for vertical or horizontal mounting of the vehicle signal face, and with a downward tilt of at least 3.5°.

For traffic control signal system indications, provide tunnel-type visors that enclose 80 percent of the lens circumference.

## **A.3 Light Emitting Diode (LED) Indications**

Use LED signal indications listed on the Approved/Qualified Products List for "Signals" and as required by the contract.

## **A.4 Background Shield**

Provide and attach background shields or backplates to vehicle signal faces unless otherwise required by the contract.

Use black polycarbonate background shields that extend at least 5 in [125 mm] on each side of the vehicle signal face and at least 4 in [100 mm] at the top and bottom.

Do not cut the bottom of a background shield attached to a vehicle signal face, mounted directly above a pedestrian signal face. For this case, install a length of pipe nipple, threaded on both ends above the pedestrian signal face to allow the separate rotation of the vehicle signal face and the pedestrian signal face.

Provide background shields with a nonreflective black, dull finish. Attach background shields to vehicle signal faces so no background light shows between the shield and the vehicle signal face.

## **B Mounting Vehicle and Pedestrian Signal Faces**

Mount vehicle and pedestrian signal faces using straight, angle, or two-way plumbizer signal mounts. Provide signal head mounts and required appurtenances for mounting vehicle and pedestrian signal faces to mast arms, vertical pole shafts, and pedestal shafts in accordance with the contract requirements.

Use straight, angle, or two-way plumbizers listed on the Approved/Qualified Products List under "Signals."

Provide four and five-section signal faces and signal head mounting spacers at the point of mounting to the plumbizer.

Use signal head mounting spacers listed on the Approved/Qualified Products List under "Signals."

If the contract requires signal brackets and pipe fittings for mounting vehicle and pedestrian signal faces, provide signal brackets and pipe fittings in accordance with the following:

- (1) Use nominal 1½ in [40 mm] diameter standard anodized aluminum pipe signal bracket and pipe fitting for signal brackets and pipe fittings for mounting vehicle and pedestrian signal faces.
- (2) Provide signal brackets long enough to provide vehicle and pedestrian signal face alignment, to allow programming of optically programmed vehicle signal faces, or of a length directed by the Engineer.
- (3) Provide locknuts, nipples, locknipples, gaskets, washers, and other hardware used to fasten vehicle and pedestrian signal faces to signal bracketing and pipe fittings, fabricated of anodized aluminum and traffic signal industry standard signal hardware.
- (4) Mount signal brackets and pipe fittings plumb or level, symmetrically arranged, and securely assembled.
- (5) Construct signal brackets and pipe fittings to conceal traffic signal conductors, watertight, and free of sharp edges or protrusions to prevent damage to the traffic signal conductor insulation.

### **3834.3 SAMPLING AND TESTING**

Do not install the material specified in this section until approved by the Engineer.

## **3835 PEDESTRIAN SIGNAL FACES**

### **3835.1 SCOPE**

Provide pedestrian signal faces to direct pedestrian movements as part of a traffic control signal system.

### **3835.2 REQUIREMENTS**

#### **A General**

Use standard ITE black polycarbonate pedestrian signal faces listed on the Approved/Qualified List under "Signals," unless otherwise required by the contract.

Provide LED modules for pedestrian indications and pedestrian signal indications with countdown timers listed on the Approved/Qualified Products List under "Signals."

#### **B Signal Brackets and Pipe Fittings.....3834.2.C**

### **3835.3 SAMPLING AND TESTING ..... 3833**

Submit four sets of manufacturer's drawings, warranty information, and the product invoice, to the Engineer for approval.

## **3837 ELECTRICAL SERVICE EQUIPMENT**

### **3837.1 SCOPE**

Provide electrical service equipment for controlling and distributing electrical power, providing over-current protection, and a means to cut-off power to items of electrical equipment as part of a traffic control signal system, roadway lighting system, automatic traffic recorder system, or other electrical system.

### **3837.2 REQUIREMENTS**

#### **A Service Equipment**

##### **A.1 General**

For electrical service for the traffic control signal system, roadway lighting system, automatic traffic recorder system, or other electrical system, provide and install the following, as required by the contract:

- (1) Meter socket,

- (2) Disconnecting means,
- (3) Ground rod,
- (4) Grounding and bonding materials,
- (5) Conduit,
- (6) Conduit fittings, and
- (7) Power conductors.

In addition, for installations on wood poles, provide and install the following, as required by the contract:

- (1) Conduit risers, and
- (2) Weather head.

For installations on wood poles, size the power conductors that run above the disconnecting means and through the meter socket to the weather head for the rating of the service disconnect. Ensure these power conductors meet the requirements of the power company and extend beyond the weather head for connection to the power conductors from the source of power.

Provide parts of the service equipment that use copper wire and have connections that are NRTL listed for use with copper wire. Refer to NEC article 100 for the definition of the term "Listed."

## **A.2 Meter Socket**

Use a commercial-type meter socket with the following characteristics:

- (1) Rated for 200 A, 480 V,
- (2) Containing a positive bypass mechanism,
- (3) Containing lugs that allow the power conductors to be stripped and laid into the lugs without cutting, and
- (4) Approved by the power company.

The power company will provide and install the meter.

## **A.3 Circuit Breaker Load Center**

Unless otherwise required by the contract, provide a disconnecting means meeting the following characteristics:

- (1) Three-wire,
- (2) Solid neutral,
- (3) 100 A, 120/240 VAC,
- (4) NEMA 3R rain-tight enclosure for outdoor use,
- (5) Circuit breaker load center, and
- (6) NRTL-listed for use as service equipment.

Use a load center with a front cover and inner dead front cover capable of easy removal for installation, maintenance, and wiring. Ensure the front cover is hinged at the top with a slip-hinge arrangement that allows the cover to be left in an open position, and a snap closure at the bottom.

Provide lugs for power conductor connections in the load center that are NRTL-listed for use with copper wire. Provide solder-less, set screw-type lugs, sized for the conductors assigned to each lug.

Provide the circuit breaker load center with an isolated, bondable neutral bar with the capacity to accept the number and size of neutral and grounding conductors required by the contract or the NEC. Ensure neutrals bond in accordance with NEC.

Unless otherwise required by the contract, provide and install circuit breakers in the load center as follows:

- (1) One 2-pole, 100 A main circuit breaker,
- (2) One 1-pole, 30 A circuit breaker for signal system, and
- (3) Two 1-pole, 15 A circuit breakers for roadway lighting.

Mark the 120/240 VAC circuit breakers with the "on" and "off" positions and with the load carried. Provide circuit breakers and load center enclosures from the same manufacturer.

#### **A.4 General Duty Safety Switch**

Use a general duty safety switch with an isolated, bondable neutral bar capable of accepting the numbers and sizes of neutral and grounding conductors required by the contract or the NEC. Ensure bonding of the neutral in accordance with NEC.

If required by the contract, provide a disconnecting means with the following characteristics:

- (1) Three-wire,
- (2) Fusible,
- (3) Two-pole,
- (4) Solid neutral,
- (5) Single throw,
- (6) 60 A, 120/240 VAC,
- (7) NEMA 3R rain-tight enclosure for outdoor use,
- (8) NRTL-listed for use as service equipment.

Ensure lugs contained in the safety switch are sized for the conductor material and size assigned to each lug. Provide the required fuses.

### **A.5 Heavy Duty Safety Switch**

Install a safety switch to turn off power to the sign lights. Provide a safety switch with the following characteristics:

- (1) A NEMA 3R rain tight enclosure for outdoor use made from sheet metal and zinc-coated with a gray finish,
- (2) 30 A, heavy-duty, single-throw, fusible with an insulated solid neutral,
- (3) Rated for 240 VAC for a 120/240 V sign lighting system and 600 VAC for a 240/480 V sign lighting system,
- (4) With two, 20 A cartridge type fuses, and
- (5) Three-wire, 2-pole for either switch. For the 600 VAC switch, the Contractor may use 4-wire, 3-pole.

Install the safety switch in a vertical upright position.

### **A.6 Enclosed Circuit Breaker**

If required by the contract, provide and install an enclosed circuit breaker where shown on the plans for cutting power to the electrical system or systems.

Mount the circuit breaker in a NEMA 3R rain-tight enclosure for outdoor use. Provide a circuit breaker with the following characteristics:

- (1) Two-pole,
- (2) 100 A, 120/240 VAC,
- (3) Thermo-magnetic breaker,
- (4) NRTL-listed for use as service equipment, and
- (5) Clearly marked with "on" and "off" positions and identified with the load it is carrying.

If lugs are necessary to connect the power conductor to the breaker, provide NRTL-listed, solder-less, set screw-type lugs for use with copper wire. Include provisions for a padlock on the rain-tight enclosure.

### **A.7 Signal Service Cabinet Type SSB**

Provide a signal service cabinet with the following characteristics:

- (1) A meter socket,
- (2) Main and branch circuit breakers,
- (3) A luminaire test switch,
- (4) Enclosed photoelectric controls, and
- (5) Provisions for a battery back-up system.

Use signal service cabinets listed on the Approved/Qualified Products List under "Signals."



Provide uninterrupted power supplies for signal service cabinets listed on the Approved/Qualified Products List under "Signals."

Use batteries for uninterrupted power supplies listed on the Approved/Qualified Products List under "Signals."

## **B Transformer and Circuit Breaker Assembly**

### **B.1 Transformer**

Provide an outdoor, general purpose, dry-type transformer meeting the following characteristics:

- (1) Primary — 480 V, two 5 percent taps below 480 V,
- (2) Secondary — 120/240 VAC,
- (3) Rating — 7.5 KVA, single phase, and
- (4) Size — 16 in [400 mm] high, 12 in [300 mm] wide, and 10½ in [270 mm] deep.

Provide transformers and related wiring compartments that are NRTL-listed for indoor-outdoor applications, and meeting the requirements of relevant NEMA and IEEE standards. Mount the transformer on the equipment pad as required by the contract and as approved by the Engineer.

### **B.2 Enclosed Circuit Breaker**

Protect the transformer with a circuit breaker mounted in a NEMA 3R rain-tight enclosure for outdoor use. Provide 2-pole, 20 A, 480 VAC, thermo-magnetic circuit breakers. If lugs are necessary for power conductor connections to the breaker, provide NRTL-listed solder-less, set screw-type lugs for use with copper wire. Include provisions for a padlock on the rain-tight enclosure. Mount the circuit breaker enclosure as required by the contract and as approved by the Engineer.

## **3837.3 SAMPLING AND TESTING**

Submit six sets of manufacturer's drawings and specifications for the proposed transformer and circuit breaker assembly to the Engineer for approval.

After approval, the Engineer will distribute the drawings to the following:

- (1) Contractor,
- (2) Contractor's fabricator,
- (3) Engineer,
- (4) Traffic Electrical Systems Engineer,
- (5) District Traffic Engineer, and
- (6) Traffic Signal Cabinet or other pad mount cabinet.

## **3838 ELECTRICAL JUNCTION BOXES**

### **3838.1 SCOPE**

Provide junction boxes as part of a traffic control signal system, freeway ramp control signals, automatic traffic recorder systems, roadway lighting systems, or other electrical systems for the following:

- (1) Accessing electrical wiring,
- (2) Facilitating installation of electrical wiring, and
- (3) Changing from field cable wiring to individual conductors.

### **3838.2 REQUIREMENTS**

#### **A Metal Junction Boxes Attached to a Bridge**

Use metal junction boxes attached to a bridge meeting the following characteristics:

- (1) NEMA Type 4 galvanized cast-iron metal,
- (2) Equipped with a cover made of the same material as the box, attached with stainless steel hex-head screws or bolts and nuts, and containing a gasket around the cover perimeter,
- (3) Equipped with four mounting lugs,
- (4) Meeting the minimum size requirements of the NEC, and
- (6) Bossed conduit entrances capable of accommodating the nominal outside diameter of the conduit shown on the plans and threaded to provide five full threads.

Attach junction boxes using two unit threaded bolt anchorages as required by the contract. If the contract does not specify the anchorages, use anchorages approved by the Engineer and with hardware to allow removal of the junction box.

#### **B Metal Junction Boxes on Wood Poles**

Provide and install metal junction boxes with terminal blocks on wood poles for the following:

- (1) Temporary traffic control signal systems;
- (2) Flashing beacon systems;
- (3) Advance warning flashers; or
- (4) Vehicle, pedestrian signal faces, or flashing signal indications.

Use metal junction boxes on wood poles meeting the following characteristics:

- (1) Meeting the requirements of NEC,
- (2) NEMA, Type 3R,
- (3) At least 12 in × 12 in × 6 in [300 mm × 300 mm × 150 mm] deep,
- (4) ¼ in [6 mm] drain hole on the bottom side,
- (5) Equipped with a cover with a gasket around the perimeter and attached with stainless steel screws, and
- (6) Equipped with terminal blocks meeting the requirements of 2565.3.J, "Wiring," for terminating field conductors and traffic signal conductors, attached to the back of the junction box so the terminal screws of the terminal block face the box opening, and covered with an electrical insulating coating after conductor terminations on the terminal block.

Provide and install liquid-tight flexible metal conduit and conduit fittings as shown on the plans, between the metal junction box and each type wood pole-mounted signal bracketing.

### **C Junction Boxes in Rigid PVC Conduit Runs Attached to a Bridge**

For junction boxes mounted to bridges, use PVC junction boxes with the following characteristics:

- (1) Equipped with a cover attached by stainless steel screws,
- (2) At least 6 in × 6 in × 6 in [150 mm × 150 mm × 150 mm] deep,
- (3) Attached to the bridge as approved by the Engineer, and
- (4) Meeting the requirements of NEC.

### **D (Blank)**

### **E Junction Boxes for Roadway Lighting Systems**

For roadway lighting systems, use NEMA Type 4 junction boxes meeting the following characteristics:

- (1) Hot-dip galvanized cast iron with interchangeable cover and side hub plates, brass cap screws, gaskets for cover and hub plates, for use with rigid steel conduit,
- (2) Inside dimensions of 8½ in × 8½ in × 4 in [216 mm × 216 mm × 100 mm] unless otherwise required by the contract, and
- (3) Equipped with four mounting lugs
- (4) Equipped with a cover made of the same material as the box, fastened with stainless steel hex-head screws or bolts and nuts, and containing a neoprene gasket around the cover perimeter.
- (5) Bossed conduit entrances that accommodate the nominal outside diameter of the conduit shown on the plans and threaded to provide five full threads.

Attach junction boxes to concrete using masonry anchorages or powder activated studs with the hardware necessary to allow removal of the junction box.

### **3838.3 SAMPLING AND TESTING**

Submit three sets of shop drawings of the proposed metal junction boxes and mounting details to the Engineer for approval.

## **3839 CONDUIT EXPANSION FITTINGS**

### **3839.1 SCOPE**

Provide conduit expansion fittings for conduit runs attached to bridges.

### **3839.2 REQUIREMENTS**

Refer to the NEC, article 100 for the definition of the term "Listed."

Provide expansion fittings with the following characteristics:

- (1) Weatherproof manufactured units that provide for conduit movement as required by the contract,
- (2) NRTL-listed, iron or steel, and protected by galvanizing or plating for use with RMC or IMC, and
- (3) NRTL-listed for rigid PVC conduit.

### **3839.3 SAMPLING AND TESTING**

Obtain the Engineer's approval before installing the expansion fittings.

## **3840 WOOD POLES**

### **3840.1 SCOPE**

Provide wood poles for traffic control signal systems, electric lighting systems, and mounting service equipment.

### **3840.2 REQUIREMENTS**

Provide wood poles meeting the following requirements:

- (1) ANSI 2051,

- (2) The length shown on the plans,
- (3) Class II, unless otherwise required by the contract,
- (4) The species specified by Table 3491-1, "Bored Hole Diameter Requirements,"
- (5) Treated with preservative in accordance with 3491, "Preservatives and Preservative Treatment of Timber Products." Do not use Creosote.

**3840.3 SAMPLING AND TESTING ..... 3491**

**3850 LIGHTING SERVICE CABINET**

**3850.1 SCOPE**

Provide electrical service cabinets for distributing electrical power, providing over current protection, and providing a means to cut off power to roadway lighting systems.

**3850.2 REQUIREMENTS**

**A General**

Use lighting service cabinets and sub assemblies listed and labeled by a National Recognized Testing Laboratory (NRTL) as defined by the U.S. Department of Labor.

Ensure the NRTL is listed by OSHA in its scope of recognition for the tests conducted in accordance with this section.

Provide lighting service cabinets meeting the following characteristics:

- (1) Complete and operational as required by the contract,
- (2) NEMA 3R rated for the enclosure,
- (3) Provides electrical service for roadway lighting,
- (4) Listed and labeled by the NRTL as in compliance with UL 508 and UL 508A,
- (5) Listed and labeled by the NRTL as suitable for use as service equipment, and
- (6) Listed and labeled by the NRTL as approved for outdoor use.

## **B Electrical Equipment and Wiring**

### **B.1 (Blank)**

### **B.2 Lighting Contactors**

Use lighting contactors listed on the Approved/Qualified Products List under "Lighting."

### **B.3 (Blank)**

### **B.4 (Blank)**

## **C Photoelectric Control**

Use photoelectric controls (photo cells) listed on the Approved/Qualified Products List under "Lighting."

## **D Type L1 and Type L2 Service Cabinet**

Use Type L1 and Type L2 service cabinets listed on the Approved/Qualified Products List under "Lighting."

## **E Type Rural Lighting and Flasher (RLF) Service Cabinet**

Use Type RLF service cabinets listed on the Approved/Qualified Products List under "Lighting."

### **F (Blank)**

## **G Type A Service Cabinet**

Use Type A service cabinets listed on the Approved/Qualified Products List under "Lighting."

## **H Type B Service Cabinet**

Use Type B service cabinets listed on the Approved/Qualified Products List under "Lighting."

## **3850.3 SAMPLING AND TESTING**

Submit to the Engineer, for approval by the Lighting Engineer, five complete sets of shop detail drawings of the lighting service cabinets and anchor rods, in accordance with 2471.3.B.1, "Shop Detail drawings, General Requirements," and 2471.3.B.3, "Submittal for Engineer's Review and Approval." After approval, the Engineer will distribute the drawings to the following:

- (1) Contractor,
- (2) Contractor's fabricator,

- (3) Engineer,
- (4) Traffic Electrical Systems Engineer, and
- (5) District Traffic Engineer.

## **3861 PLANT STOCK**

### **3861.1 SCOPE**

Provide species and varieties of trees, shrubs, vines, and perennials suitable for roadside landscape planting. The Department will use the term “plant” to describe trees, shrubs, vines, or perennials.

### **3861.2 REQUIREMENTS**

Unless otherwise specified as collected stock (wild or grown in other than nursery conditions) or as Department-provided plants, provide plants grown in a nursery for at least 2 years and meeting the requirements of the current edition of the *Inspection and Contract Administration Manual for Mn/DOT Landscape Projects (ICAMMLP)* for grading and accepting plant stock. Provide a Certificate of Nursery Inspection from the Department of Agriculture of the state of plant origin in accordance with 2571.2.A.2, “Plant Stock and Materials Documentation.”

#### **A Classification of Plants**

The Department will classify trees, shrubs, vines, and perennials for landscaping purposes by species, variety, and size or age as required by the contract.

If the contract requires a dimensional size, provide plants with the minimum range of height, stem caliper, or spread acceptable, meeting the requirements of the current edition of the *ICAMMLP*.

#### **B Plant Names**

The Department will specify the botanical and common names of plant materials based on the requirements of *Hortus Third*.

#### **C Plant Hardiness**

Provide plant stock hardy to the Minnesota zone that includes the project and meeting the following requirements:

- (1) Documented as continuously grown for at least the last 2 years within the acceptable growing range limits as shown on the standard planting detail (A) in the plans, or

- (2) If grown outside the acceptable growing range limits, documented as having the seed source or root and graft stock originating from within the acceptable growing range limits as shown on the standard planting detail (A) in the plans.

The Engineer will resolve questions regarding plant stock hardiness or botanical identification.

#### **D (Blank)**

#### **E Quality and Condition**

Provide a Certificate of Nursery Inspection from the Department of Agriculture of the state of plant origin in accordance with 2571.2.A.2, "Plant Stock and Materials Documentation."

Provide plant species or variety shown on the plans, free of disease, disfiguring knots, sun scald, insect infestations, dead or broken branches, bark abrasions, and other unacceptable conditions as described in the current edition of *ICAMMLP*.

Provide plants that meet all applicable criteria for plant type, size, and age as listed in the current edition of the *ICAMMLP* for each plant shown on the plans.

Provide container grown plants with root systems capable of holding the soil intact after removal from the container. The Engineer will reject nursery grown plants with root systems not consistent with criteria listed in the current edition of the *ICAMMLP*.

The Engineer will reject plants delivered with broken or bruised branches, stems, or canes unless the Contractor prunes the damaged growth without affecting the size or symmetry. The Engineer will reject balled and burlapped plants delivered with broken or disturbed balls. Deliver and install bare root plants in a dormant condition unless otherwise approved by the Engineer. If installing plants that have broken dormancy as approved by the Engineer, the Department will withhold payment for the initial planting operations until the Engineer determines the plant acceptability after the first year of plant establishment.

Provide coniferous trees meeting the dimensional requirements in the current edition of the *ICAMMLP* and containing buds or new growth at the terminal ends of the branches. During the spring planting season, the Contractor may plant coniferous plants with new growth during storage in a holding bin. The Engineer will reject coniferous plants dug after producing new growth. The Engineer will reject coniferous trees not fully branched from bottom to top.



Provide pine trees with a terminal leader bud and terminal leaders no longer than 18 in [500 mm]. Train a new central leader in conifers delivered with multiple or missing leaders.

## **F Digging and Handling**

Dig and handle plants with reasonable care and skill to prevent damage to stems, roots, branches, and the trunk.

For balled and burlapped plants, preserve a firm ball of undisturbed soil around the root system. Provide balled and burlapped plants meeting the requirements of the current edition of the *ICAMMLP*.

Wrap and bound balled and burlapped plants to maintain an intact and solid soil ball during handling, shipment, and planting. Handle balled and burlapped plants by the soil ball and not by the branches or trunk. The Contractor may use wire baskets with balled and burlapped plants unless otherwise specified in 2571.3.F, "Installation of Plants."

## **G Packing and Shipping**

Ship plant material meeting the requirements of the nursery inspection and plant quarantine regulations of the states of origin and destination and the Federal regulations governing interstate movement of nursery stock as administered through each state Department of Agriculture.

Ship plants true to name. Legibly and securely label each bundle, bale, or individual plant with the following information for each species or variety:

- (1) Name,
- (2) Size, and
- (3) Quantity.

Package and ship plants without damage. After digging the plants, cover the roots with a suitable moisture-holding material to protect the roots from drying out. Do not remove the material until delivery to the planting site. Protect roots from the sun, wind, and freezing temperatures. If transporting plants in closed vehicles, provide ventilation to prevent bud break.

### **3861.3 SAMPLING AND TESTING**

The Engineer will inspect plants at time of delivery of plants to the project site. Acceptance requirements for each plant stock and form are described in the current edition of the *ICAMMLP*.

The Engineer may randomly inspect no greater than three balled and burlapped or container plants, of each variety delivered to the planting site for condition and size of the root system. The Engineer may pull back the burlap and wire basket or remove plants from containers. Replace plants becoming unsuitable for planting from the inspection at no additional cost to the Department.

The Engineer will reject plants not meeting dimensional requirements as described in the current edition of the *ICAMMLP*. The Engineer will measure the height of coniferous trees of the pine, spruce, and fir species to the upper limit at the midpoint of the terminal leader.

Remove and replace rejected plants, unless otherwise directed by the Engineer.

## **3874 FILTER BERM**

### **3874.1 SCOPE**

Provide filter berms to slow, filter, and divert storm water runoff and other pollutant water.

### **3874.2 REQUIREMENTS**

Provide the following types of filter berms as required by the contract:

#### **A Type 1 — Compost**

Provide compost berms meeting the following requirements and characteristics:

- (1) Consists of Compost Grade 1 in accordance with 3890, "Compost,"
- (2) Constructed in a trapezoidal shape based on a view of the side profile,
- (3) At least 24 in [60 cm] high in loose volume,
- (4) Bottom at least 36 in [90 cm] wide in loose volume,
- (5) Sides with slopes no greater than 1:2 (V:H), and
- (6) Seed mix 21-222 or 21-112 in accordance with 3876, "Seed."

#### **B Type 2 — Slash Mulch**

Provide slash mulch berms meeting the following requirements and characteristics:

- (1) Consists of Type 5 mulch in accordance with 3882, "Mulch Material,"
- (2) Constructed in a trapezoidal shape based on a view of the side profile,
- (3) At least 24 in [60 cm] high in loose volume,
- (4) Bottom at least 36 in [90 cm] wide in loose volume, and

- (5) Sides with slopes no greater than 1:2 (V:H).

### **C Type 3 — Rock Weeper System**

Provide rock weeper systems meeting the following requirements and characteristics:

- (1) Composed of a Type IV geotextile filter fabric liner in accordance with 3733, "Geotextiles,"
- (2) Front half composed of coarse filter aggregate in accordance with 3149, "Granular Material," 1½ ft [0.5 m] high with a 1:2 (V:H) slope,
- (3) Back half composed of Class I quarry run riprap in accordance with 3601, "Riprap Material,"
- (4) No higher than 16 in [40 cm],
- (5) Bottom no greater than 24 in [60 cm] wide, and
- (6) Side profile forms a triangle with 1:2 (V:H) front and back slopes.

### **D Type 4 — Topsoil**

Provide topsoil filter berm meeting the following requirements and characteristics:

- (1) Composed of salvage topsoil material stripped from the constriction site and used as perimeter control in accordance with 2105, "Excavation and Embankment,"
- (2) At least 36 in [90 cm] high,
- (3) Bottom at least 60 in [150 cm] wide,
- (4) Sides with slopes no greater than 1:2 (V:H),
- (5) Seed mix 21-111 or 21-112 in accordance with 3876, "Seed," and
- (6) Type I mulch in accordance with 3882, "Mulch Material."

## **3874.3 SAMPLING AND TESTING — (BLANK)**

## **3875 WATER TREATMENT**

### **3875.1 SCOPE**

Provide water treatment methods to minimize turbid water levels from dewatering practices that discharge to receiving waters.

## **3875.2 REQUIREMENTS**

Provide water treatment methods meeting NPDES, ACOE, DNR, local watersheds, or any other applicable regulatory requirements.

### **A Passive**

Use passive dewatering treatment methods, using time and gravity to settle out sediments, if draining basins, traps, ditches, or sumps to prepare the construction site for the next storm event.

#### **A.1 Rock Weepers**

Provide rock weepers for vegetated or impermeable lined channels in accordance with 3874.2.C, "Type 3 — Rock Weeper System."

#### **A.2 Perforated Riser (Standpipe)**

Provide a riser pipe in a pond, basin, or trap outlet structure meeting the following requirements or characteristics:

- (1) Two-thirds the height of the outlet above the floor of the structure,
- (2) Made of perforated PVC or metal pipe of the same diameter as the outlet structure, and
- (3) Surrounded by clean rock from 1 in to 2 in [25 mm to 50 mm], for the entire height of the riser pipe.

Install a trash guard on the top overflow.

#### **A.3 (Blank)**

#### **A.4 Floating Head Skimmer**

Provide a schedule 40 PVC pipe at least 1.5 in [38 mm] diameter for the floating head skimmer. Use a flocculant with a floating head skimmer in accordance with 3898, "Flocculants," to provide additional treatment if shown on the plans.

#### **A.5 Portable Sediment Tanks**

Provide prefabricated portable sediment tanks meeting the following requirements and characteristics:

- (1) Designed to settle sands, loamy sands, and sandy loams,
- (2) Contain 16 cu. ft [0.45 cu. m] of storage per gallon [liter] per minute of pump discharge capacity,
- (3) Contain orifice attachment portals for dewatering hoses and sediment cleanout access,

- (4) Include weirs and replaceable media filters of slash mulch, excelsior fibers, or other filter media to meet the project pollutant load, and
- (5) Used in accordance with 3898, "Flocculants."

Provide additional tanks to meet item (2) above or, if outfall water is not visibly clear.

## **B Active**

Provide pumps, hoses, pressurized tanks, or a combination of these items to depress the water table allowing for construction work to be completed in dry soil conditions.

### **B.1 Rock Barrel**

Provide a 55 gal [200 L] barrel with 12 in [300 mm] slits cut into the base. Install a sleeved 8 in [200 mm] diameter perforated pipe in the barrel. Provide a flocculant sock in accordance with 3898, "Flocculants," and place the sock at the bottom of the barrel and around the base of the perforated pipe. Surround the slits in the bottom of the barrel with clean rock with a diameter from 1 in to 2 in [25 mm to 50 mm]. Place the clean rock on a 1:2 (V:H) slope around the barrel.

### **B.2 In-line Flocculant Sock**

Provide a flocculant in accordance with 3898, "Flocculants," in the hose connecting one containment facility to another. Locate the flocculant sock after the pump.

### **B.3 In-line Pressurized Filter Systems**

Provide a portable water quality monitoring system consisting of sand media, pressurized bags, or cartridges to produce required turbidity or chemical reduction. Use liquid flocculants in accordance with 3898, "Flocculants," if necessary. Provide a portable water quality monitoring system meeting the discharge requirements shown on the plans.

## **3875.3 SAMPLING AND TESTING**

Provide samples for testing meeting the requirements of the NPDES construction permit. Make modifications to the method in accordance with the test results.

## 3876 SEED

### 3876.1 SCOPE

Provide seed for planting to establish temporary and permanent vegetative cover.

### 3876.2 REQUIREMENTS

Provide seed meeting the following requirements and characteristics:

- (1) From a vendor listed on the Approved/Qualified Product List and approved to blend or sell the type of mix used;
- (2) Meeting the requirements of Minnesota Statutes 21.80-21.91 and any applicable federal regulations, including those governing labeling and weed seed tolerances;
- (3) Conditioned to remove all pieces of stem, straw, or other chaff longer than 1½ in [38 mm] so that it can pass through a drill seeder without plugging;
- (4) Supplied on a pure live seed (PLS) basis; and
- (5) Meeting the tolerance requirements for germination and purity factors of the following Minnesota Seed Law Rules applied to seed lots sampled and tested by the following Association of Official Seed Analysts (AOSA) methods:
  - (5.1) 1510.0050,
  - (5.2) 1510.0060,
  - (5.3) 1510.0070,
  - (5.4) 1510.0080,
  - (5.5) 1510.0090, and
  - (5.6) 1510.0100.

Apply Rhizobial inoculants to legume seed with the rhizobial culture appropriate for the species being inoculated as directed by the manufacturer or as shown on the special provisions.

Apply Mycorrhizal inoculants for native warm season grasses as shown on the plans.

Apply Azospirillum inoculants to grass seed as shown on the plans.

Use inoculants before the expiration date. Provide a label showing the expiration date of the inoculant.

Store seed and inoculant in accordance with 1606, "Storage of Materials," and under controlled conditions. Before planting, maintain seed at or below 70 °F [21 °C] and at or below 10 percent moisture content, and protect seed from rain, direct sunlight, rodents, and insects.

The Department defines PLS as the product of the percent of viable seed (“total germination and hard seed or dormant seed when applicable”) multiplied by the percent of pure seed divided by 100 percent.

**A (Blank)**

**B (Blank)**

**C (Blank)**

**C.1 (Blank)**

**C.2 (Blank)**

**C.3 (Blank)**

**D Seed Mix Designations**

**D.1 Standard Seed Mixes**

Use seed of the species and germplasm meeting the requirements of the Seeding Manual, and the State Seed Mix Acceptable Substitution Table, or as specified in the special provisions.

<b>Table 3876-1 State Seed Mixes</b>			
<b>Category &amp; Mix No.</b>	<b>PLS Rate, <i>kg/ha</i></b>	<b>PLS Rate, <i>lb/acre</i></b>	<b>Name</b>
<b>Cover Crop</b>			
<b>21-111</b>	112.1	100	Oats Cover Crop
<b>21-112</b>	112.1	100	Winter Wheat Cover Crop
<b>21-113</b>	123.3	110	Soil Building Cover Crop
<b>Mid-Term Stabilization</b>			
<b>22-111</b>	34.2	30	Two-year Stabilization
<b>22-112</b>	44.8	40	Five-year Stabilization
<b>Non-Native Grassland</b>			
<b>25-121</b>	38.4	61	Sandy General Roadside
<b>25-131</b>	246.6	220	Low Maintenance Turf
<b>25-141</b>	66.1	59	Mesic General Roadside
<b>25-142</b>	50.4	45	Agricultural Roadside
<b>25-151</b>	134.5	120	High Maintenance Turf
<b>Mid-term Stabilization Native</b>			

<b>32-241</b>	45.6	38	Native Construction
<b>Stormwater Facilities</b>			
<b>33-261</b>	39.2	35	Stormwater South and West
<b>33-262</b>	49.3	44	Dry Swale / Pond
<b>33-361</b>	39.2	35	Stormwater Northeast
<b>Wetland</b>			
<b>34-171</b>	5.9	5.3	Wetland Rehabilitation
<b>34-181</b>	5.6	5	Emergent Wetland
<b>34-261</b>	35.3	31.5	Riparian South & West
<b>34-262</b>	16.3	14.5	Wet Prairie
<b>34-271</b>	13.5	12	Wet Meadow South & West
<b>34-361</b>	35.3	31.5	Riparian Northeast
<b>34-371</b>	14	12.5	Wet Meadow Northeast
<b>Native Grassland</b>			
<b>35-221</b>	40.9	36.5	Dry Prairie General
<b>35-241</b>	40.9	36.5	Mesic Prairie General
<b>35-421</b>	12.3	11	Dry Prairie Northwest
<b>35-441</b>	12.3	11	Mesic Prairie Northwest
<b>35-521</b>	14	12.5	Dry Prairie Southwest
<b>35-541</b>	13.5	12	Mesic Prairie Southwest
<b>35-621</b>	12.3	11	Dry Prairie Southeast
<b>35-641</b>	13.5	12	Mesic Prairie Southeast
<b>Woodland</b>			
<b>36-211</b>	38.7	34.5	Woodland Edge South & West
<b>36-311</b>	37.6	33.5	Woodland Edge Northeast
<b>36-411</b>	39.8	35.5	Woodland Edge Northwest
<b>36-711</b>	39.8	35.5	Woodland Edge Central

## D.2 Site Specific Seed Mixes

Provide seed mixes in accordance with *Native Seed Mix Design for Roadsides* if shown on the plans.

## E Blending

Provide uniformly blended seed mixtures as required by the contract and meeting the requirements of the Seeding Manual. Blend mixtures meeting the requirements of the Department's Approved Seed Vendor Agreement. Blend and package native seed



mixtures according to size to allow installation from the appropriate seed box of native seeding equipment and in accordance with the following:

- (1) Combine the seeds of sedges and rushes for installation by hand or with the small seed box,
- (2) Combine the seeds of small and medium seeded forbs for installation with the small seed box,
- (3) Combine the seeds of most grasses and large-seeded forbs for installation with the fluffy seed box, and
- (4) Combine large seeds of cover crop species such as oats and winter wheat for installation with the grain box.

**F Minimum PLS**

Provide seed meeting the minimum purity and germination requirements for certification in accordance with the seed certification standard on file with the appropriate seed certifying agency. If using non-certified seed approved as substitutions, provide seed meeting the minimum PLS requirement listed on the State Seed Mix Acceptable Substitution Table.

**G Acceptable Varieties and Origin**

Use seed of introduced species that has been certified by the Minnesota Crop Improvement Association (MCIA) or the appropriate seed certifying agency in the seed's state of origin. Use seed of varieties listed in the State Seed Mix Acceptable Substitution Table.

Where native species occur in predominately non-native mixes, use seed varieties as listed in the State Seed Mix Acceptable Substitution Table or seed certified as Source Identified by the MCIA.

In native seed mixtures, use seed of native species certified in the Source Identified class by the MCIA.

In native seed mixtures, use seed of native species with a genetic origin from Minnesota or the following regions of adjacent states:

<b>Table 3876-2</b>	
<b>Native Species from Adjacent States</b>	
<b>State</b>	<b>Regions within State</b>
North Dakota	From the Minnesota border west to and including the counties of Towner, Benson, Eddy, Foster, Stutsman, Lamoure, and Dickey.

South Dakota	From the Minnesota border west to and including the counties of Brown, Spink, Beadle, Jerauld, Aurora, Douglas, and Bon Homme.
Iowa	From the Minnesota border south to and including the counties of Plymouth, Cherokee, Buena Vista, Pocahontas, Humboldt, Wright, Franklin, Butler, Bremer, Fayette, and Clayton.
Wisconsin	From the Minnesota border east to and including the counties of Iron, Price, Taylor, Clark, Jackson, Monroe, Vernon, Richland, Iowa, and Lafayette.

If performing work adjacent to an area of environmental sensitivity or a remnant native plant community as identified during environmental review and shown on the plans, use seed from a more local source in accordance with the following if shown on the plans:

- (1) Native seed mixtures with at least 85 percent of native components having a genetic origin from within 150 mi of the project site,
- (2) Native seed mixtures with at least 85 percent of native components having a genetic origin from within 75 mi of the project site, and
- (3) Native seed mixtures with at least 85 percent of native components having a genetic origin from within 25 mi of the project site.

## H Substitutions

The Contractor may substitute species or germplasm listed in the Seeding Manual with corresponding species or germplasm listed in the State Seed Mix Acceptable Substitution Table. Use native species from the State Seed Mix Acceptable Substitution Table only for projects in regions of the state where the substitute species is native in accordance with the State Seed Mix Acceptable Substitution Table. The Contractor may request permission to use alternate substitutions from the Office of Environmental Services, Erosion and Stormwater Management Unit if a species or germplasm on the State Seed Mix Acceptable Substitution Table is not available. Do not make alternate substitutions before approval by the Erosion and Stormwater Management Unit and amendment of the State Seed Mix Acceptable Substitution Table.

The Department will allow substitutions for seed of native species in accordance with the following priority:

- (1) Default Source: MCIA certified in the Source Identified class with a genetic origin in the region defined in 3876.2.G, "Acceptable Varieties and Origins,"

- (2) Primary Authorized Substitution: Source Identified seed certified by a seed certifying agency other than MCIA and with a genetic origin in the region defined in 3876.2.G, "Acceptable Varieties and Origins,"
- (3) Secondary Authorized Substitution: Certified seed of varieties/germplasm listed in the State Seed Mix Acceptable Substitution Table, and
- (4) Tertiary Authorized Substitution: Wild Type with a genetic origin in the region defined in 3876.2.G, "Acceptable Varieties and Origins." The Department defines "wild type seed" as seed from a local or regional ecotype originating from remnant native stands and not modified by any intentional selection process.

### **3876.3 SAMPLING AND TESTING**

#### **A Testing and Viability**

Provide seed tested in accordance with the official rules for testing on file with the AOSA and meeting the minimum germination requirements of 3876.2.F, "Minimum PLS," during installation. Plant seed within 12 months of viability testing exclusive of the month the test was completed.

Upon request by the Engineer, provide seed test reports from a registered seed technologist for each lot of seed being used. Take samples of seed lots delivered to the project in accordance with the Schedule for Materials Control for testing and inspection, or more often as requested by the Engineer. The Department will use a tetrazolium test in lieu of a standard germination test for quality control. If the Department's inspection and testing results disagree with those obtained at the origin, the Department's findings will be conclusive and binding. The Contractor may challenge the Department's seed test results and may request re-testing at no additional cost to the Department.

#### **C Labeling**

Label seed meeting the requirements for agricultural seed as specified in the Minnesota Seed Law, Section 21.82. Mechanically print the following information on the label for every mix component, including components that make up no greater than 5 percent of the total mix:

- (1) Total PLS weight for the bag,
- (2) Total bulk weight for the bag,
- (3) Area covered by the amount of seed in the bag when applied at the rate specified for that mix in Seeding Manual or special provision,
- (4) PLS percent for each mix component, and
- (5) County of genetic origin for each native component.

Label bags separately, including bags of small-seeded species placed inside of larger bags of large-seeded species. Label outer bags with the mix number.

Attach applicable certification tags from appropriate seed certifying agencies to each bag containing certified seed or provide a certification certificate with the certified seed.

Attach a Mn/DOT Approved Seed Vendor tag to each bag of seed. Ensure that the tag matches the type of mix labeled.

The Department considers the labeling and tags required in this section and by state and federal law as the certificate of compliance for the provided seed.

## **3877 TOPSOIL BORROW**

### **3877.1 SCOPE**

Provide topsoil material for use as a medium to establish and sustain healthy plant growth for water quality and permanent erosion protection. Provide manufactured soils for use as a medium for treating and filtering stormwater in rain gardens, horizontal filter berms, dikes, bioswales, and bioslopes.

### **3877.2 REQUIREMENTS**

Provide material from vendors that have been approved by the Mn/DOT's Erosion and Storm water Management Unit.

Provide topsoil material blended from defined sand, compost, and loam to sandy loam topsoil sources with soil and root additives to provide infiltration rates for water quality, to provide for plant establishment, or both. Manufactured topsoil's in section E, F, G, and H are blended on a volume basis of materials with large differences in bulk density. When the individual components have been verified to meet the appropriate specification, the blended material in the ratio indicated shall meet this specification.

Provide compost in accordance with 3890, "Compost." Provide sand in accordance with 3149, 3126, or 3128. Provide loam to sandy loam topsoil from soil horizons meeting the requirements of the Soil Science Society of America, A or B designation, or from alluvial deposits. In addition to the requirements, any of the topsoil types may require soil conditioners, plant hormones, or root stimulators in accordance with 3896, "Soil and Root Additives," as shown in the plans or as a result of the fertility test.

Aggregate material from sources other than gravel pits and quarries must also meet the minimum contaminants requirements in US EPA 503 or Minnesota Rule 7035.2846 Subp. 6, Sec. A.

### A Type A Topsoil Borrow

Provide topsoil borrow ranging from a silt loam, loam, clay loam, sandy clay loam, or sandy loam soils for general use as a turf growing medium and in accordance with Table 3877-1:

<b>Table 3877-1</b>		
<b>Type A Topsoil Borrow Requirements</b>		
<b>Requirement</b>	<b>Range</b>	<b>Test Method</b>
Material passing ¼ in [35 mm]	≥ 85%	—
Clay	5% – 40%	ASTM D 422
Silt	10% – 70%	ASTM D 422
Sand	10% – 70%	ASTM D 422
Organic matter	3% – 20%	ASTM D 2974
pH	6.1 – 7.8	ASTM G 51

### B Type B Topsoil Borrow

Provide loam topsoil borrow ranging into sandy clay loam, sandy loam, or clay loam soils as a plant growing medium for landscape and planting beds and in accordance with Table 3877-2:

<b>Table 3877-2</b>		
<b>Type B Topsoil Borrow Requirements</b>		
<b>Requirement</b>	<b>Range</b>	<b>Test Method</b>
Material passing ¼ in [35 mm]	≥ 90%	—
Clay	5% – 30%	ASTM D 422
Silt	10% – 50%	ASTM D 422
Sand	20% – 70%	ASTM D 422
Organic matter	3% – 20%	ASTM D 2974
pH	6.1 – 7.5	ASTM G 51
Soluble salts	≤ 0.15 siemens/m [1.5 mmho/cm]	—

### C Type C Topsoil Borrow

Provide screened and pulverized Type B topsoil Borrow for use as a plant growing medium in critical areas, such as steep slopes and as a top dressing for erosion stabilization mats.

**D Type D Topsoil Borrow**

Provide topsoil consisting of a sandy loam soil for use as a well-drained course sand medium for vegetative plant restoration or preservation and in accordance with Table 3877-3:

<b>Table 3877-3 Type D Topsoil Borrow Requirements</b>		
<b>Requirement</b>	<b>Range</b>	<b>Test Method</b>
Material passing No.10 [2.00 mm]	>90%	ASTM D 422
Clay (by weight)	5% – 20%	ASTM D 422
Silt (by weight)	5% – 40%	ASTM D 422
Coarse sand (by weight)*	50% – 75%	ASTM D 422
Organic matter (by weight)	3% – 15%	ASTM D 2974
pH	6.1% – 7.5%	ASTM G 51
Soluble salts	≤ 0.15 siemens/m [1.5 mmho/cm]	—
* Particle size ranging from #40 sieve (0.425 mm) to #10 sieve ( 2.0 mm)		

**E Type E Topsoil Borrow**

Provide topsoil borrow consisting of three blended components of sandy loam topsoil, sand, and compost for use as a plant growing medium for rooting, water quality, and infiltration. The components consist of the following by volume.

- (1) Sixty percent sand in accordance with 3149.2.J, “Fine Filter Aggregate;” or 3149.2K, “sand cover”
- (2) Twenty percent Grade 2 compost in accordance with 3890, “Compost;” and
- (3) Twenty percent sandy loam topsoil meeting the requirements of the USDA Soil Texture Triangle or Type B Topsoil borrow.

Supplement with root additives to stimulate root establishment in water quality treatment facility as shown on the plans.

**F Type F Topsoil Borrow**

Provide topsoil borrow containing three blended components consisting of loam soil, sand, and compost for use as structural soil for plant establishment in streetscape boulevards. The components consist of the following by volume:

- (1) One-third loam topsoil meeting the requirements of the USDA Soil Texture Triangle;
- (2) One-third sand in accordance with 3149.2. K “sand cover;” and
- (3) One-third compost in accordance with 3890, “Grade 2 Compost.”

### **G Type G Topsoil Borrow**

Provide topsoil borrow containing two blended components of sand and compost for water quality, plant growing medium, and filtration medium with a filtration rate of 2.5 in/h to 4 in/h [6 cm/h to 10 cm/h]. The components consist of the following by volume:

- (1) At least 60% and no more than 80% sand meeting the gradation requirements if 3126, "Fine Aggregate for Portland Cement Concrete;" and
- (2) At least 20% and no more than 40% compost meeting requirements of 3890, "Grade 2 Compost."

### **H Type H Topsoil Borrow**

Provide topsoil borrow containing two blended components of a topsoil ranging from a silt loam, loam, clay loam, sandy clay loam, or sandy loam soils, and compost for a plant growing medium to enhance existing soils. The components by volume consist of:

- (1) 50% Topsoil meeting the requirements of USDA Soil texture triangle for silt loam, loam, clay loam, sandy clay loam, or sandy loam, or Type A Topsoil Borrow and
- (2) 50% compost meeting requirement of 3890, "Grade 2 Compost."

Provide Type 4 fertilizer in accordance with 3881, plant hormones in accordance with 3896, "Soil and Root Additives," as per plan.

## **3877.3 SAMPLING AND TESTING**

Submit a list of prospective sources for topsoil material to the Engineer at the preconstruction meeting to allow for inspecting, testing, and approving the sources. Provide a manufactured soil vendor's certificate of compliance to the Engineer before the Engineer samples the product. If federal or state chemical or biological requirements conflict, provide material meeting the most stringent requirement.

Fertility testing Will be in accordance with the standard testing procedures of the University of Minnesota Soils Testing Laboratory, Soil Science Department. Test blended topsoil for each individual component before blending.

## 3878 SOD

### 3878.1 SCOPE

Provide sod for turf establishment, erosion control, energy dissipation of low flow water outfalls, river banks, and channel bottoms.

### 3878.2 REQUIREMENTS

Provide sod consisting of densely-rooted bluegrass or other permanent grasses and flowers, depending on sod type shown on the plans. Provide material from vendors on the Approved/Qualified Products List.

Cut turf-type sod in uniform strips at least 12 in [300 mm] wide and ¾ in [20 mm] thick. Cut the sod thicker to retain and expose the dense root system in the bottom side of the sod. Cut the sod when it contains sufficient moisture to withstand exposure and handling during the transplant operations. Rake the sod free of debris and trim the top growth to a height from 1 in to 3 in [25 mm to 75 mm].

Do not use sod strips with dry or dead edges upon delivery. Between June 1 and September 15, do not cut sod more than 24 h before delivery.

Provide native sod in the dimensions specified in the plans or by the manufacturer's recommendations for handling immediately before installation.

Before delivery, provide certification from the grower to the Engineer stating the grass varieties contained in the sod. Do not place sod until the Engineer approves the certification. Provide salt tolerant and the netted sods from certified growers as defined by the Minnesota Crop Improvement Association and the Office of Environmental Services. The Engineer will require certification of conformance based on third party inspection and documentation process for all material from certified growers.

#### A Lawn Sod

Provide lawn sod meeting the following requirements and characteristics:

- (1) Soil is moist,
- (2) Uniform texture,
- (3) Dark green,
- (4) Does not contain grass with blade widths greater than 0.2 in [5 mm],
- (5) Weed-free,
- (6) Contains no greater than 0.2 in [5 mm] of thatch over the base soil,
- (7) Consists of a blend of 4 or 5 fine leafed turf grasses, and



- (8) At least two-thirds of the grasses, as determined by initial seeding proportions, consist of improved and elite type Kentucky bluegrass varieties as specified in the Seeding Manual.

**B (Blank)**

**C Salt Tolerant Sod**

Provide salt-tolerant sod for use along boulevards or in a potential salt environment meeting the following requirements and characteristics:

- (1) Low maintenance type,
- (2) Fine leafed,
- (3) Uniform texture,
- (4) Free of noxious, broad-leafed, and grassy weeds,
- (5) Contains less than 3 percent coarse grasses, and
- (6) Originated from the blend of grass seed of seed components listed by the Minnesota Crop Improvement Association, Minnesota Turf Association, and the Office of Environmental Services.

**D Mineral Sod**

Provide mineral sod meeting the following requirements and characteristics:

- (1) Commercially produced on or harvested from mineral based soils consisting of no greater than 10 percent organic matter by weight,
- (2) Fine leafed,
- (3) Uniform texture,
- (4) Free of noxious, broad-leafed, or grassy weeds,
- (5) Contains less than 3 percent coarse grasses,
- (6) Consists of a blend of 4 or 5 fine leafed turf grasses, and
- (7) At least 35 percent of the grasses, as determined by initial seeding proportions, consist of improved type Kentucky bluegrass varieties as specified in 3876, "Seed."

**E Native Sod**

Provide native sod meeting the following requirements:

- (1) Commercially produced from native grass and flower seed mixtures in accordance with 3876, "Seed," and as shown on the plans, and
- (2) Seeded and grown in turf reinforcement mats or natural organic mats for at least 30 days before delivery and installation.

### **3878.3 SAMPLING AND TESTING**

The Engineer will obtain test samples for determination of soil organic matter content of mineral sod from the soil exposed in the bottom side of the sod rolls. The Engineer will test for organic matter content meeting the requirements of ASTM D 2974.

The Department may conduct its own inspection during sod production in the fields or at the project. Provide representative samples of the sod to the Engineer if requested. Do not deliver sod until the Engineer approves the samples.

## **3879 AGRICULTURAL LIME**

### **3879.1 SCOPE**

Provide Agricultural Liming Material (ALM) containing calcium compounds, magnesium compounds, or both, capable of neutralizing soil acidity and providing an increase in soil pH within six months of placement into the soil.

### **3879.2 REQUIREMENTS**

ALM includes the following forms:

- (1) Limestone (calcitic or dolomitic),
- (2) Burned lime,
- (3) Slaked lime, and
- (4) Marl.

Gypsum is not a liming product. Provide lime product containing at least 80 percent Total Neutralizing Power (TNP) ground fine to provide the following characteristics:

- (1) At least 90 percent, including fine particles obtained in the grinding process, passes through a No 8 [2.36 mm] sieve;
- (2) At least 60 percent passes through a No. 20 [850 µm] sieve;
- (3) At least 50 percent passes through a No. 60 [250 µm] sieve;
- (4) A maximum water content of 10 percent;
- (5) ALM with a rating of at least 1,000 lb Effective Neutralizing Power (ENP) per ton [1,120 kg ENP per tonne] of ALM.

Obtain the ALM from a Minnesota Department of Agriculture (MDA) licensed distributor or producer. For ALM supplied in bulk, deliver the ALM to the project with the following information on a billing, delivery invoice or scale ticket label:

- (1) Distributor or producer's name, address, telephone number, and source of production or stockpile location;
- (2) Customer's name;
- (3) Date of sale or transfer;
- (4) Type of ALM;
- (5) Minimum weight in pounds of ENP per ton [mass in kilograms ENP per tonne], accurate within 3 percent; and
- (6) Weight or cubic yards [cubic meters] of ALM distributed and weight per cubic yard [cubic meter].

For ALM supplied in bags or other container types, affix the following information to the bag or container:

- (1) Distributor or producer's name and address;
- (2) Minimum weight in pounds ENP per ton [mass in kilograms ENP per tonne], accurate to within 3 percent; and
- (3) The net weight.

### 3879.3 SAMPLING AND TESTING

Collect samples in accordance with the MDA Agricultural Lime Official Sampling Methods. Submit samples to MDA or the University of Minnesota testing lab for analysis of the following:

- (1) Percent of TNP,
- (2) Percent passing the No. 8 [2.36 mm] sieve, No. 20 [850 µm] sieve, and No. 60 [250 µm] sieve,
- (3) Percent dry matter, and
- (4) The weight in pounds ENP per ton [mass in kilograms ENP per tonne] of ALM rating.

Perform sampling and testing within 90 days before applying the lime material to the land. The weight in pounds ENP per ton of ALM is defined as follows:

$$\left( \frac{2,000 \text{ lb}(1,000\text{kg})}{\text{ton}} \right) (\text{ENP}) \left( \frac{\text{PDM}}{100} \right) = \frac{W}{T}$$

when:

$$\text{ENP} = \left( \frac{\text{FinenessIndex}}{100} \right) \times \left( \frac{\% \text{TNP}}{100} \right)$$

Fineness Index =

$$0.2(\% \text{ passNo.8} - \% \text{ passNo.20}) + 0.6(\% \text{ passNo.20} - \% \text{ passNo.60}) + 1(\% \text{ passNo.60})$$

PDM = percent dry matter =  $100 - \% \text{ Moisture}$

W = weight, lb [kg] ENP

T = Ton [tonne] of ALM

The Engineer may accept material provided in accordance with this section, on the basis of the distributor's or producer's guaranteed analysis. The Department reserves the right to sample, test, inspect, and accept or reject the material based on its own tests.

## **3881 FERTILIZER**

### **3881.1 SCOPE**

Provide fertilizer for use in establishing vegetative cover and landscape plantings.

### **3881.2 REQUIREMENTS**

#### **A General**

Provide a manufactured grade of inorganic or organic fertilizer produced in granular or granulated form. The fertilizer shall contain at least the minimum analysis shown on the plans, and shall consist of a blended or homogeneous form containing the specified percentages of total nitrogen, available phosphoric acid (or phosphorous), and water-soluble potash (or potassium), in that order.

If the fertilizer is provided in closed containers, clearly mark the containers with the following information in accordance with Minnesota Department of Agriculture (MDA) regulations:

- (1) The weight,
- (2) The type of nutrients, and
- (3) The manufacturer's guaranteed analysis.

If the fertilizer is provided in bulk, provide the above information in an invoice, delivery ticket, or written form. Include a suitable bill-of-lading with each shipment that contains the information in accordance with MDA regulations.

#### **B Types**

Provide fertilizer that conforms to the requirements for one of the following types, as shown on the plans.

### **B.1 Type 1 — Commercial Fertilizer**

Provide commercial fertilizer meeting the following characteristics:

- (1) Consisting of dry granulated nutrients produced by mining and manufacturing processes and commonly used in the agricultural or lawn care industries; and
- (2) Containing nitrogen, phosphorous, and potassium.

### **B.2 Type 2 — Phosphorous-Free Fertilizer**

Provide commercial fertilizer meeting the following characteristics:

- (1) Consisting of dry granulated nutrients produced by mining and manufacturing processes and commonly used in the agricultural or lawn care industries, and
- (2) Contains nitrogen and potassium.

### **B.3 Type 3 — Slow-Release Fertilizer**

Provide slow-release fertilizer with the following characteristics:

- (1) Specifically processed to release nitrogen at a slow rate over a growing season;
- (2) Containing nitrogen, phosphorous, and potassium;
- (3) The primary nitrogen sources shall be in a coated, prilled urea form; and
- (4) At least 70 percent of the nitrogen component shall be slow-release water-insoluble nitrogen.

### **B.4 Type 4 — Natural-Based Fertilizer**

Provide natural-based fertilizer with the following characteristics:

- (1) With at least 50 percent of the mass and at least 50 percent of the macronutrients derived from natural or organic material;
- (2) Consisting of dry granulated nutrients with a moisture content of less than 10 percent;
- (3) Consisting of granules with an approximate size from No. 7 [2.8 mm] sieve to No. 30 [0.6 mm] sieve;
- (4) Derived from aerobically composted feed stock supplemented with ammonium sulfate, ferrous sulfate, and sulfate of potash to meet the ratios shown on the Plans; and
- (5) Free of sewage sludge, raw manure, or uncomposted organic matter.

### **3881.3 SAMPLING AND TESTING**

The Department may approve the fertilizer based on the manufacturer's guaranteed analysis, but the Department reserves the right to sample and test the material at the source, or at the project before final acceptance. The Department will perform chemical analysis tests in accordance with the methods established by the Association of Official Agricultural Chemists.

## **3882 MULCH MATERIAL**

### **3882.1 SCOPE**

Provide mulch material for controlling erosion and establishing vegetative cover.

### **3882.2 REQUIREMENTS**

Provide mulch material meeting the requirements of one of the following types, as required by the contract.

#### **A Type 1**

Use Type 1 mulch with the following characteristics:

- (1) Grain straw, hay, cuttings of agricultural grasses, and legumes. If using Type 1 mulch in conjunction with native grasses (300 Series Mixtures), provide Type 1 mulch consisting of grain straw only;
- (2) Free of seed bearing stalks of noxious grasses or weeds as defined by the rules and regulations of the Minnesota Department of Agriculture (MDA);
- (4) Free of Canada thistle or leafy spurge fragments or seeds;
- (5) Free of cattail (*Typha sp*), reed canary grass (*Phalaris arundinacea*), birds-foot trefoil (*Lotus corniculatus*), and crown vetch (*Coronilla varia*); and
- (6) In an air-dried condition at the time of delivery.

Provide bales used for bale barriers with the following characteristics:

- (1) Densely packed,
- (2) Tightly wrapped with two strands of twine or wire, and
- (3) Rectangular shaped with a minimum nominal size of 14 in × 18 in × 36 in [350 mm × 450 mm × 850 mm].

**B (Blank)**

**C Type 3**

Use Type 3 mulch consisting of clean grain straw certified by the Minnesota Crop Improvement Association (MCIA) as weed free. Provide mulch bales in an air-dried condition at the time of delivery and with an MCIA inspection tag attached indicating the mulch passed inspection.

**D (Blank)**

**E Type 5**

Use Type 5 mulch consisting of raw wood slash from hard or soft timber harvested during clearing and grubbing operations on the project. Provide Type 5 mulch that is a product of a mechanical chipper, hammermill, or tub grinder. Ensure the material passes a 4 in [100 mm] sieve and no more than 20 percent of the material by mass passes a 0.1 in [2.36 mm] sieve. Provide Type 5 mulch with individual pieces of a length no greater than 20 in [500 mm].

Provide mulch from a supplier outside of the Emerald Ash Borer quarantine areas or, if the mulch originates from within the quarantine areas, obtain a Compliance Agreement with the MDA. The Department will not allow mulch transported in or through a quarantine area to be transported outside the Emerald Ash Borer quarantine area without approval from the MDA. Find the quarantine area by contacting the MDA at 1-888-545-6684 or visit the MDA Emerald Ash Borer website.

**F Type 6**

Use Type 6 mulch consisting of raw wood material from hard or soft timber and that is the product of a mechanical chipper, hammermill, or tub grinder. Ensure the mulch is substantially free of mold, dirt, sawdust, and deleterious material. Do not use wood material in an advanced state of decomposition. Provide wood material free of chipped-up manufactured boards or chemically treated wood, including wafer board, particle board, and Chromated Copper Arsenate (CCA) or penta treated wood. Ensure the air-dried material passes a 4 in [100 mm] sieve and no more than 20 percent of the material by mass passes a 0.1 in [2.36 mm] sieve. Do not allow unattached bark, green-leaf composition to exceed 20 percent by mass. Provide Type 6 mulch with individual pieces of a length no greater than 20 in [500 mm].

Provide mulch from a supplier outside of the Emerald Ash Borer quarantine areas or, if the mulch originates from within the quarantine areas, obtain a Compliance Agreement with the MDA. The Department will not allow mulch transported in or through a quarantine area to be transported outside the Emerald Ash Borer quarantine

area without approval from the MDA. Find the quarantine area by contacting the MDA at 1-888-545-6684 or visit the MDA Emerald Ash Borer website.

### **G Type 7 (Prairie Mulch)**

Use prairie mulch that has been thrashed to remove seeds so it consists of clippings, chaff, or residue from harvesting or cleaning operations. This material may be harvested from native stands or from native grass production fields. Provide prairie mulch free of the following:

- (1) Noxious weed seeds,
- (2) Canada thistle or leafy spurge fragments or seeds,
- (3) Cattail (*Typha sp.*),
- (4) Reed canary grass (*Phalaris arundinacea*),
- (5) Birds-foot trefoil (*Lotus corniculatus*),
- (6) Crown vetch (*Coronilla varia*),
- (7) Wild parsnip (*Pastinaca sativa*),
- (8) Spotted knapweed (*Cenaurea stoebe*), and
- (9) Queen anne's lace (*Daucus carota*).

### **H Type 8 (Prairie Hay)**

Use prairie hay that has not been thrashed to remove seeds so it consists of directly-bailed material. The Contractor may harvest this material from native stands or from native grass fields. Provide prairie hay free of the following:

- (1) Noxious weed seeds,
- (2) Canada thistle or leafy spurge fragments or seeds,
- (3) Cattail (*Typha sp.*),
- (4) Reed canary grass (*Phalaris arundinacea*),
- (5) Birds-foot trefoil (*Lotus corniculatus*),
- (6) Crown vetch (*Coronilla varia*),
- (7) Wild parsnip (*Pastinaca sativa*),
- (8) Spotted knapweed (*Cenaurea stoebe*), and
- (9) Queen anne's lace (*Daucus carota*).

### **I Type 9**

Use aggregate mulch from  $\frac{3}{8}$  in [9.5 mm] to 2 in [50 mm], with 5 percent by mass allowable passing the  $\frac{3}{8}$  in [9.50 mm] sieve. The Contractor may crush aggregate to produce aggregate mulch.



### **3882.3 SAMPLING AND TESTING**

Obtain test samples at a rate in accordance with the Schedule of Materials Control. Test for moisture content in accordance with ASTM D 4444 and sieve analysis in accordance with ASTM D 422.

## **3884 HYDRAULIC EROSION CONTROL PRODUCTS**

### **3884.1 SCOPE**

Provide hydraulically applied Hydraulic Erosion Control Products (HECPs) to control erosion on all soil types and to establish vegetative cover.

### **3884.2 REQUIREMENTS**

Provide HECPs meeting the following requirements and characteristics:

- (1) Noncorrosive to hydraulic application equipment,
- (2) Nonfoaming or containing mixture enhancers to prevent foaming and mixing problems during agitation in the application equipment, and
- (3) Safe to the applicator, adjacent workers, and the environment if properly applied in accordance with the EPA and OSHA.

Apply HECPs with equipment capable of mechanical agitation and slurry bypass.

Provide an Applicator's Certification from the manufacturer before applying the Type 5 and Type 6 HECPs.

## **A Tackifiers**

### **A.1 Type Natural Tackifier**

Provide the following types of natural tackifiers with an erosion control performance no greater than 3 months:

- (1) Water soluble natural proteins,
- (2) Vegetable gums,
- (3) Guar gums,
- (4) Starch,
- (5) Psyllium,
- (6) Pitch,
- (7) Rosin types blended with gelling and hardening agents, or
- (8) Water soluble blends of hydrophilic polymers, viscosifiers, sticking aids, and other gums.

If using guar gum based tackifiers, provide tackifier with at least 95 percent guar gum by weight and the remaining weight consisting of dispersing and cross-link additives.

If using starch based tackifiers, provide non-ionic, cold-water soluble, pre-gelatinized granular cornstarch.

If using psyllium based tackifiers, provide a finely ground muciloid coating of plantago seeds applied as a dry powder or a wet slurry to the surface of the soil.

If using pitch or rosen based tackifiers, provide non-ionic pitch and rosin emulsion with a solids content of at least 48 percent. Provide rosin consisting of at least 26 percent of the total solids content. Use non-corrosive, water-dilutable emulsion soil stabilizer capable of curing to water-insoluble binding and cementing agent upon application.

## **A.2 Type Synthetic Tackifier**

Provide synthetic tackifiers with an erosion control performance no greater than 18 months and meeting the following characteristics and requirements:

- (1) Consists of polyvinyl acetate emulsion formulations containing at least 55 percent active solids;
- (2) Does not contain poly-acrylates or polyvinyl-acrylics;
- (3) Water-soluble;
- (4) Remains flexible and does not re-emulsify after curing;
- (5) Does not inhibit water and oxygen infiltration;
- (6) Consists of organic, biodegradable, non-polluting, non-volatile, non-toxic material;
- (7) Effective on all soil types with either acid or alkaline condition; and
- (8) Air cures within 48 h.

## **A.3 Type Polyacrylamide Tackifier**

Provide polyacrylamide (PAM) tackifiers meeting the following requirements and characteristics:

- (1) Break down within 6 months,
- (2) Naturally break down in soil,
- (3) Liquid formulation containing PAM as the primary active ingredient and meeting the following requirements:
  - (3.1) Linear, anionic copolymer of acrylamide and sodium acrylate, and
  - (3.2) Residual monomer content of the PAM no greater than 0.05 percent by weight.

- (4) Available as a prepackaged product and labeled to indicate the Minnesota Department of Agriculture registered and approved as a soil and plant amendment product,
- (5) Labeled as one of the following:
  - (5.1) Formulated as a water-in-oil emulsion containing at least 2.6 lb pure PAM per gal [0.31 kg pure PAM per L], and containing at least 30 percent active pure PAM, or
  - (5.2) Formulated as a liquid dispersed polyacrylamide (LDP), containing at least 4.4 lb pure PAM per gallon [0.53 kg pure PAM per liter], and containing at least 35 percent active pure PAM.
- (6) Drying time no greater than 4 h.

Provide a certification showing the percent of pure PAM present by weight, the percent activity, the average molecular weight, and the charge density of the PAM. Provide a material safety data sheet for the prepackaged product. The Contractor may include Type 1c Polyacrylamide as part of a polymer stabilized fiber matrix.

### **B Type Hydraulic Compost Matrix**

Provide hydraulic compost matrix meeting the following characteristics and requirements:

- (1) Contains plant or livestock manure feedstock finished compost in accordance with 3890, "Compost,"
- (2) Contains peat moss, wood cellulose, straw fibers or other organic fibers blend containing humus, enzymes, vitamins, auxins, amino acids, and tackifier,
- (3) Suspends with agitation in water,
- (4) Includes a tracer dye for contrast against soils for visual metering, and
- (5) Contains at least 60 percent compost, peat moss, and tackifier by weight with the remaining weight composed of additional organic fibers.

### **C Type Hydraulic Mulch**

Provide hydraulic mulch meeting the following characteristics and requirements:

- (1) Contains shredded wood paper fibers, natural fibers, or both containing no germination or growth inhibiting factors,
- (2) Contains from 2.5 percent to 5.0 percent tackifier by weight if premixed in the bag,
- (3) Contains moisture content no greater than 15 percent at the time of delivery,
- (4) If washed on a No. 20 [850  $\mu$ m] sieve, at least 50 percent retained on the sieve, and
- (5) Functional for no greater than 3 months after application.

#### **D Type Stabilized Fiber Matrix**

Provide stabilized fiber matrix meeting the following requirements and characteristics:

- (1) Premanufactured matrix containing defibrated organic fibers with at least one of the following additives:
  - (1.1) Soil flocculants,
  - (1.2) Crosslinked hydro-colloidal polymers, and
  - (1.3) 5 percent Crosslinked tackifiers.
- (2) Contains moisture content no greater than 15 percent by weight,
- (3) Cures within 48 h, and
- (4) Functional for at least of 3 months.

#### **E Type Bonded Fiber Matrix**

Provide bonded fiber matrix meeting the following requirements and characteristics:

- (1) Composed of wood fibers or wood by products,
- (2) At least 25 percent of the fibers average 0.4 in [10.16 mm] long and with at least 50 percent retained on No. 25 sieve,
- (3) Fibers colored with water soluble, non-toxic dye,
- (4) Contains at least 10 percent blended hydrocolloid based guar gum binder by volume,
- (5) Crosslinker contains slow-release and agricultural based fertilizers or other proprietary chemicals no greater than 2 percent by volume,
- (6) Binder and crosslinkers do not dissolve or disperse upon rewetting,
- (7) Contains moisture content no greater than 15 percent by weight, and
- (8) Functional for at least 6 months.

#### **F Type Fiber Reinforced Matrix**

Provide fiber reinforced matrix composed of a chemical and mechanical matrix containing the following:

- (1) Organic defibrated fibers,
- (2) Cross-linked insoluble hydro-colloidal tackifiers, and
- (3) Reinforcing natural or synthetic fibers.

Provide for functional longevity of at least 12 months.

### **3884.3 SAMPLING AND TESTING**

Submit to the Engineer a manufacturer's Certificate of Compliance. Test for moisture meeting the requirements of ASTM D 4444. Perform particle sieve analysis meeting the requirements of ASTM D 422. Use a standard test board or free liquid quality control before placement of Type 5 Bonded Fiber Matrix and Type 6 Fiber Reinforced Matrix Hydraulic to ensure the liquids separate from fibrous solids no greater than 1 in [25 mm] in 1 min as shown on the board.

## **3885 ROLLED EROSION CONTROL PRODUCTS**

### **3885.1 SCOPE**

Provide temporary and permanent rolled out products designed to reduce soil erosion and assist in the growth, establishment, and protection of vegetation.

### **3885.2 REQUIREMENTS**

#### **A.1 Rolled Erosion Control Product (RECP)**

Provide rolled erosion control product meeting the following requirements and characteristics:

- (1) Degradable material manufactured into rolls,
- (2) Composed of processed natural or polymer fibers,
- (3) Bound together to provide erosion control and vegetation establishment, and
- (4) Listed on the Erosion Control Technology Council (ECTC) web page.

#### **A.2 Mulch Control Nettings (MCN)**

Provide mulch control nettings meeting the following requirements and characteristics:

- (1) Biodegradable woven extruded geosynthetic mesh,
- (2) Used as a temporary degradable rolled erosion control product to anchor loose fiber mulch, and
- (3) Placed on the bottom of freshly placed sod, on top of hydraulic soil stabilizer, or alone to reinforce the materials during vegetation establishment.

#### **A.3 Open Weave Textile (OWT)**

Provide open weave textile meeting the following requirements and characteristics:

- (1) Degradable rolled erosion control product,

- (2) Composed of processed natural yarns woven into a matrix, and
- (3) Used to provide erosion control and vegetation establishment.

**A.4 Erosion Control Blanket (ECB)**

Provide erosion control blanket meeting the following requirements and characteristics:

- (1) Degradable rolled erosion control product,
- (2) Composed of natural or polymer fibers, and
- (3) Bound together to form a continuous matrix to provide erosion control and establish vegetation.

**A.5 Turf Reinforcement Mat (TRM)**

Provide turf reinforcement mat, also known as erosion stabilization mat, meeting the following requirements and characteristics:

- (1) Rolled erosion control product, and
- (2) Composed of non-degradable synthetic fibers, filaments, nets, and wire mesh.

The Contractor may supplement the TRM material with degradable components processed into a permanent, three-dimensional matrix.

**B Acceptable Types**

**B.1 Erosion Control Nettings; Mulch Control Nettings**

Provide erosion control netting and mulch control netting in accordance with Table 3885-1:

<b>Table 3885-1 Mulch Control Netting Requirements</b>				
<b>Type</b>	<b>ECTC</b>	<b>Minimum Openings, in [mm]</b>	<b>Functional Longevity, months</b>	<b>Minimum Tensile Strength, lb/ft [kN/m]</b>
MCN 1*	1A none	½ [13]	1 – 3	5 [0.073]
MCN 2	2A none	½ [13]	9 – 12	5 [0.073]
MCN 3	3A none	½ [13]	18 – 24	25 [0.36]
* For areas that will be mowed or have animal entrapment concerns in accordance with the DNR permit guidance manual.				

**B.2 Erosion Control Netting; Open weave textile**

Provide erosion control netting made of open weave textile in accordance with Table 3885-2:

<b>Table 3885-2 Open Weave Textile Netting Requirements</b>				
<b>Type</b>	<b>ECTC</b>	<b>Net Open Area, %</b>	<b>Functional Longevity, months</b>	<b>Product</b>
OWT 1	1C	65	3	Natural coir
OWT 2	2C	50	12	Natural coir
OWT 3	3B	39	24	Natural coir

### B.3 Erosion Control Blanket

Provide erosion control blanket in accordance with Table 3885-3:

<b>Table 3885-3 Erosion Control Blanket Requirements</b>				
<b>Type*</b>	<b>ECTC</b>	<b>Service Life, months</b>	<b>Maximum Shear Stress, lb/sq. ft [Pa]  </b>	<b>Minimum Tensile Strength, lb/ft [kN/m]†</b>
1	1C	3	1.5 [72]	50 [0.73]
2	2C	12	1.5 [72]	50 [0.73]
3	2D	12	1.75 [84]	75 [1.09]
4	3B	24	2.00 [96]	100 [1.45]
<p>* If the plans show natural netting or netless, use only that type. Use straw or wood only if shown on the plans.</p> <p>   Provide unvegetated RECP capable of sustaining the shear stress, listed above, without physical damage or excess erosion greater than 0.5 in [12.7 mm] soil loss during a 30 min flow event in large scale testing.</p> <p>† Provide the minimum average roll values, machine direction meeting the requirements of ASTM D 5035, ECTC modified.</p>				

### B.4 Turf Reinforcement Mat

Provide turf reinforcement mat in accordance with Table 3885-4:

<b>Table 3885-4 Turf Reinforcement Mat Requirements</b>				
<b>Type*</b>	<b>ECTC</b>	<b>Maximum Gradient</b>	<b>Maximum Shear Stress, lb/sq. ft [Pa]  </b>	<b>Minimum Tensile Strength, lb/ft [kN/m]†</b>
1	5A	1:0.5 (V:H)	6.0 [288]	125 [1.82]
2	5B	1:0.5 (V:H)	8.0 [384]	150 [2.19]
3	5C	1:0.5 (V:H)	10.0 [480]	175 [2.55]

*	Provide TRM with a thickness of 0.25 in. [6.35 mm], meeting the requirements of ASTM D 6525 and ASTM D 4355, and with a UV stability of 80 percent when exposed for 500 h.
	Provide fully vegetated TRM capable of sustaining the required minimum shear stress without physical damage or excess erosion greater than 0.5 in [12.7 mm] soil loss during a 30 min flow event in large scale testing.
†	Provide minimum average roll values, machine direction for tensile strength determination meeting the requirements of ASTM D 6818.

### C Anchors

Provide anchors for each category blanket in accordance with Table 3885-5:

<b>Table 3885-5 RECP Anchor Requirements</b>				
Description	Use With	Type	Minimum Diameter	Length, in [mm]
Biodegradable	Rapid degrade and natural net RECP	Stake	0.375 in [9.5 mm]	5 [125]
U-wire staple	Loam, clay soil	11 gage	—	6 [150]
	Sandy soil	11 gage	—	8 [200]
Steel pin or nail and washer	Frozen or compacted soils	≥ 1½ in [40 mm] washer	0.188 in [5 mm]	6 [150]

Apply staples at the rate as recommended by the manufacturer or meeting the requirements of the ECTC web page.

### 3885.3 SAMPLING AND TESTING

Submit to the Engineer a manufacturer's Certificate of Compliance or a current QDOR™ status issued by the ECTC.

## 3886 SILT FENCE

### 3886.1 SCOPE

Provide silt fence to retain sediment.



Provide Machine Sliced (MS) silt fence consisting of a woven geotextile fabric installed by machine and supported by steel posts.

Provide Hand Installed (HI) silt fence consisting of a woven geotextile fabric installed by hand and supported by steel posts.

Provide Super Duty (SD) silt fence consisting of concrete or water filled jersey barriers with fabric wrapped around the front face of the barrier. The Contractor may provide woven or non-woven geotextile fabric or poly/poly-reinforced sheeting.

Provide Pre-Assembled (PA) silt fence consisting of a woven geotextile fabric supported by wood posts pre-attached to the fabric.

Provide Turbidity Barrier (TB) silt fence consisting of a low permeable fabric barrier, installed in water and supported by steel cable and steel posts.

### **3886.2 REQUIREMENTS**

Provide geotextiles for MS and HI silt fences from the Approved/Qualified Products List.

#### **A Fabric**

Provide fabric meeting the following requirements and characteristics:

- (1) Uniform in texture,
- (2) Uniform in appearance,
- (3) Contains no defects, flaws, or tears affecting the physical properties,
- (4) Contains UV inhibitors and stabilizers providing a minimum service life of at least 2 years during outdoor exposure, and
- (5) Meets the requirements specified in Table 3886-1:

**Table 3886-1  
Silt Fence Requirements**

<b>Silt Fence Type</b>	<b>Width, in [mm]</b>	<b>Grab Tensile (machine direction), lb [kg]*</b>	<b>Apparent Opening Size   </b>	<b>Puncture Strength†</b>	<b>UV Stability, 500 h, % ‡</b>	<b>Permittivity #</b>	<b>Flow Rates, gpm/sq. ft [L/min/sq. m]</b>
MS, HI woven geotextile §	36 [915]	130 [59]	No. 30 sieve [0.60 mm]	—	70	1.0 s <sup>-1</sup>	100 [4,073]
PA woven geotextile	36 [915]	100 [45]	No. 30 sieve [0.85 mm]	—	70	0.1 s <sup>-1</sup>	5 [170]
SD woven or non-woven geotextile **	36 [915]	100 [59]	No. 30 sieve [0.60 mm]	—	70	—	—
TB woven or non-woven geotextile	36 [915]	200 [91]	—	90 lb [41 kg]	70	1.0 × 10 <sup>-7</sup> cm/s	—

\* ASTM D 4632

|| ASTM D 4751. Maximum average roll value.

† ASTM D 4833

‡ ASTM D 4355

# ASTM D 4491

§ Provide MS, HI woven geotextile with monofilament in both directions. Do not make substitutions.

\*\* The Contractor may use poly/poly-reinforced sheeting with a thickness of at least 6 mil [0.152 mm] or an equivalent.

## B Fasteners

Provide fasteners with a tensile strength of at least 50 lb [22 kg]. Use plastic zip ties to fasten geotextile to posts on MS, HI applications. Use wire ties or plastic zip ties to fasten geotextile to anchor points on SD applications.

## C Supports

Provide steel posts for MS, HI, and TB silt fence types in accordance with 3403, “Hot-Rolled Steel Fence Posts,” and the following:

<b>Characteristic</b>	<b>Requirement</b>
Type	T-post *
Weight	1.25 lb/ft [1.8 kg/m]
Length	≥ 5.0 ft [1.5 m]
Embedment	≥ 24 in [610 mm]
Post spacing	≥ 6.0 ft [1.8 m]
* Provide welded plate for soft soil installations.	

Provide wood posts for PA silt fence type meeting the following requirements:

<b>Characteristic</b>	<b>Requirement</b>
Type	Hardwood
Size	≥ 2 in × 2 in [50 mm × 50 mm]
Length	≥ 4.0 ft [1.25 m]
Embedment	≥ 18 in [460 mm]
Post Spacing	≥ 5.0 ft [1.5 m]

## D Portable Precast Concrete Jersey Barriers

For SD, use portable precast concrete barriers in accordance with 2533, “Portable Precast Concrete Barrier,” for main support and strength. If placing the barrier adjacent to traffic, provide a barrier with a shape meeting the requirements of the standard plates design designation shown on the plans. The Contractor may use barriers meeting obsolete standard plate designs in non-traffic areas.

## E Portable Water Filled Jersey Barriers

For SD, provide main support strength of at least 1,200 lb [544 kg] when filled with water. Provide a plastic, water-filled barrier. If placing the barrier adjacent to traffic, provide a barrier with a shape meeting the requirements of the standard plates design designation shown on the plans.

**F Steel Cable**

Provide a top line for TB made of a  $5/16$  in [8 mm] galvanized steel cable with a breaking strength of at least 9,800 lb [40.0 kN].

**3886.3 SAMPLING AND TESTING**

Provide the following to the Engineer with each shipment of geotextile:

- (1) A manufacturer's Certificate of Compliance, and
- (2) Document stating the manufacturer's minimum average roll values (MARV) and maximum average roll values for the geotextile.

The Department defines MARV as two standard deviations below the mean value of the rolls tested.

**3887 FLOTATION SILT CURTAIN**

**3887.1 SCOPE**

Provide flotation silt curtain to contain suspended sediment and floating debris in open water.

**3887.2 REQUIREMENTS**

Provide floatation silt curtains meeting the following requirements and characteristics:

- (1) Made of fabric fastened to a flotation carrier,
- (2) Weighted along the bottom edge,
- (3) Depth as shown on the plans and referring to the dimension of the curtain fabric extending below the flotation portion of the curtain, and
- (4) Table 3887-1, "Flotation Silt Curtain Requirements."

<b>Table 3887-1 Flotation Silt Curtain Requirements</b>		
<b>Characteristic</b>	<b>Type</b>	
	<b>Light Duty</b>	<b>Heavy Duty</b>
Curtain fabric material type	Impermeable, vinyl-nylon laminate	Impermeable, vinyl-coated nylon
Weight <i>oz per sq. yd</i> <i>[kg per sq. m]</i>	18 [0.6]	0.22 [0.75]

<b>Table 3887-1 Flotation Silt Curtain Requirements</b>		
<b>Characteristic</b>	<b>Type</b>	
	<b>Light Duty</b>	<b>Heavy Duty</b>
Grab tensile strength, <i>lb [kN]*</i>	300 [1.3]	500 [2.2]
Depth of curtain**	2 ft – 10 ft [0.6 m – 3 m]	2 ft – 10 ft [0.6 m – 3 m]
Flotation, <i>in [mm]</i>	6 [150] diameter marine quality expanded polystyrene	8 [200] diameter marine quality expanded polystyrene
Net buoyancy, <i>lb per ft [N per m]</i>	13 [200]	20 [300]
Top load carrying components	Fabric only	Fabric plus <sup>5</sup> / <sub>16</sub> in [8 mm] galvanized steel cable at least 9,800 lb [40 kN] break strength
Ballast	≥0.7 lb per ft [1.0 kg per m] enclosed ¼ in [6 mm] galvanized chain	≥1.1 lb per ft [1.6 kg per m] enclosed <sup>5</sup> / <sub>16</sub> in [8 mm] galvanized chain
Connection between sections	Laced grommets	Aluminum collar reinforced quick disconnects
* Minimum average roll value meeting the requirements of ASTM D 4632		
** As required by the contract.		

Remove the curtain upon completion of work. Do not allow re-suspension of sediment or loss of trash and oil into the water during the curtain removal.

### 3887.3 SAMPLING AND TESTING

Submit to the Engineer a manufacturer's Certificate of Compliance for the flotation silt curtain and components.

## 3890 COMPOST

### 3890.1 SCOPE

Provide compost material for soil amendment for landscape planting or turf establishment.

## **3890.2 REQUIREMENTS**

Provide material from vendors listed on the Approved/Qualified Products List.

Provide compost meeting the US Composting Council Seal of Testing Assurance Program and requirements for animal or plant based feedstocks or the following

- (1) Consists of a natural humus product derived from the aerobic decomposition of organic wastes.
- (2) Considered mature and useable when 60 percent decomposition has been achieved as determined by an ignition-loss analysis test method and any one additional test method including the Solvita test value of equal to or greater than 5. This means that the compost product has no offensive smell, no identifiable organic materials, and will not reheat to more than 20 °F [11 °C] above the ambient temperature.
- (3) Produced by a process to further reduce pathogens (PFRP) and weed seeds, and the process is verified by fecal coliform or *Salmonella sp.* tests, where applicable.
- (4) Compost foreign particle restrictions up to 3 percent at 0.16 in [4 mm] apply to the shredded pieces from the plastic bags used to transport feedstocks to the composting facility, but will be considered acceptable if visible in the finished product.
- (5) Meets the Minnesota Pollution Control Agency requirements for allowable levels of inherent contaminants (Minnesota Rules Chapter 7035.2836 subp. 6 Sec A), or the Code of Federal Regulations, Title 40, section 503.13(b)(3), amended for mercury.

Provide compost that is registered for sale with the State of Minnesota. Do not mix the compost with materials that do not comply with the Minnesota Rules Chapter 7045 (Hazardous Waste). Compost used in Mn/DOT transportation systems must not exceed 10 percent of the Minnesota Pollution Control Agency's Superfund residential soil cleanup guidelines, termed Soil Reference Values or SRVs (i.e. 10% of individual chemical or chemical mixture Hazard Index, Hazard Quotient, or acceptable cancer risk level). No chemical contaminant, including pesticides, can be present in concentrations that would result in toxic effects to soil organisms, plants, or animals that reside in or on the composted soil areas or use the treated area for food or shelter. At the time of delivery to the project, the compost shall be in a condition considered safe for exposure to dusts during handling.

### **A Grade 1 Compost**

Provide Grade 1 compost for use in turf establishment meeting the following requirements and characteristics:

- (1) Nutrient rich type,
- (2) Derived from the decomposition of animal material,
- (3) Texture similar to a highly organic soil, and
- (4) Meeting the requirements of Table 3890-1.

<b>Table 3890-1</b>	
<b>Grade 1 Compost Requirements</b>	
<b>Requirement</b>	<b>Range</b>
Organic matter content	≥ 30%
C/N ratio	6:1 – 20:1
NPK ratios*	2:2:1 – 4:4:2
pH	5.5 – 8.0
Moisture content	35% – 55%
Bulk density	700 lb per cu. yd – 1,600 lb per cu. yd [415 kg per cu. m – 950 kg per cu. m]
Inert material	≥ 3% at 0.15 in [4 mm]
Soluble salts	≤ 10 mmho per cm
Germination test	80% – 100%
Screened particle size	≤ 3.75 in [10 mm]
* To obtain the nitrogen, phosphorus, or potassium levels specified, the compost may be fortified with commercial fertilizer.	
Germination test must list the species of Cress or lettuce seed used.	

## **B Grade 2 Compost**

Provide Grade 2 compost as a landscape planting medium and meeting the following requirements:

- (1) Humus-rich type,
- (2) Derived from the decomposition of leaves and yard wastes,
- (3) Texture similar to a shredded peat, and
- (4) Meeting the requirements of Table 3890-2:

<b>Table 3890-2</b>	
<b>Grade 2 Compost Requirements</b>	
<b>Requirement</b>	<b>Range</b>
Organic matter content	≥ 30 %
C/N ratio	6:1 – 20:1
pH	5.5 – 8.5
Moisture content	35% – 55%
Bulk density	700 lb per cu. yd – 1,600 lb per cu. yd [415 kg per cu. m – 890 kg per cu. m]
Inert material *	≥ 3% at 0.15 in [4 mm]

Soluble salts	$\leq 10$ mmho per cm
Germination test	80% – 100%
Screened particle size	$\leq \frac{3}{4}$ in [19 mm]
* Includes plastic bag shreds.	
Germination test must list the species of Cress or lettuce seed used.	

Do not use manure at any stage of decomposition.

### C Grade 3 Compost

Provide Grade 3 as a blend of Grade 2 compost and no greater than 10 percent Grade 1 compost.

### 3890.3 SAMPLING AND TESTING

Before delivery of the compost to the project, submit to the Engineer certified test reports and a manufacturer's Certificates of Compliance.

If federal or state chemical specific requirements conflict, provide compost meeting the most stringent requirement.

## 3892 TEMPORARY SLOPE DRAIN

### 3892.1 SCOPE

Provide material for temporary slope drains to intercept, direct, and convey surface runoff or ground water down an embankment to control erosion.

### 3892.2 REQUIREMENTS

#### A General

Provide temporary slope drains consisting of the following:

- (1) Non-perforated, corrugated polyethylene pipe (HDPE) meeting the requirements of AASHTO M 252,
- (2) Corrugated metal pipe, or
- (3) Heavy duty flexible tubing.

Provide each slope drain with the same diameter pipe over the entire length of the drain. Size temporary slope drains in accordance with Table 3892-1.

<p><b>Table 3892-1</b> <b>Slope Drain Sizing</b></p>
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<b>Drainage Area, acres [ha]</b>	<b>Pipe Diameter, in [mm]</b>
0–0.5 [0–0.2]	12 [300]
> 0.5–1.5 [0.2–0.61]	18 [450]
> 1.5–2.5 [0.61–1.01]	21 [525]
> 2.5–3.5 [1.01–1.42]	24 [600]
> 3.5–5.0 [1.42–2.02]	30 [750]

Place slope drain in conjunction with diversion mounds or dykes.

## **B End sections**

### **B.1 Inlet end**

Use a watertight connection to attach the flared end section to the inlet end of pipe. Construct dikes to direct storm water runoff into the temporary slope drains. Construct the top of the earth dike over the inlet pipe and the tops of dikes carrying water to the pipe least 1 ft [0.3 m] higher than the top of the inlet pipe.

### **B.2 Outlet end**

For a pipe slope drain with an outlet into a sediment trapping device, construct the discharge at the riser crest or weir elevation. Use a riprap apron or energy dissipation device below the pipe outlet for discharging clean water into a stabilized area.

## **C Joints**

Use watertight connecting bands to connect pipe sections.

## **D Anchors**

Anchor the slope drain with stakes in accordance with the following characteristics and requirements:

- (1) Nominal 2 in × 2 in [50 mm × 50 mm] cross-section,
- (2) At least 3 ft [1 m] long,
- (3) Pointed end, and
- (4) Spacing between the stake installations no greater than 8 ft [2.5 m].

## **E Bedding**

Hand tamp the soil around and under the entrance section in 4 in [100 mm] layers to the top of the earth dike to prevent piping failure around the inlet.

## **3892.3 SAMPLING AND TESTING**

The Engineer will visually inspect temporary slope drains.

## 3893 SANDBAGS

### 3893.1 SCOPE

Provide material for sandbags to dike-off construction areas or serve as temporary erosion control installations.

### 3893.2 REQUIREMENTS

Use sandbags consisting of a woven polypropylene fabric sewn together with double stitching. Provide polypropylene fabric in accordance with Table 3839-1:

<b>Table 3839-1 Polypropylene Fabric Properties</b>		
<b>Property</b>	<b>Test</b>	<b>Minimum Tolerance</b>
Grab Tensile Strength	ASTM D 4632	420 N
UV Stability	ASTM D 4355	70%

Provide sandbags with an overall size of at least 14 in × 26 in [350 mm × 650 mm].

### 3893.3 SAMPLING AND TESTING — (BLANK)

## 3896 SOIL AND ROOT ADDITIVES

### 3896.1 SCOPE

Provide soil and root additives to improve soil or root stock to stimulate growth, and improve the health of plant stock or seed.

### 3896.2 REQUIREMENTS

Provide soil and root additives registered and approved for sale in Minnesota by the Department of Agriculture (MDA), listed on the Approved/Qualified Products List by the Department's Erosion and Stormwater Management Unit, and meeting the following requirements as required by the contract:

#### **A Plant Hormones**

Provide rooting hormone powder or liquid to stimulate rooting of plant cuttings, bare root stock, and perennial plant material. The material shall contain known root hormones including any of the following:

- (1) Indole-3-butyric acid (IBA),
- (2) Indole acetic acid (IAA), or
- (3) Cytokinins.

Provide powder that does not contain inert ingredients that are harmful to the environment.

## **B Hydrophilic Polymers**

Provide super-absorbent polymer or hydrophilic compound meeting the following requirements and characteristics:

- (1) Organic,
- (2) Made of fully biodegradable cross-linked polymer or other hydroscopic compound with water-binding groups,
- (3) Minimum life span of at least 60 days in the soil.
- (4) Consists of the following:
  - (4.1) Potassium polyacrylate/polyacrylamide copolymer,
  - (4.2) Sugar alcohols,
  - (4.3) Polysaccharides,
  - (4.4) Humates, and
  - (4.5) Alpha-hydroxypropionic acid or other documented hydrophilic compound.

Apply the hydrophilic polymers at the rate recommended by the manufacturer.

## **C Mycorrhizal Inoculum**

Provide mycorrhizal inoculum meeting the following requirements and characteristics:

- (1) Contains microorganisms symbiotic with and beneficial to plant roots;
- (2) Capable of being applied to the soil or base of a plant as a liquid, powder, or pellet; and
- (3) Contains defined live spore count.

When known, use Minnesota origin materials. Apply the mycorrhizal inoculum as recommended by the manufacturer for new plantings. Provide a mycorrhizal inoculum that does not contain antagonistic pathogens or at trace levels as defined by the MDA.

### **C.1 Type 1**

Type 1 is for use with native grass plantings. Provide species of Endomycorrhizal fungi containing at least 3 species of glumos fungi. Additional species of *Gigaspora*,

*Scutellospora*, *Entrophospora*, *Acaulospora*, or *Sclerocystis* may also be present. Ectomycorrhizal species of *Pisolithus* or *Rhizopogon* can also be present.

## **C.2 Type 2**

Type 2 is for use with plant stock, such as shrubs, trees etc. Provide species of ectomycorrhizal fungi containing species of *Rhizopogon* fungi and other cold tolerant species.

### **D Iron Sulfate**

Provide ferric sulfate or ferrous sulfate in pellet or granular form containing at least 18.5 percent iron expressed as metallic iron to lower pH. The Engineer will accept the product based on information contained on its label.

### **E Activated Charcoal**

Provide activated charcoal to neutralize or deactivate residual organic pesticide or chemical contaminants in the soil meeting the following requirements:

- (1) Finely ground to increase absorptive surfaces, and
- (2) Electrically charged to attract the molecules of organic chemicals.

### **F Rhizobium Inoculum**

Provide rhizobium inoculum as a delivery system of living organisms to address atmospheric nitrogen when part of native and non-native legume plant roots and meeting the following characteristics and requirements:

- (1) Sterilized carbon based carrier (lignite/charcoal, peat, or compost) of legume specific rhizobium strains;
- (2) Capable of being applied with a sticking agent to legume seeds or broadcast during seeding and some fertilizing operations;
- (3) Within 1 pH unit of neutral;
- (4) Particles size based on manufacturer recommended application and installation method;
- (5) Low level of measurable contaminants based on Pikovskave, SS Malate Medium; and
- (6) Capable of maintaining appropriate moisture and air content for living nitrogen fixing organisms.

Store rhizobium inoculum at temperatures from 40 °F to 77 °F [4 °C to 25 °C] and away from direct sunlight. Use the rhizobium inoculum per the manufacturer's recommendations. Do not use pesticides, some seed treatments, and typical chloride-based fertilizers.

Provide non-native legume rhizobium inoculum for clovers and alfalfa crop species on lignite or charcoal carriers.

Provide native legume seed rhizobium inoculum for seeds of native legumes of *Amorpha*, *Astragalus*, *Chamaecrista*, *Dalea*, *Desmodium*, and *Lespedeza* species seed-applied on peat or compost carrier.

Provide native legume-broadcast rhizobium inoculum for native legumes of *Amorpha*, *Astragalus*, *Chamaecrista*, *Dalea*, *Desmodium*, and *Lespedeza* species broadcast on a peat or clay carrier in a pelletized form.

## **G Compost Tea**

Provide commercially produced compost tea produced from compost in accordance with 3890 and containing the following biological organisms based on certified test results:

- (1) Active bacteria: At least 15 µg per gram of compost,
- (2) Total bacteria: At least 150 µg per gram of compost,
- (3) Active fungi: At least 15 µg per gram of compost,
- (4) Total fungi: At least 150 µg per gram of compost,
- (5) Average fungal hyphal diameter: At least 1/8 in [3.5 mm],
- (6) Individual fungal hyphal diameter: At least 3/32 in [2.5 mm],
- (7) The following types of protozoa:
  - (7.1) At least 8,000 flagellates per gram of compost,
  - (7.2) At least 8,000 amoebae per gram of compost, and
  - (7.3) Zero ciliates per gram of compost.

Aerobic nematodes are acceptable if present.

Anaerobic root nematodes or nematode feeding nematodes are not acceptable.

The Contractor may choose to modify the Compost Tea by one of the two following methods:

### **G.1 Bacteria-Dominated Compost Tea**

Provide bacteria-dominated compost tea consisting of the following:

- (1) High-nitrogen feedstocks, and
- (2) Green materials including the following:
  - (2.1) Manure,
  - (2.2) Grass clippings,
  - (2.3) Legumes including alfalfa, peas, clover, and bean plant residues,

- (2.4) Additional green feedstock materials containing sugars and proteins may include any green plant debris, plant based food scraps, and coffee grounds.

Use bacteria-dominated compost tea as a foliar spray for herbaceous plants and turf grass to prevent foliar diseases.

## **G.2 Fungi-Dominated Compost Tea**

Provide fungi-dominated compost tea consisting of the following:

- (1) Animal manure,
- (2) Green plant material, and
- (3) Shredded wood material including the following:
  - (3.1) Wood chips,
  - (3.2) Saw dust, and
  - (3.3) Paper products.

Use fungi-dominated compost tea to suppress woody plant diseases and to introduce beneficial fungi for root development immediately after tree planting.

## **H (Blank)**

### **3896.3 SAMPLING AND TESTING — (BLANK)**

## **3897 SEDIMENT CONTROL LOG**

### **3897.1 SCOPE**

Provide sediment control logs for slowing water velocities, filtering sediment, and diverting storm water runoff.

### **3897.2 REQUIREMENTS**

Use sediment control logs required by the contract and meeting the following requirements for perimeter protection, slope breaks, ditch checks, inlet protection, and flow diversions for small drainage areas less than ¼ acre and ½ cfs [0.01 cu. ms]. Stake and install in accordance with 2573, "Storm Water Management."

#### **A Straw**

Provide straw logs consisting of Type 1 straw mulch in accordance with the following requirements and characteristics:

- (1) Free of seed bearing stalks of noxious grasses or weeds as defined by the rules and regulations of the Minnesota Department of Agriculture,
- (2) Encased in polypropylene netting capable of photo degrading from 6 months to 9 months and with openings  $\frac{1}{2}$  in  $\times$   $\frac{1}{2}$  in [13 mm  $\times$  13 mm],
- (3) Forming a cylindrical log with a diameter from 8 in to 9 in [200 mm to 225 mm], and
- (4) With a density from 2 lb per cu. ft to 4 lb per cu. ft [32 kg per cu. m to 64 kg per cu. m].

## **B Wood Fiber**

Provide wood fiber logs made of excelsior fibers in accordance with the following requirements and characteristics:

- (1) Encased in a polypropylene netting capable of photo degrading from 9 months to 12 months and with openings  $\frac{1}{2}$  in  $\times$   $\frac{1}{2}$  in [13 mm  $\times$  13 mm],
- (2) Forming a cylindrical log with a diameter from 6 in to 7 in [150 mm to 175 mm]
- (3) Consisting of at least 80 percent of the fiber material at least 6 in [150 mm] long,
- (4) With a density from 1.4 lb per cu. ft to 3.6 lb per cu. ft [22 kg per cu. m to 58 kg per cu. m], and
- (5) With a flow through rate of at least 40 gpm per ft [492 L/min per m].

## **C Coir**

Provide coir logs consisting of compressed natural coir coconut fibers in accordance with the following requirements and characteristics:

- (1) Coir coconut fibers placed in coir netting,
- (2) With a density of at least 5 lb per cu. ft [7.5 kg per cu. m],
- (3) Having a diameter of at least 8 in [200 mm], and
- (5) With a service life of at least 5 years.

## **D Wood Chip**

Provide wood chip logs consisting of Type 5 mulch in accordance with the following requirements and characteristics:

- (1) Encased in a photodegradable geotextile or natural fiber sock capable of photo degrading from 6 months to 9 months,
- (2) Containing 100 percent mulch material passing a 4 in [100 mm] sieve,
- (3) Containing no greater than 20 percent by weight of the material passing a 0.1 in [2.36 mm] sieve, and
- (4) Forming a cylindrical log with a diameter of 9 in [225 mm].

**E Compost**

Provide compost logs meeting the following characteristics and requirements:

- (1) Consisting of a blend of weed free compost and partially decomposed wood chips meeting the following requirements and characteristics:
  - (1.1) From 30 percent to 40 percent weed free, Grade 2 compost in accordance with 3890, "Compost,"
  - (1.2) From 60 percent to 70 percent partially decomposed wood chips,
  - (1.3) Containing 100 percent compost passing a 2 in [51 mm] sieve with at least 70 percent compost retained on the  $\frac{3}{8}$  in [10 mm] sieve, and
  - (1.4) Pneumatically shot into the casing.
- (2) Forming a cylindrical geotextile casing sock made of a natural fiber material capable of photo degrading from 6 months to 9 months, and with  $\frac{3}{8}$  in [10 mm] openings not limiting water infiltration,
- (3) With an 8 in [200 mm] diameter, and
- (4) With a flow rate of at least 10 gpm per ft [125 L/min per m].

**F (Blank)****G Rock**

Wash aggregate before placing in a rock bag. Provide Class D rock for logs in accordance with 3137, "Coarse Aggregate for Portland Cement Concrete," and meeting the following requirements and characteristics:

- (1) Gradation in accordance with Table 3137-1, "Coarse Aggregate for General Use," CA-3 or equivalent,
- (2) Photo degradable geotextile casing material with a grab tensile strength of at least 130 lbf [575 N] and a Mullen Burst Strength of at least 175 psi [1,200 kPa], and
- (3) Casing material from 4 in to 6 in [100 mm to 150 mm] in diameter when filled with rock.

**3897.3 SAMPLING AND TESTING**

Provide samples and sample sizes meeting the Schedule of Materials Control.



## **3898 FLOCCULANTS**

### **3898.1 SCOPE**

Provide naturally derived additives for coagulating dispersed clays, and reducing turbidity in storm water runoff and use flocculants as part of a designed storm water treatment system.

### **3898.2 REQUIREMENTS**

Use environmentally benign flocculants that are biodegradable and consist of natural origin biopolymers to improve water quality and protect aquatic biota.

Use flocculants meeting the following requirements detailed by each type.

#### **A Liquid Flocculant**

Store the flocculant in a concentrated liquid state. Ensure the manufacture's label is affixed to the container and lists the percent of concentration in the container and the application dose rate. Obtain the Engineer's verification of the dose rate calculations before applying to the treatment system.

#### **B Flocculant Sock**

Use flocculant in a gelatin-like state, packaged in individual compartments of the encasing sock material. Ensure the encasing material allows water to flow through it so the water comes in contact with the gelatin-like flocculant material.

Use a Flocculant Sock with attachment anchor cords or grommets for use in pipes, sediment control filter systems, and ditch bottoms.

Provide a Flocculant Sock capable of treating at least 250,000 gal [945 cu. m] of the water flowing through it.

#### **C Granular Flocculant**

Store the flocculant in a granulated state. Ensure the manufacture's label is affixed to the bag or container and states the purity of the product and the application mixing rate. Obtain the Engineer's verification of the dose rate calculations before applying the treatment system.

### **3898.3 SAMPLING AND TESTING**

Before delivery and use on the project, submit to the Engineer a Certificate of Compliance and MSDS for approval.