STANDARD SPECIFICATIONS FOR CONSTRUCTION

2020 EDITION

VOLUME 1

Changes from the 2018 Edition

Vertical change lines have been added to indicate text that has changed from the 2018 Edition. These change lines are intended as a courtesy to the reader, and MnDOT does not guarantee that all text changes are indicated by change lines.

- Change lines are in the left and right margins bordering paragraphs with change(s). The change lines border the whole paragraph, even if only one line in the paragraph has changed.
- For tables, each row with change(s) has heavy vertical outside border lines on both sides.

MINNESOTA

DEPARTMENT OF TRANSPORTATION

ST. PAUL, MINNESOTA

STANDARD SPECIFICATIONS FOR CONSTRUCTION

2020 EDITION

VOLUME 1

ORDER NUMBER 98833

It is hereby ordered that these Minnesota Department of Transportation Standard Specifications for Construction, 2020 Edition, be adopted for application of State and Federal Aid construction Contracts awarded in Minnesota.

Upon being published and made available for distribution, these Standard Specifications shall become effective by reference in the Contract Plans, Supplemental Specifications, or Special Provisions.

Nancy Daubenberger Digitally signed by Nancy Daubenberger Date: 2021.02.22 14:12:51 -06'00'

Nancy J. Daubenberger
Deputy Commissioner of Transportation
Chief Engineer

These Minnesota Department of Transportation Standard Specifications for Construction, 2020 Edition, are hereby approved for application on Highway, Street and related construction Contracts as referenced in the Contract Plans, Supplemental Specifications, or Special Provisions and they shall apply as noted and amended by those documents.

Thomas Ravn Digitally signed by Thomas Ravn Date: 2021.02.22 14:02:25 -06'00'

Thomas D. Ravn
State Construction Engineer

I hereby certify that the changes contained in these Minnesota Department of Transportation Standard Specifications for Construction, 2020 Edition, were prepared by me or under my general supervision and that I am a duly registered professional engineer under the laws of the State of Minnesota.

Mark Gieseke Digitally signed by Mark Gieseke Date: 2021.02.22 13:58:32 -06'00'

Mark Gieseke
Assistant Commissioner
Reg. No. 18962

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DIVISION I

GENERAL REQUIREMENTS AND COVENANT

Definitions and Terms

1101 WORDING OF SPECIFICATIONS

Since the 2014 edition, the Minnesota Department of Transportation's *Standard Specification for Construction* (Standard Specifications) has emphasized the active voice. In Division 1, the Contractor's and Department's responsibilities are written in the active voice-indicative mood. In a sentence written in the active voice-indicative mood, someone acts on something. For example: "The Engineer will take a sample."

In Divisions 2 and 3, only the Department's responsibilities are written in the active voice-indicative mood.

In Divisions 2 and 3, the Contractor's responsibilities are written in active voice-imperative mood; the Department states its requirements or directions for performing the Work to the Contractor. The imperative mood is used when the party issuing an instruction and the party receiving it are already understood. Such statements have the same force as if they contained the word "shall" and are considered mandatory. In an imperative sentence such as, "Pour the concrete," the Department is indicating that it requires the Contractor to pour the concrete. In the Material Specifications in Division 3, the subject may also be the supplier, fabricator, or manufacturer supplying the Materials, products, or Equipment for use on the Project.

1102 ABBREVIATIONS AND MEASUREMENT UNITS

1102.1 GLOSSARY OF ACRONYMS AND ABBREVIATIONS

Acronyms and abbreviations in the Contract documents represent the full text shown in Table 1102.1-1.

Table 1102.1-1
Acronyms and Abbreviations Used

Acronym or Short Form	Full Name or Meaning
AA	Aluminum Alloy
AASHTO	American Association of State Highway and Transportation Officials
AC	Alternating Current
ACI	American Concrete Institute
ADA	Americans with Disabilities Act
AES	Area of Environmental Sensitivity
AGC	Associated General Contractors of America, Inc.
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALR	Areas of Localized Roughness
AMS	Alpha Methyl Styrene
ANSI	American National Standards Institute
APL	Approved/Qualified Products List
APS	Accessible Pedestrian Signal
ARTBA	American Road & Transportation Builders Association
ASME	American Society of Mechanical Engineers

Acronym or Short Form	Full Name or Meaning
ASR	Alkali Silica Reactivity
ASTM	ASTM International; formerly American Society of Testing and Materials
ATR	Automatic Traffic Recorder
AWG	American Wire Gauge
AWPA	American Wood Protection Association
AWS	American Welding Society
BMP	Best Management Practice
CA	Corrugated Aluminum
CAS	Corrugated Aluminized Steel
CCTV	Closed Circuit Television
CIP	Cast-In-Place
CLSM	Controlled Low Strength Material
CMP	Communications Plenum Cable or Corrugated Metal Pipe
CMS	Changeable Message Sign
COAX	Radio Frequency Transmission Cable (Coaxial Cable)
CP	Corrugated Polyethylene
CPR	Concrete Pavement Rehabilitation
CRCP	Continually Reinforced Concrete Pavement
CRSI	Concrete Reinforcing Steel Institute
CS	Corrugated Steel
CV	Compacted Volume
DBE	Disadvantage Business Enterprise
DBR	Dowel Bar Retrofit
DCP	Dynamic Cone Penetrometer or Penetration Index Method
DFT	Dry Film Paint Thickness
DSB	Drainable Stable Base
DTI	Direct Tension Indicator
EEO	Equal Employment Opportunity
EIA	Electronic Industries Alliance
EV	Excavated Volume
EVP	Emergency Vehicle Pre-Emption
FAA	Fine Aggregate Angularity
FAA	Federal Aviation Administration
FDR	Full Depth Reclamation
FHWA	Federal Highway Administration, U.S. Department of Transportation
HDPE	High Density Polyethylene
HE	High Early
HH	Handhole
HMA	Hot Mix Asphalt
HPS	High Pressure Sodium
ICAMMLP	Inspection and Contract Administration Manual for MnDOT Landscape Projects
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineers Society
IMC	Intermediate Metal Conduit
IP	Inertial Profiler
IRI	International Roughness Index
ISO	International Organization for Standardization or formerly Insurance Services Office (depends on context)

Acronym or Short Form	Full Name or Meaning
ISSA	International Slurry Surfacing Association
ITC	Information Transmission Capacity
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
JMF	Job Mix Formula used in the Bituminous Specifications
KML	Keyhole Markup Language
kVA	Kilovolt Ampere
LED	Light Emitting Diode
LV	Loose Volume for Measurements, or Leveling Course for Bituminous
MAR	Maintenance Access Route
MASH	Manual for Assessing Safety Hardware
MDA	Minnesota Department of Agriculture
MDR	Mixture Design Report used in the Bituminous Specifications
MN MUTCD	Minnesota Manual on Uniform Traffic Control Devices
MN Statutes	Minnesota Statutes
MnDOT	Minnesota Department of Transportation
MPCA	Minnesota Pollution Control Agency
MRI	Mean Roughness Index
MSDS	Material Safety Data Sheets
NCR	Nonconformance Report
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NMC	Non-Metallic Conduit
No.	When reference is to wire, it is the AWG gauge number.
NPDES	National Pollutant Discharge Elimination System
NRTL	National Recognized Testing Laboratory
OGAB	Open Graded Aggregate Base
OSHA	Occupational Safety and Health Administration
(P)	Plan Quantity as Defined in 1103, “Definitions”
PAR	Pedestrian Access Route
PASB	Permeable Asphalt Stabilized Base
PASSRC	Permeable Asphalt Stabilized Stress Relief Course
PCC	Portland cement concrete
PC-CS	Polymeric Coated-Corrugated Steel
PCI	Precast/Prestressed Concrete Institute
PE	Polyethylene
PG	Performance Grade (for bituminous)
PLS	Pure Live Seed
PPF	Pavement Profile File
ProVAL	Profile Viewing and Analysis
PROWAG	Proposed Right-of-way Accessibility Guidelines
PTL	Plan Thickness Lot
PVC	Polyvinyl Chloride or Probe Verification Core
QA	Quality Assurance
QAC	Quality Acceptance Core
QAI	Quality Assurance Inspector
QC	Quality Control
QCP	Quality Control Plan or Quality Control Probing

Acronym or Short Form	Full Name or Meaning
RAP	Recycled Asphaltic Pavement
RAS	Recycled Asphalt Shingles
REA	Rural Electrification Administration
RLF	Rural Lighting and Flasher
RSC	Rigid Steel Conduit
SAE	SAE International; formerly the Society of Automotive Engineers
SAP	State-aid Project Number
SFDR	Stabilized Full Depth Reclamation
SI	International System of Units (The Modernized Metric System)
SP	State Project Number
SSPC	Society for Protective Coatings
SV	Stockpiled Volume
SWPPP	Storm Water Pollution Prevention Plan
TGB	Targeted Group Business
TH	Trunk Highway
TMS	Traffic Management System
TP	Thermoplastic
UL	Underwriters Laboratories, Inc.
USCG	United States Coast Guard
USDA	United States Department of Agriculture
UTBWC	Ultra Thin Bonded Wearing Course
UV	Ultraviolet
VAC	Volt Alternating Current (60 Hz)
VDC	Volt Direct Current
VT	Verification Test
W/C	Water/Cement Ratio
XHHW	Moisture and Heat Resistant Cross Linked Synthetic Polymer

1102.2 UNITS OF SIZE AND MEASUREMENT

The Contract documents show sizes and measurements in inch-pound (U.S. Customary).

When reading the Contract documents, use the system of measurements used by the Department on the Bid Schedule.

Table 1102.2-1
Symbols for US Customary Measurement Units

Symbol	Units (Kind of Quantity Measurement)
A	ampere (electric current)
acre	acre (area)
cal	calorie (energy)
cu yd	cubic yard (volume)
°F	degree Fahrenheit (temperature)
F	farad (electric capacitance)
ft/s	feet per second (velocity)
ft lbf	foot pound (torque)
gal	gallon (volume)
gpm	gallons per minute (flow rate)
H	henry (inductance)
Hz	hertz (frequency - cycles or impulses per second)

Symbol	Units (Kind of Quantity Measurement)
mph	miles per hour (velocity)
Ω	ohm (electric resistance)
oz	ounce (mass)
lbf	pound-force (force)
psi	pounds per square inch (pressure, stress)
s	second (time)
S	siemens (electrical conductance)
sq yd	square yard (area)
T	ton (mass)
V	volt (electric potential)
W	watt (power)
yard	yard (length)
MBM	1000 board feet measure
M gallon	1000 gallons (volume)

Table 1102.2-2
Symbols for Metric Measurement Units

Symbol	Units (Kind of Quantity Measurement)
A	ampere (electric current)
Cd	candela (luminous intensity)
cu m	cubic meter (volume)
cu m/s	cubic meters per second (flow rate)
°C	degree Celsius (temperature)
F	farad (electric capacitance)
G	gram (mass)
ha	hectare (area)
Hz	hertz (frequency - cycles or impulses per second)
J	joule (energy)
km/h	kilometer per hour (velocity)
L	liter (volume)
M	meter (length)
m/s	meters per second (velocity)
T	metric ton (mass)
N	newton (force)
Ω	ohm (electric resistance)
N●m	newton meter (torque)
Pa	pascal (pressure, stress)
s	second (time)
S	siemens (electrical conductance)
sq km	square kilometer (area)
sq m	square meter (area)
V	volt (electric potential)
W	watt (power)

1103 DEFINITIONS

Unless another intention clearly appears, words and phrases (including technical words and phrases and such others as have acquired a special meaning) shall be construed according to rules of grammar and according to general usage.

Wherever the following terms, or pronouns in place of them, are used in the Contract documents, the intent and meaning shall be interpreted as follows:

Activity
A discrete, identifiable task or event that takes time, can be measured, has a definable start and finish date, furthers the Work's progress, and can be used to plan, schedule, and monitor a Project.

Activity Code
A predefined code in P6 assigned to an Activity to group or categorize its properties.

Activity Count
The number of Activities Included in a schedule.

Activity ID
A unique identification code assigned to an Activity that remains constant throughout the Project. An Activity ID may contain letters, numbers, special characters, or any combination thereof.

Activity Name
A unique description assigned to an Activity using the Verb, Object, Location (VOL) format which defines the Work to be performed during the Activity in the schedule. An Activity Name may also be referred to as an Activity description.

As-built Schedule
The final schedule submitted by the Contractor with actual start and finish dates for each Activity.

Addendum
A supplement to the Proposal Package covering additions, corrections, or changes in the bidding conditions for the advertised Work that is issued by the Department to prospective Bidders before the date and time for opening Proposals.

Advertisement For Bids
The public announcement, as required by law, inviting Proposals for the Work to be performed or Materials to be furnished.

Aggregate
Natural materials such as sand, Gravel, crushed rock, or taconite tailings, and crushed concrete or salvaged bituminous mixtures, usually with a specified particle size, for use in base course construction, paving mixtures, and other applications.

Approved/Qualified Products List
A list of products that the Department has pre-approved or pre-qualified for use on a Project. The Department uses this list to verify the acceptability of products used in the performance of the Work. Products on an *Approved Products List* have been approved for a specific use as defined in the relevant technical section of the Specifications; whereas, products on a *Qualified Products List* are qualified as having met specific minimum requirements as defined in the relevant technical section of the Specifications, but the Specifications may require further sampling, testing, and inspection specific to the product use.

Areas of Environmental Sensitivity
An area on the Project that the Contract has identified to need special protection during construction, including, but not limited to areas needing protection of habitat, wildlife,

recreational or cultural resources/properties, ecological significance, geological features, visual quality, or its sensitivity to disturbance.

Areas of Localized Roughness
Areas greater than or equal to the limiting criteria for a continuous MRI calculation with a 25 foot interval, as calculated using the FHWA's Profile Viewing and Analysis (ProVAL) software application.

Auxiliary Lane
The portion of the Roadway adjoining the Traveled Way for parking, speed-change, or other purposes supplementary to through traffic movement.

Award
The Department's selection of a Bidder's Proposal, subject to execution and approval of the Contract.

Bar Chart
A graphic representation of a Project that shows the Activities for the Project as rectangles placed on a time scale.

Bar Chart Schedule
A schedule format which includes an Activity information table and Bar Chart.

Baseline Schedule
A schedule which represents the Contractor's planned timing and sequencing to accomplish the entire Project scope of Work within the Contract Time. Once accepted by the Department, the Baseline Schedule becomes the Progress Schedule.

Best Management Practices (BMP)
Management practices for erosion prevention, sediment control, dust control, and water quality that are the most effective and practicable means of controlling, preventing, and minimizing degradation of surface water, including avoidance of impacts, construction-phasing, minimizing the length of time soil areas are exposed, prohibitions, and other management practices published by state or designated area-wide planning agencies.

Bid Schedule
A listing of Contract Items in the Proposal Form showing quantities and units of measurement that provides for the Bidder to insert bid Unit Prices.

Bidder
An individual, firm, or corporation submitting a Proposal for the advertised Work.

Bituminous Engineer
The Department engineer responsible for statewide guidance on bituminous mixtures and pavements. This individual has responsibilities delegated from the Materials Engineer.

Bituminous Manual
A Department manual that contains the requirements governing quality and use of Materials related to bituminous applications, the fundamental principles involved in bituminous surfacing, descriptions of procedures for practical application, and information on bituminous mixtures, Equipment and calibrations, and sampling and testing methods. References to the *Bituminous Manual* from the Contract are to the edition in effect on the letting date.

Bridge
Per MN Statutes §165.01 Subd. 3, a "Bridge" is defined as a Structure, including supports, erected over a depression or an obstruction, such as water, Highway, or railroad, and having a track or passageway for carrying traffic or other moving loads and having an opening measured horizontally along the center of the Roadway of ten feet or more between under copings of abutments, between spring line of arches, or between extreme ends of openings for multiple boxes. Bridge also includes multiple pipes where the clear distance between openings is less than half of the smaller contiguous opening.

Bridge Construction Manual
A Department manual that promotes uniform inspection and interpretation of the Specifications related to Bridge construction. The *Bridge Construction Manual* contains information on surveying and staking, preparation of foundations and backfill, pile driving, false work and forms, reinforcement, concrete Bridge construction, steel construction, timber construction, surface preparation, painting of structural steel, construction on railroad right-of-way, and conduit systems. References to the *Bridge Construction Manual* from the Contract are to the edition in effect on the letting date.

Bridge Engineer
The Director of the Department's Office of Bridges and Structures, acting directly or through an authorized representative within the scope of the particular duties or functional unit referenced in the Contract.

Brush
Shrubs, trees, and other plant life having a diameter of 4 inches or less at a point 24 inches above the ground surface, as well as fallen trees and branches.

Building, Bridge Demolition, and Relocation Website
A Department Regulated Material Management website that provides assistance on building demolition/relocation and Bridge demolition/rehabilitation projects to ensure proper identification and management of regulated Materials.

Business Day
Every day on the calendar, except Saturday, Sunday, and Holidays.

Calendar Day
Every day on the calendar.

Carbonate
Sedimentary rock composed primarily of Carbonate minerals, including dolostone (dolomite, $CaMg(CO_3)_2$), Limestone (calcite, $CaCO_3$) and mixtures of dolostone and Limestone.

Certificate of Compliance
A certificate obtained by the Contractor from the manufacturer, producer, or supplier of a product and submitted to the Department that certifies that the product, as provided to the Contractor, complies with the relevant Contract requirements in accordance with 1603, "Materials: Specifications, Samples, Tests, and Acceptance."

Certified CCTV Technician
An individual certified by the Contractor and approved by the Engineer to perform all Work associated with a CCTV system.

Certified Test Report
A test report obtained by the Contractor from the manufacturer, producer, or supplier of a product and submitted to the Department that indicates actual results of tests or analyses, covering elements of the Contract documents for the product or workmanship, and includes validated certification.

Change Order
A written agreement between the Department and the Contractor, executed on the prescribed form and approved as required by law, covering the performance of extra work or other alterations or adjustments to the Contract.

Chemical Laboratory Director
The Department representative responsible for the supervision of the Analytical and Binder Laboratories located within the Office of Materials and Road Research. This individual has responsibilities delegated from the Materials Engineer.

City, County, or Township
A political subdivision of the State used to designate or identify the location of the proposed Work.

Commissioner
The Commissioner of the Department, or the chief executive of the political subdivision, governmental body, board, commission, office, department, division, or agency constituted for administration of the Contract within its jurisdiction.

Completion Date
The date by which the Work is specified to be completed.

Concrete Engineer
The Department engineer responsible for statewide guidance on concrete mixtures and pavements. This individual has responsibilities delegated from the Materials Engineer.

Concrete Manual
A Department manual that establishes fundamental principles of concrete construction, provides test methods and inspection procedures for control of concrete production and placement, and includes Materials and Materials testing, properties and mix designations, mix design, batching and mixing placement operations, reports and work sheets, charts and other data. References to the *Concrete Manual* from the Contract are to the edition in effect on the letting date.

Constraint (CPM only)
A restriction placed on an Activity that may restrict or distribute Float for a network or sub-network of Logic.

Contract
The written agreement between the Department and the Contractor setting forth their obligations, including, but not limited to, the performance of the Work, the furnishing of labor and Materials, the basis of payment, and other requirements contained in the Contract documents. The Contract documents include the Advertisement for Bids, Proposal, Contract form, Contract Bonds, Standard Specifications, Supplemental Specifications, Special Provisions, Plans, Notice to Proceed, and Change Orders that are required to complete the construction of the Work in an acceptable manner. All of the Contract documents collectively constitute one Contract.

Contract Bonds
The approved forms of security executed by the Contractor and Surety(ies), including the Payment Bond, the Performance Bond, and a Warranty Bond when required by the Contract:

Payment Bond: A bond furnished in accordance with MN Statutes §574.26 and meeting the terms specified in MN Statutes §574.26 Subd. 2 (2).

Performance Bond: A bond furnished in accordance with MN Statutes §574.26 and meeting the terms specified in MN Statutes §574.26 Subd. 2 (1).

Warranty Bond: A bond furnished to secure the Contractor's performance of warranty obligations.

Contract Item (Pay Item)
A specifically described unit of Work for which the Contract defines a Unit Price. The sum of the scopes of Work for all Contract Items equals the scope of Work for the Contract.

Major Contract Item: A Contract Item with an original value equal to or greater than 5 percent of the original Contract amount. A Major Contract Item at the time of bid will remain a Major Contract Item.

Minor Contract Item: A Contract Item with an original value less than 5 percent of the original Contract amount. A Minor Contract Item does not become a Major Contract Item through overruns, Change Orders, etc.

Contract Starting Date
The latest date specified for the beginning of construction operations as set forth in the Proposal Package.

Contract Time
The Completion Date, number of Working Days, or number of Calendar Days allowed for completion of the Contract and any intermediate Milestones, including authorized extensions in accordance with 1806, "Determination and Extension of Contract Time."

Contractor
The individual, firm, or corporation contracting for and undertaking prosecution of the prescribed Work; the party of the second part to the Contract, acting directly or through a duly authorized representative.

Controlling Activity
The first incomplete Activity(ies) with the earliest start date that resides on a Critical Path. A Controlling Activity may also be referred to as a driving Activity.

CPM Schedule
A schedule developed using the Critical Path Method.

County
See City, County, or Township.

Critical Activity
An Activity on a Critical Path.

Critical Path
The longest continuous sequence of Work establishing the scheduled Completion Date of the Project or a Milestone.

Critical Path Method (CPM)
A network scheduling technique using Activity durations and Relationships between Activities to model the Plan to execute the Work. Early dates are calculated by a forward pass using the Data

Date, and late dates are calculated by a backward pass using the Completion Date calculated by the forward pass or a Constrained date.

Culvert
A Structure constructed entirely below the elevation of the Roadway surface and not a part of the Roadway surface, which provides an opening under the Roadway for the passage of water or traffic.

Data Date
The date from which a schedule is calculated and the date up to which progress is reported.

Department
The State Department of Transportation, or the political subdivision, governmental body, board, commission, office, department, division, or agency constituted for administration of the Contract within its jurisdiction.

Detour
A Road or system of Roads, usually existing, designated as a temporary route by the Department to divert through traffic from a section of Roadway being improved.

Disincentive
An amount that the Contractor will permanently forfeit if the Contactor's performance of the Work does not meet the conditions stated in the Specification.

District Materials Engineer
A Department engineer, located within a district, having responsibilities delegated from the Materials Engineer.

District Materials Laboratory
A Department laboratory located within a district, having responsibilities delegated from the Materials Engineer.

District Traffic Engineer
A Department engineer, located within a district, having responsibilities delegated from the Traffic Engineer.

Divided Highway
A Highway with separated Traveled Ways for traffic in opposite directions.

Dormant Seeding
Seeding allowed in the late fall when the ground temperature is too low to cause seed germination so that the seed remains in a dormant condition until spring.

Dormant Sodding
Sodding allowed in the late fall when the ground temperature is too low so that normal rooting does not take place until spring.

Drainage Manual
A Department manual that contains design criteria and basic working knowledge of hydrology and hydraulic design for use in the design and evaluation of highway drainage features. References to the *Drainage Manual* from the Contract are to the edition in effect on the letting date.

Easement
A right acquired by the Department to use or control property for a designated purpose.

Engineer
A Department engineer authorized as the Department's representative responsible for the engineering supervision of the Work and delegated with those duties and authorities defined in the Contract. The Contract may redefine the 'Engineer' as a specific Department engineer (i.e. Concrete Engineer, Bridge Engineer, Materials Engineer, Traffic Engineer, Roadway Engineer, etc.) with jurisdiction over the engineering details of specific construction items; however, the Engineer is the main point of contact for the Contractor and should receive copies of all correspondence between the Contractor and other Department representatives.

Equipment
All machinery, tools, and apparatus, together with the necessary supplies for upkeep and maintenance, necessary for the proper construction and acceptable completion of the Work within its intended scope.

Erosion Control Schedule
A written document (weekly) by the Contractor illustrating construction sequences and schedule of proposed methods to control erosion and manage sediment.

Errors and Omissions
A deficiency in the Contract that results in multiple interpretations of a requirement, as determined by the Engineer, except for those resolved by the orders of precedence in 1504, "Coordination of Contract Documents."

Extra Work
Any Work not required by the Contract as Awarded but found essential to the satisfactory completion of the Contract within its intended scope. Such Work shall be authorized and performed in accordance with 1402, "Contract Revisions."

Feed Point
The Lighting Service Cabinet, the point of connection between the service conductors, and the Lighting System circuitry.

Float
See Total Float.

Free Float
The number of days by which an Activity may be delayed from its early dates without delaying the early start date of any Successor. Free Float is a unique attribute of an Activity.

Frontage Road (or Street)
A local Road or Street auxiliary to and located on the side of a Highway for service to abutting property and adjacent areas and for control of access.

Geotechnical Manual
A Department manual that describes the various procedures and descriptive terminology used by MnDOT to investigate and evaluate geotechnical site conditions for current or future transportation related projects. References to the *Geotechnical Manual* from the Contract are to the edition in effect on the letting date.

Grade Separation
A Bridge with its approaches that provides for Highway or pedestrian traffic to pass without interruption over or under a railroad, Highway, Road, or Street.

Grading and Base Engineer
A Department engineer responsible for statewide guidance on grading and base. This individual has responsibilities delegated from the Materials Engineer.

Grading and Base Manual
A Department manual that serves as a tool to assist Department personnel in measuring the quality of Materials and evaluate the Work as construction progresses. References to the *Grading and Base Manual* from the Contract are to the edition in effect on the letting date.

Grading Grade
Grading Grade is the bottom of the Aggregate base.

Gravel
Naturally occurring rock or mineral particles produced by glacial and water action. Particle size ranges from 3 inches diameter to the size retained on a No. 10 Sieve.

Highway, Road, Roadway, or Street
General terms denoting a public way for purposes of vehicular travel, including the entire area within the Right-of-way.

Hold Point
Prior to the Contractor commencing Work on a construction Activity, the Work must be inspected, verified and/or accepted so that the Engineer can offer continuance of the Work. All Material placed before corrective action occurs is considered unauthorized Work per 1512.2, "Unauthorized Work."

Holidays
The days of each year set aside by legal authority for public commemoration of special events, and on which no public business shall be transacted except as specifically provided in cases of necessity. Unless otherwise noted, Holidays shall be as established in MN Statutes §645.44.

Hydraulic Engineer
The Department engineer responsible for statewide guidance on hydraulics, hydrology and drainage standards. This individual has responsibilities delegated from the Bridge Engineer. Responsible for the overall direction, supervision and management of the Bridge Office Hydraulics Unit.

Impact Schedule
A schedule prepared to demonstrate the impact of a proposed change.

Incentive
An amount, up to a maximum, that the Contractor can earn by meeting the requirements in the specification establishing the incentive.

Incidental
Whenever the word "incidental" is used in the Contract it shall mean no direct compensation will be made.

Industry Standard
An acknowledged and acceptable measure of quantitative or qualitative value or an established procedure to be followed for a given operation within the given industry. This will generally be in the form of a written code, standard, or specification by a creditable association valid on the date of the Advertisement for Bids.

Inertial Profiler
Pavement Smoothness measuring Equipment that is used to collect International Roughness Index (IRI) data on a pavement surface.

Inspection and Contract Administration Manual for MnDOT Landscape Projects
A Department manual that provides clear, objective, and measurable criteria on decision-making and payment criteria for those responsible for plant installation and establishment design, or inspection. References to the *Inspection and Contract Administration Manual for MnDOT Landscape Projects* (*ICAMMLP)* from the Contract are to the edition in effect on the letting date.

Inspector
The Engineer's authorized representative assigned to make detailed inspections of Contract Work.

Interchange
A grade-separated Intersection with one or more turning Roadways for travel between Intersection legs.

International Roughness Index
A pavement Smoothness measurement that represents how rough the Road feels to drivers and passengers.

Intersection
The general area where two or more Highways join or cross, within which are included the Roadway and roadside facilities for traffic movements in the area.

Keyhole Markup Language
A file format used to display geographic location data.

Laboratory Manual
A Department manual that outlines laboratory test procedures for Materials testing. References to the *Laboratory Manual* from the Contract are to the edition in effect on the letting date.

Lag
The designated amount of time that an Activity's start or finish is delayed from the start or finish of its Predecessor.

Layer
The total embankment thickness for each Material type, composed of a single or multiple Lifts.

Lift
A unit of Material within a Layer that is placed for compaction.

Light Poles
Structures designed to support luminaires and may include other external attachments such as transformer bases and mast arms or davits.

Lighting Engineer
A Department engineer responsible for statewide guidance on lighting. This individual has responsibilities delegated from the Traffic Engineer.

Lighting Service Cabinets
NRTL listed enclosures including electrical distribution components and control circuitry for Lighting Systems.

Lighting System
Includes Lighting Units, Lighting Service Cabinets, conductors, cables, and other components required for complete and operational Lighting Systems.

Lighting Units
Includes Light Poles, light pole wiring, above ground splices, wire holders, rodent intrusion barrier, and luminaires. Underpass luminaires are Lighting Units but do not include some of these components. Foundations are not considered as part of this definition.

Limestone
See Carbonate.

Logic
The interdependencies between Activities in a schedule. Logic may also be referred to as Relationships in a schedule. Logic is implied in Bar Chart Schedules and explicit in CPM Schedules.

Look-ahead Schedule
A schedule that spans at least 7 Calendar Days of actual progress and at least 14 Calendar Days of planned Work on a rolling basis.

Longest Path
The longest continuous sequence of Work through the latest Activity in a CPM Schedule. Typically, the Longest Path establishes the scheduled Completion Date of the Project.

Loop
A one-way turning Roadway that curves about 270 degrees to the right, primarily to accommodate a left-turning movement, but which may also include provisions for another turning movement.

Maintenance Access Route
An authorized maintenance equipment route used for snow and ice removal that has a 6-foot minimum clear width between any raised obstacles (such as push button stations, foundations, buildings, V curb, utility poles, sign posts, etc.).

Marl
Marl is unconsolidated sedimentary rock or soil consisting of clay and lime.

Materials
Any substances specified for use in the performance of the Work.

Materials Engineer
The Director of the Department's Office of Materials and Road Research acting directly or through an authorized representative within the scope of the particular duties or functional unit referenced in the Contract.

Materials Laboratory
The Department's Central Materials Laboratory.

Maximum Density
Maximum Density of a particular soil is the maximum density as determined by the Moisture Density Test Method (Proctor) test in the *Grading and Base Manual*.

Mean Roughness Index
The average (mean) of the left and right wheel path IRI values.

Milestone
A date specified in the Contract, such as the date that the Contract Time expires. In CPM Schedules, a Milestone shall be represented as an Activity with zero duration.

Minnesota Manual On Uniform Traffic Control Devices
A Department manual that establishes the standards for traffic control devices that regulate, warn, and guide Road users along all Roadways within the State. References to the *MN MUTCD* from the Contract are to the edition in effect on the letting date.

Minnesota Seal Coat Handbook
A manual published by the Minnesota Local Road Research Board's Research Implementation Committee that provides tools for Roadway designers and technicians to design and implement seal coat operations.

Minnesota Temporary Traffic Control Field Manual
A Department manual that contains typical traffic control layouts. References to the *Minnesota Temporary Traffic Control Field Manual* from the Contract are to the edition in effect on the letting date.

Missing Logic
When an Activity, except for the first Activity in the schedule, does not have at least one Predecessor or when an Activity, except for the last Activity in the schedule, does not have at least one Successor.

Monetary Deduction
An equitable adjustment made pursuant to 1512.1, "Unacceptable Work," when the Contractor's Work or Materials do not meet standards specified in the Contract, or do not meet generally accepted industry standards if the Contract does not provide specific standards.

Narrative Report
A descriptive report submitted with each schedule.

Near-Critical Activity
An Activity with a Total Float value within 10 Working Days of the Total Float on a Critical Path. If no Activities in the schedule are within 10 Working Days of Total Float of a Critical Path, the next most Critical Activities shall be considered Near-Critical Activities.

Nominal Value
The intended, named, or stated value, as opposed to the actual value. The Nominal Value of something is the value that it is supposed or intended to have, or the value by which it is commonly known.

Nonconformance Report (NCR)
A report the Contractor submits to the Engineer that documents any deviation from the Quality Control Plan (QCP), accepted shop drawings, or Contract requirements.

Notice To Proceed
Written notice to the Contractor to proceed with the Work including, if applicable, the date of beginning of Contract Time. Notice to Proceed 1 (NTP1) occurs upon the Department's acceptance of the Contractor's first Preliminary Schedule. Notice to Proceed 2 (NTP2) occurs upon the Department's acceptance of the Contractor's Baseline Schedule.

NPDES Permit
The general permit issued by the MPCA that authorizes the discharge of storm water associated with construction Activity under the National Pollutant Discharge Elimination System Program.

Open-ended Activity
An Activity, except for the first Activity in the schedule, which does not have at least one finish-to-start or start-to-start Predecessor Relationship, or an Activity, except for the last Activity in the schedule, which does not have at least one finish-to-start or finish-to-finish Successor Relationship.

Optimum Moisture Content
The Optimum Moisture Content is the moisture content as determined by any of the following methods:

(1) Moisture Density Test Method (Proctor)
(2) One-Point Proctor Method
(3) *Estimated Optimum Moisture Content* Form G&B-305

Organic Soils
Organic Soils contain ≥ 5 percent organic Material by weight.

Original Duration
The estimated time reported in the schedule that is needed to perform an Activity, expressed in Working Days.

Out-Of-Sequence Work
When a Relationship between Activities is invalidated by actual progress, or in other words, when a Successor actually starts or actually finishes earlier than its Predecessor Relationship indicates it should be able to start or finish.

(P)
A designation in the summary of quantities on the Plans meaning that the Plan Quantity will be the quantity for payment. The Department will not measure or recalculate Plan Quantities, except as provided in 1901, "Measurement of Quantities."

Pavement Profile File
ProVAL's standard file format that contains pavement elevation data.

Pavement Structure
The combination of Layers placed on a Subgrade to support the traffic load and distribute it to the Roadbed.

Pay Item
See Contract Item.

Pedestrian Access Route
A paved pedestrian walkway with a 4-foot minimum width and no raised objects within it and a maximum 2 percent cross slope.

Permanent Erosion Control Measures
Soil-erosion control measures such as curbing, Culvert aprons, riprap, flumes, sodding, erosion mats, and other means to minimize erosion on the completed Project while establishing permanent perennial vegetation.

Plan Quantity
The quantity listed in the summary of quantities on the Plans. The summary of quantities will usually be titled "Statement of Estimated Quantities," "Schedule of Quantities for Entire Bridge," or "Schedule of Quantities."

Plans
The Plans, profiles, typical cross-sections, and Standard Plans and Standard Plates that show the locations, character, dimensions, and details of the Work.

Predecessor
An Activity that is defined by schedule Logic to precede another Activity.

Preliminary Schedule
An initial schedule which shows the Contractor understands the contractual Milestones and Plans to complete the Project within the contractually required interim and Completion Dates. The Preliminary Schedule may be submitted in either Bar Chart or CPM format.

Professional Engineer
A person registered and licensed by the State of Minnesota to practice one or more branches of engineering. The Contract may require that the Contractor provide a Professional Engineer, registered and licensed in a specific branch of engineering, to perform certain responsibilities.

Profile Grade
The trace of a vertical plane intersecting the top surface of the Roadbed or Pavement Structure, usually along the longitudinal centerline of the Traveled Way. Profile Grade means either elevation or gradient of such trace according to the context.

Profile Viewing and Analysis
An FHWA software application that allows users to view and analyze pavement profiles.

Progress Schedule
The schedule submitted by the Contractor and accepted by the Department for managing the Project. For example, the Baseline Schedule is the Progress Schedule from the Data Date of the Baseline Schedule to the Data Date of the first Update Schedule. The first Update Schedule is the Progress Schedule from its Data Date to the Data Date of the next accepted Update Schedule, and so on.

Project
The specific section of the Highway, the location, or the permanent construction improvements as defined by the Contract.

Project Schedule
See Progress Schedule.

Project Site
The area available to the Contractor for use in performing the Work, as defined on the Plans by the Right-of-way and the end and beginning of the Project.

Proposal
The offer of a Bidder on the prescribed Proposal Form to perform the Work and furnish the labor and Materials at the bid Unit Prices.

Proposal Form
The approved form on which the Department requires Proposals to be prepared and submitted for the Work, in accordance with 1206, “Preparation and Delivery of Proposal.”

Proposal Guaranty
The security furnished with a Proposal to guarantee that the Bidder will enter into the Contract if the Department awards the Contract to the Bidder.

Proposal Package
All documents and information provided by the Department to prospective Bidders in accordance with 1202, "Contents of Proposal Package."

Pure Live Seed
A percentage calculated by multiplying the percent of viable seed ("total germination and hard seed or dormant seed when applicable") by the percent of pure seed and dividing the product by 100.

Qualified Laboratory
A laboratory accredited through the AASHTO Accreditation Program (AAP), and/or an AASHTO accredited laboratory.

Quality Assurance
The Activities performed by the Department that have to do with making sure the quality of a product or process meets the relevant Contract requirements.

Quality Compaction
A compaction method as defined in 2106.3G.2 "Quality Compaction."

Quality Control
The Activities performed by the Contractor that have to do with making the quality of a product or process meet the relevant Contract requirements.

Questionnaire
The specified forms on which a Bidder may be required to furnish information as to ability to perform and finance the Work.

Ramp
A connecting Roadway for travel between Intersection legs at or leading to an Interchange.

Rebaseline Schedule
A schedule that includes significant modification to the schedule Logic, Activity durations, or other significant attributes of a schedule. A Rebaseline Schedule is usually prepared for the purpose of depicting a significant change in the Contractor's Plan. Once accepted by the Department, the Rebaseline Schedule becomes the Progress Schedule.

Redundant Logic
A Relationship representing a link between Activities that is also represented in a parallel path or Relationship. If removed, Redundant Logic should not impact any CPM Schedule calculations.

Relationship
An interdependency between two Activities. Relationships link an Activity to its Predecessor(s) and Successor(s). Relationships may also be referred to as the Logic of the schedule. Examples of Relationships are finish-to-start, start-to start, and finish-to-finish. Relationships are implied in Bar Chart Schedules and explicit in CPM Schedules.

Remaining Duration
The estimated time reported in the schedule that is needed to complete an Activity, expressed in Working Days.

Revised Schedule
A schedule prepared and submitted by the Contractor and accepted by the Department that includes a significant modification to the schedule Logic, Activity durations, or other significant attributes of a schedule. The Revised Schedule is usually prepared for the purpose of depicting a

significant change in the Contractor's plan. Once accepted by the Department, the Revised Schedule becomes the Progress Schedule.

Right-of-way
A general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to a Highway.

Road
See Highway, Road, Roadway, or Street.

Road Core
The Road Core is the area below the Grading Grade to the bottom of the excavation and between the following:

(1) For embankment heights ≤ 30 feet, from the Grading Grade point of intersections (P.I.s) with a 1:1 (Vertical: Horizontal) slope
(2) For embankment heights > 30 feet, from the Grading Grade point of intersections (P.I.s) with a 1:1 1/2 (Vertical: Horizontal) slope

Road Design Manual
A Department manual that establishes uniform design policies and procedures in preparation of Road Plans. References to the *Road Design Manual* from the Contract are to the edition in effect on the letting date.

Roadbed
The graded portion of a Highway within top and side slopes, prepared as a foundation for the Pavement Structure and Shoulders.

Roadway
See Highway, Road, Roadway, or Street.

Scale
A device used to measure the mass or the proportion of a liquid or solid. This definition includes metering devices.

Schedule of Materials Control
A Department schedule that outlines the minimum sampling and testing requirements for most Materials used in Highway construction. References to the *Schedule of Materials Control* from the Contract are to the edition in effect on the letting date.

Seeding Manual
A Department manual that provides guidance on seed mixtures specified by the Department and methods for their installation and establishment. References to the *Seeding Manual* from the Contract are to the edition in effect on the letting date.

Select Grading Material
Select Grading Materials are mineral soils found in the Triaxial Chart in the *Grading and Base Manual*, excluding: Organic Soils, Silt, and Marl.

Shoulder
The portion of the Roadway contiguous with the Traveled Way for accommodation of stopped vehicles, for emergency use, and for lateral support of the Pavement Structure.

Sidewalk
That portion of the Roadway primarily constructed for the use of pedestrians.

Sieve
A woven wire screen meeting the requirements of *AASHTO M92,* "Standard Specification for Wire-Cloth Sieves for Testing Purposes," for the size required by the Contract.

Signing Engineer
A Department engineer responsible for statewide guidance on signing. This individual has responsibilities delegated from the Traffic Engineer.

Silt
Silt is a soil category as defined in the *Grading and Base Manual*; Silt has ≥80 percent of its particles larger than 2 micrometer and smaller than 75 micrometer, as determined by test procedure 1302 in the *Laboratory Manual*.

Site Management Plan
A Contractor-provided written amendment to the Department's SWPPP that indicates the means and methods the Contractor will use for performing Work in or adjacent to waters of the State.

Smoothness
The Mean Roughness Index (MRI) value per 0.1 mile segment of pavement.

Special Provisions
Additions and revisions to the Standard Specifications and Supplemental Specifications that cover conditions specific to a Contract.

Specifications
The Standard Specifications, the Supplemental Specifications, the Special Provisions, and any Department-approved changes to these Contract documents.

Specimen Tree
A tree indicated in the Contract or identified by the Engineer that is notable and valued because of its species, size, condition, age, longevity, durability, crown development, function, visual quality, and public or private prominence or benefit.

Standard Plans and Standard Plates
Department-provided drawings consisting of sheets or details of design and construction for various Structures, features, and products.

Standard Signs and Markings Manual
A Department manual that establishes, determines, and communicates standards and specifications concerning standard dimensions, colors, and other requirements of the various types of Highway signs and pavement messages. References to the *Standard Signs and Markings Manual* from the Contract are to the edition in effect on the letting date.

Standard Specifications
The current edition of the *Minnesota Department of Transportation Standard Specification for Construction*, which are approved for general use.

State
The State of Minnesota acting through its elected officials and their authorized representatives.

Stormwater Pollution Prevention Plan
A comprehensive Plan required by the NPDES Permit to identify sources of pollution and describe BMPs to reduce pollution from stormwater runoff at a construction site. The construction plan sheets and Contract documents are a part of the SWPPP that includes both temporary and permanent BMPs during construction.

Street
See Highway, Road, Roadway, or Street.

Structural Metals Engineer
A Department engineer responsible for the overall direction, supervision, and management of the Structural Metals Inspection Unit. This individual has responsibilities delegated from the Bridge Engineer.

Structures
Bridges, Culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, endwalls, buildings, sewers, service pipes, underdrains, foundation drains, and other man-made features.

Subcontractor
An individual, firm, or corporation to whom the Contractor sublets part of the Contract.

Subgrade
The top surface of a Roadbed upon which the Pavement Structure and Shoulders are constructed. Also, a general term denoting the foundation upon which a base course, surface course, or other construction is to be placed, in which case reference to Subgrade operations may imply depth as well as top surface.

Substructure
The part of a Bridge below the bearings of simple and continuous spans, skewbacks, or arches and tops of footings for rigid frames, together with the backwalls, wingwalls, and wing protection railings.

Successor
An Activity that is defined by schedule Logic to succeed another Activity.

Superintendent
The Contractor's authorized representative in responsible charge of the Work.

Superstructure
The entire Bridge except the Substructure.

Supplemental Agreement
See Change Order.

Supplemental Specifications
Additions and revisions to the Standard Specifications that are formally approved after the Standard Specifications are approved and issued.

Surety
The corporation, partnership, or individual, other than the Contractor, executing a bond furnished by the Contractor.

Temporary By-Pass
A section of Roadway, usually within existing Right-of-way, provided to temporarily carry all traffic around a specific Work site.

Temporary Erosion Control Measures
Soil-erosion control measures to temporarily protect the Project from erosion before and during the installation of Permanent Erosion Control Measures.

Temporary Sediment Control Measures
Sediment trapping and filtering devices such as sediment control logs, Silt fence, sediment basins, inlet protection, and other means to temporarily control sediment until installation of Permanent Erosion Control Measures.

Top of Subgrade
The Top of Subgrade is the surface of Material immediately beneath the granular Material. If there is no granular Layer, then the Top of Subgrade is the Grading Grade.

Total Float
The number of days by which an Activity may be delayed without delaying the Project or a Constrained date. Total Float is calculated as the difference between an Activity's early and late dates. Total Float is affected by Constraints.

Township
See City, County, or Township.

Traffic Electrical Systems Engineer
A Department engineer responsible for statewide guidance on traffic electrical systems. This individual has responsibilities delegated from the Traffic Engineer.

Traffic Engineer
The Director of the Department's Office of Traffic Engineering acting directly or through an authorized representative within the scope of the particular duties or functional unit referenced in the Contract documents.

Traffic Engineering Manual
A Department manual that establishes uniform guidelines and procedures to aid Road users in recognizing and understanding various traffic control devices. References to the *Traffic Engineering Manual* from the Contract are to the edition in effect on the letting date.

Traffic Lane
The portion of a Traveled Way for the movement of a single line of vehicles.

Traveled Way
The portion of the Roadway for the movement of vehicles, exclusive of Shoulders and Auxiliary Lanes.

Turn Lane
An auxiliary lane for left or right turning vehicles.

Turn-On
The time when the complete and operational Lighting System or Signal System meets the installation, operational, and testing requirements as specified in the Contract.

Uniform Soils
Uniform Soils have the same soil class per the Triaxial Chart in the *Grading and Base Manual* and have similar color, moisture content, and performance characteristics.

Unit Day
12:00 AM to 11:59 PM (0000-2399) or any portion thereof.

Unit Price
The price per unit of a Contract Item.

Update Schedule
A schedule prepared at least monthly by incorporating the actual progress of the previous month into the Progress Schedule. Once accepted by the Department, the Update Schedule becomes the current Progress Schedule.

User Defined Field
A customizable code in P6 assigned to an Activity to group or categorize its properties.

Verification Testing
Sampling and testing performed by the Department to validate the quality of the product per Title 23 – Highways, Code of Federal Regulation 637.203.

Weather Contingency
Time reserved in a schedule for inclement weather that would prevent progress of the Work.

Work
The furnishing of all labor, Materials, Equipment, and other Incidentals necessary or convenient to the successful completion of the Project and the performance of all duties and obligations imposed on the Contractor by the Contract. Also used to indicate the construction required or completed by the Contractor.

Work Breakdown Structure (WBS)
A framework of levels and nodes used to organize and order Activities within a schedule.

Working Day
A Calendar Day, exclusive of Saturdays, Sundays, and Holidays, on which weather and other conditions not under the control of the Contractor will permit construction operations to proceed for at least 4 hours, with the normal working force engaged in performing the progress-controlling operations.

Working Drawings
Stress sheets, shop drawings, erection plans, falsework plans, framework plans, cofferdam plans, bending diagrams for reinforcing steel, or any other supplementary plans or similar data that the Contractor is required to furnish and submit to the Engineer.

Bidding Requirements and Conditions

1201 PREQUALIFICATION OF BIDDERS

The Department will not require prequalification of the Bidders before submission of Proposals, but the Department may require a written statement from the apparent low Bidder before Award. If the Department requires a written statement, the statement shall include the following:

(1) Bidder experience
(2) Bidder certifications
(3) Bidder licenses
(4) The amount of capital and Equipment available for performance of the proposed Work

1202 CONTENTS OF PROPOSAL PACKAGE

The Proposal Package will include the following:

(1) Location and description of the proposed construction
(2) Bid Schedule

(3) Contract Time
(4) Amount and nature of the required Proposal Guaranty
(5) Basis for comparison of proposals, if other than by total cost
(6) Date, time, and place for opening Proposals (also defined in the Advertisement for Bids)
(7) Any Special Provisions and other supplementary requirements
(8) Plans, Specifications, and other documents included in the Proposal Package

The Bidder shall not alter the contents of the Proposal Package, unless authorized in writing by the Department. The Department considers alterations to include any unauthorized additions, deletions, or changes.

1203 ACCESS TO PROPOSAL PACKAGE

The Department will provide Bidders with access to the Proposal Package through the online E-Plan Room. The Department may require a fee for Bidders to purchase and download copies of the Proposal Package.

1204 INTERPRETATION OF QUANTITIES IN BID SCHEDULE

The quantities in the Bid Schedule are estimates only. The Department will use these quantities to compare Proposals in accordance with 1301, "Consideration of Proposals."

During the Project, the Department may increase, decrease, or eliminate quantities of Contract Items in accordance with 1402, "Contract Revisions"; and will measure and pay for accepted quantities of Contract Items in accordance with 1901, "Measurement of Quantities."

1205 EXAMINATION OF PROPOSAL PACKAGE AND SITE OF WORK

1205.1 PROPOSAL PACKAGE AND SITE OF WORK

Before submitting a Proposal, the Bidders shall carefully examine the Proposal Package and perform a reasonable investigation of the site of Work. Submitting a Proposal is considered an affirmative statement that the Bidder has examined the Proposal Package and performed a reasonable investigation of the site of Work, and is satisfied as to the character, quality, quantities, and conditions to be encountered in performing the Work. A reasonable site investigation includes investigating or reviewing the following:

(1) Project Site
(2) Borrow sites
(3) Haul routes
(4) Utility property in accordance with 1507, "Utility Property and Service"
(5) All other locations related to the performance of the Work
(6) Any additional information the Department makes available in accordance with 1205.2, "Additional Information"

The Bidder shall immediately notify the Department of any apparent defect in the Proposal Package. The Department will determine if a defect exists and, if necessary, will issue an Addendum to all prospective Bidders to address the correction.

1205.2 ADDITIONAL INFORMATION

When available, the Department may make the following additional information available to Bidders:

(1) All Department boring logs and other records of subsurface investigation
(2) Record drawings
(3) Results of other preliminary investigations
(4) Other documents

A review of this additional information is not a substitute for a Bidder's own evaluation, interpretation, or judgment in preparing a Proposal. Bidders shall understand that this additional information is not part of the Proposal Package and will not become part of the Contract. The Department makes this additional information available for the Bidders' information only and warns the Bidders not to rely on any included estimates or quantities. If not included in the Proposal Package, the additional information may be available upon request, and Bidders shall be deemed to have knowledge of the availability of this additional information. Bidders are solely responsible for all assumptions, deductions, and conclusions that they may reach. The Department does not make or imply a warranty as to the accuracy, sufficiency, or reliability of this additional information.

If the Department has taken test borings on the Project, the Department may or may not include the test boring information on the Plans. If the Department includes test boring information on the Plans, the Bidders shall understand the following with regard to the test boring information:

(1) The Department takes borings by ordinary and conventional methods and with care deemed adequate for the Department's design purposes.
(2) The logs of the borings may have been edited or abridged and may not reveal all information that might be useful or of interest to the Contractor.
(3) The Department will make any field logs and laboratory logs relating to the borings available to the Bidders or Contractor.
(4) The Department may have taken some borings to gather information for purposes other than those related to the construction of the Project.
(5) The Department does not warrant that the information is complete, but believes that the information as to the conditions and materials reported within each test hole was accurate at the time the boring was taken.
(6) The Department does not warrant that conditions adjacent to test borings will necessarily be the same as shown on the logs because subsurface conditions outside of each individual test hole are unknown to the Department, and soil, rock, and water conditions cannot be relied upon to be consistent and uniform.
(7) The Department will not be responsible for any interpretations made by the Contractor.
(8) The absence of notations on the logs regarding water does not necessarily mean that the borings were dry or that the Contractor will not encounter subsurface water during the course of construction.

1206 PREPARATION AND DELIVERY OF PROPOSAL

1206.1 PREPARATION AND DELIVERY

The Bidder shall use the electronic submittal process. The Bidder shall submit the electronic Proposal in accordance with AASHTOWare Project Bids software and the "Bid Express" website (www.bidx.com).

The Bidder shall submit its Proposal by the date and time for opening Proposals. Bid Express will not accept Proposals past the date and time of the opening of Proposals.

The Bidder shall submit the Proposal Guaranty electronically or file a hard copy of the Proposal Guaranty with the Department by the same date and time.

If a Bidder fails to provide a Unit Price for any Pay Item on the Bid Schedule, except for "Lump Sum" Pay Items, the Department will reject the Proposal.

If a Pay Item in the Proposal requires the Bidder to choose an alternate Pay Item, the Bidder shall indicate its choice in accordance with the Specifications for that Pay Item.

1206.2 ALLOWABLE SUBSTITUTIONS

When directed by the Department, the Bidder shall submit a flash drive Proposal using AASHTOWare Project Bids and EBSX files. The Bidder shall label the flash drive with the Proposal number.

The Bidder shall deliver the Proposal and the Proposal Guaranty in a sealed envelope. The Bidder shall mark the sealed envelope with the name of the Bidder, the Proposal number, the Project number, and the letting date. The Bidder shall deliver the sealed envelope to the Department as specified in the Advertisement for Bids as follows:

(1) To the address specified
(2) In care of the official receiving the Proposals
(3) By the date and time for opening Proposals

If the Department receives a Proposal after the date and time for opening Proposals, the Department will return the Proposal to the Bidder unopened.

1207 IRREGULAR PROPOSALS

The Department may reject irregular Proposals. The Department will consider a Proposal to be irregular for any of the following reasons:

(1) Bidder submits its Proposal on a form other than the Proposal Form
(2) Bidder alters the contents of the Proposal Package, as defined in 1202, "Contents of Proposal Package"
(3) Proposal is incomplete, indefinite, or ambiguous as to the meaning
(4) Proposal contains unauthorized alternate bids
(5) Proposal is a conditional Proposal that does not meet the requirements in 1211, "Conditional Proposals"
(6) Any Unit Prices in the Proposal are unbalanced in excess of or below the reasonable cost analysis values

In accordance with 1206, "Preparation and Delivery of Proposal," the Department will reject any Proposal in which the Bidder fails to provide a Unit Price for any Pay Item or Work on the Proposal Form, except for "Lump Sum" Pay Items.

1208 PROPOSAL GUARANTY

The Bidder shall include with its Proposal a Proposal Guaranty that meets the following requirements:

(1) Equal to 5 percent of the total amount of the Proposal
(2) Made payable to the Department
(3) In the form of a certified check, a cashier's check, or a bond

If providing a Proposal Guaranty in the form of a bond, the bond must meet the following requirements:

(1) Issued by a corporation authorized by the Minnesota Department of Commerce to contract as a Surety in the State of Minnesota
(2) Conditioned on execution of the Contract in accordance with 1306, "Execution and Approval of Contract"

1210 REVISION OF PROPOSAL PACKAGE OR WITHDRAWAL OF PROPOSALS

If submitting a Proposal electronically, the Bidder may revise its Proposal an unlimited number of times and may withdraw its Proposal before the date and time for opening Proposals.

If submitting a Proposal in accordance with 1206.2, "Allowable Substitutions," the Bidder may revise or withdraw its Proposal after delivery to the Department if the Department receives the Bidder's written request for withdrawal or revision before the date and time for opening Proposals.

The Department reserves the right to revise the Proposal Package at any time before the date and time for opening Proposals. The Department will issue a numbered and dated Addendum for any revision of the Proposal Package. The Department will electronically post each Addendum as announced in an e-mail notification to each Bidder on the Department's list of Bidders. The Department will include each Addendum with all Proposal Forms issued to the Bidder after the date of the Addendum.

If revisions made by an Addendum require change to Proposals or reconsideration by the Bidder, the Department may postpone opening Proposals. If the Department postpones opening Proposals, the Department will specify the new date and time for opening Proposals in the Addendum.

The Bidder shall acknowledge receipt of each Addendum in the electronic proposal.

1211 CONDITIONAL PROPOSALS

The Department will accept conditional Proposals only as authorized by the Department in this section. The Department will Award the Contract to a Bidder with a conditional Proposal if doing so is in the best interest of the Department.

If the Bidder submits Proposals on multiple Projects and the amount of the Proposals for the multiple Projects is more than the Bidder is able to perform, the Bidder may complete and include the following statement with each Proposal to limit the amount of Projects awarded:

"This Bidder can only enter into a Contract or Contracts totaling no more than $_____, and hereby authorizes the Department to determine which Proposal or Proposals to award and which to reject."

With each statement, the Bidder shall provide the Proposal number and all Project numbers for which the statement applies.

1212 OPENING OF PROPOSALS

The Department will open Proposals at the time, date, and place defined in the Proposal Package and the Advertisement for Bids. The Department will electronically post Proposal results after the opening.

1213 DISQUALIFICATION OF BIDDERS

The Department may disqualify a Bidder and reject the Bidder's Proposal for any of the following reasons:

(1) If an individual, firm, or corporation, either under the same or different name, submits more than one Proposal for the same Project
(2) The Department finds evidence of collusion among Bidders
(3) The Bidder failed to perform on a previous Contract with the State

Bidding Requirements and Covenants

1301 CONSIDERATION OF PROPOSALS

After opening Proposals, the Department will compare the Proposals based on the correct summation of the products of the scheduled quantities and unit bid prices. If the lowest responsible Bidder has submitted prices on more than one alternate item, the Department reserves the right to determine which alternate to accept. If the extended bid item price, obtained by multiplying the unit bid price by the bid item

quantity, is incorrectly calculated, the Department will use the unit bid price to recalculate the extended bid item price.

The Department will not consider Proposals that do not include a Proposal Guaranty in accordance with 1208, "Proposal Guaranty."

The Department reserves the right to take the following actions:

(1) Reject any or all Proposals
(2) Waive defects and technicalities in a Proposal
(3) Advertise for new Proposals

1302 AWARD OF CONTRACT

Within 33 Calendar Days after opening Proposals, the Department will Award the Contract to the lowest responsible Bidder provided that the lowest responsible Bidder complies with the Proposal requirements. The Department may also decide not to make a Contract Award. The Department will notify the lowest responsible Bidder electronically, in writing, or by other means that the Department has accepted the Proposal subject to execution and approval of the Contract as required by law.

The Department and the lowest responsible Bidder may mutually agree to extend the time within which the Department makes the Award.

1303 CANCELLATION OF AWARD

Before Contract execution, the Department reserves the right to cancel the Award of the Contract without liability.

1304 RETURN OF PROPOSAL GUARANTY

After opening and auditing the Proposals, the Department will immediately return Proposal Guaranties to all Bidders, except for the two lowest Bidders. The Department will retain the Proposal Guaranties of the two lowest Bidders until execution and approval of the Contract as required by law. After execution and approval of the Contract, the Department will return the Proposal Guaranties of the two lowest Bidders, except in the case of forfeiture as specified in 1307, "Failure to Execute Contract." The Department will only return Proposal Guaranties that the Bidders submit as checks (certified or cashier's).

1305 REQUIREMENT OF CONTRACT BOND

The lowest responsible Bidder shall submit with the signed Contract a Payment Bond and a Performance Bond each equal to the Contract Amount as required by MN Statute § 574.26. The Department will review the Surety and form of the Contract Bonds and provide approval if acceptable.

1306 EXECUTION AND APPROVAL OF CONTRACT

The lowest responsible Bidder shall return the Contract to the Department with the required Payment and Performance Bonds within 7 Calendar Days after Award.

If the Contract specifies the Contract Time as Working Days and the lowest responsible Bidder fails to return the signed Contract documents within 7 Calendar Days, the Department may reduce the Contract Time to reflect the delay caused by the Contractor.

If the Contract specifies the Contract Time as a Completion Date, the lowest responsible Bidder's delay in returning the signed Contract documents is a non-excusable delay under 1806.2C, "Non-Excusable Delays," and the Contractor is not entitled to an extension of the Contract Time.

If the lowest responsible Bidder is unable to return the signed Contract documents within the specified time due to the absence of one or more of the required signers, the Department may extend the time if the Contractor submits satisfactory evidence that the Contract documents will be signed.

A foreign or nonresident corporation that is awarded a Contract shall provide proof that it has met all legal requirements for transacting business in the State of Minnesota, as a condition precedent to Contract approval.

The Department will provide the lowest responsible Bidder with a notice of approval or disapproval of the Contract and Contract Bonds within 14 Calendar Days after the lowest responsible Bidder properly signs and returns the Contract documents to the Department. The Award is not binding and the Contract is not effective until both parties fully execute the Contract and the Department approves the Contract, as required by law.

1307 FAILURE TO EXECUTE CONTRACT

The Department will retain the Proposal Guaranty as liquidated damages sustained, not as a penalty, if the lowest responsible Bidder fails to perform any of the following within the time specified in the Proposal Package:

(1) Sign the Contract documents
(2) Provide the required Contract Bonds
(3) Comply with any other requirements imposed as a condition precedent to the Contract approval

If the Department cancels the Award, the Department may choose any of the following actions:

(1) Award the Contract to the next lowest responsible Bidder
(2) Advertise for new Proposals
(3) Otherwise perform the Work as decided by the Department

Scope of Work

1401 INTENT OF CONTRACT

The intent of the Contract is to provide for construction of the Project and compensation for the Work in accordance with the Contract documents.

The titles and headings of the various sections and subsections of the Contract are intended for convenience of reference.

The Contractor shall construct and complete the Project in every detail as described in the Contract. The Department will require the Contractor to perform the Work diligently and vigorously to completion. The Contractor shall consider the public interests and the obligations and rights of all other parties concerned. The Contractor shall assume full responsibility for performance of the Work and shall furnish all labor, Materials, Equipment, tools, supplies, transportation, and other Incidentals necessary or convenient for successful completion of the Project.

The Contract may not fully describe every detail. When the Contract is silent or omits a detailed description, the Contractor shall perform in accordance with the best general practice and provide Materials and workmanship meeting the quality specified in the Contract. The Department's failure to itemize every exception or condition in the Contract does not mean that the Contract provisions will be enforced equally under all conditions or on all parts of the Work.

In the interest of avoiding repetitious wording in the Specifications, certain words and phrases have been omitted where reference is clearly related by expressions of authority or intention. Where certain words and terms appear, they are to be construed with reference to the definitions, abbreviations, heading, titles, item names, and other pertinent provisions of the Contract documents, as may be implied.

1402 CONTRACT REVISIONS

1402.1 GENERAL

The Engineer reserves the right to make, in writing, at any time during the progress of the Work, such changes in quantities and such alterations in the Work as are necessary to satisfactorily complete the Project or for reasons of the Department's interest. Revisions to the Contract will not add Work beyond the limitations imposed by law or beyond the termini of the proposed construction except as may be necessary to satisfactorily complete the Project. Revisions to the Contract neither invalidate the Contract nor release the Surety, and the Contractor agrees to perform the Work as revised. Either party to the Contract may assert that a Contract revision has occurred.

If the Contractor believes it has encountered a Contract revision as set forth in 1402.2, "Differing Site Conditions," 1402.3, "Significant Changes to the Character of Work," 1402.4, "Suspensions of Work Ordered by the Engineer," 1402.5, "Extra Work," or 1402.6, "Eliminated Items," the Contractor shall provide notice as required by these clauses and as required by 1403, "Notification for Contract Revisions." Failure to provide notice as specified in 1403, "Notification for Contract Revisions" constitutes a waiver of the Contractor's entitlement to compensation or a time extension and releases the Department from responsibility for providing compensation or a time extension.

If the Engineer concludes that a Contract revision is necessary, the Department will compensate the Contractor for the revision in accordance with 1904, "Compensation for Contract Revisions," 1905, "Compensation for Eliminated Items," and 1907, "Payment for Surplus Material." No payment, except as specifically provided by the payment provisions of the Contract, will be made for any increased expenses, loss of expected reimbursement, or loss of anticipated profits suffered or asserted by the Contractor, whether resulting directly from revisions in the Work or indirectly from unbalanced allocation of expenses among the Contract Items, for any variation between the quantities in the Bid Schedule and the actual quantities ordered and performed, or from any other cause. If necessary, the Engineer may extend time in accordance with 1806, "Determination and Extension of Contract Time."

In 1402.2, "Differing Site Conditions," 1402.3, "Significant Changes to the Character of the Work," and 1402.4, "Suspensions of Work Ordered by the Engineer," the term "adjustment" means compensation in accordance with 1904, "Compensation for Contract Revisions," 1905, "Compensation for Eliminated Items," and 1907, "Payment for Surplus Material," and the granting of a time extension in accordance with 1806, "Determination and Extension of Contract Time."

1402.2 DIFFERING SITE CONDITIONS

During the progress of the Work, if one of the following subsurface or latent physical conditions is encountered at the site, the party encountering such conditions shall promptly notify the other party in writing of the specific differing conditions before they are disturbed and before the affected Work is performed:

(1) Differ materially from those indicated in the Contract
(2) If unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the Work provided for in the Contract

Upon written notification, the Engineer will investigate the conditions. If the Engineer determines that the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any Work under the Contract, the Engineer will make an adjustment, excluding loss of anticipated profits, and will modify the Contract in writing accordingly. The Engineer will notify the Contractor of the determination whether or not an adjustment of the Contract is warranted.

The Department will not allow a Contract adjustment that results in a benefit to the Contractor, unless the Contractor has provided the required written notice.

1402.3 SIGNIFICANT CHANGES TO THE CHARACTER OF WORK

The Engineer reserves the right to make, in writing, at any time during the progress of the Work, such changes in quantities and such alterations in the Work as are necessary to satisfactorily complete the Project. Such changes in quantities and alterations shall not invalidate the Contract nor release the Surety, and the Contractor agrees to perform the Work as altered.

If the alterations or changes in quantities significantly change the character of the Work under Contract, whether those alterations or changes are in themselves significant changes to the character of the Work or, by affecting other Work, cause such other Work to become significantly different in character, an adjustment, excluding loss of anticipated profits, will be made to the Contract. The Contractor and Department shall agree on the basis for an adjustment in writing before the performance of the Work. If the Contractor and Department cannot agree, the Engineer will make an adjustment either for or against the Contractor in such amount as the Engineer determines to be fair and equitable.

If the alterations or changes in quantities do not significantly change the character of the Work under the Contract, the Department will pay for the altered Work as provided elsewhere in the Contract.

The term "significant change" shall be construed to apply only to the following circumstances:

(1) When the character of the Work as altered differs materially in kind or nature from that involved or included in the original proposed construction, or

(2) When a major Contract Item of Work is increased in excess of 125 percent or decreased below 75 percent of the original Contract quantity. Any allowance for an increase in quantity shall apply only to that portion in excess of 125 percent of the original Contract Item quantity, or in case of a decrease below 75 percent, to the actual amount of Work performed.

1402.4 SUSPENSIONS OF WORK ORDERED BY THE ENGINEER

If the performance of all or any portion of the Work is suspended or delayed by the Engineer in writing for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry) and the Contractor believes that additional compensation, or Contract Time, or both are due as a result of such suspension or delay, the Contractor shall submit to the Engineer in writing a request for adjustment no later than 7 Calendar Days after receipt of notice to resume Work. The request shall set forth the reasons and support for such adjustment.

Upon receipt, the Engineer will evaluate the Contractor's request. If the Engineer agrees that the cost, or time required for the performance of the Contract, or both have increased as a result of such suspension and the suspension was caused by conditions beyond the control of and not the fault of the Contractor, its suppliers, or subcontractors, and not caused by weather, the Engineer will make an adjustment (excluding profit) and modify the Contract in writing accordingly. The Engineer will notify the Contractor of the determination whether or not an adjustment of the Contract is warranted.

The Department will not allow a Contract adjustment unless the Contractor has submitted the request for adjustment within the time prescribed.

The Department will not allow a Contract adjustment under this clause to the extent that performance would have been suspended or delayed by any other cause, or for which an adjustment is provided for or excluded under any other term or condition of this Contract.

1402.5 EXTRA WORK

If the Contractor believes that it has been required to perform Extra Work, the Contractor shall notify the Engineer in accordance with 1403, “Notification for Contract Revisions.” Failure to provide notice as specified in 1403, “Notification for Contract Revisions,” constitutes a waiver of the Contractor’s entitlement to compensation or a time extension and releases the Department from responsibility from providing

compensation or a time extension. If the Engineer determines, in the Engineer's sole discretion, that Extra Work is required, the Department will compensate the Contractor for Extra Work in accordance with 1904, "Compensation for Contract Revisions," and determine the appropriate time extension, if any, in accordance with 1806, "Determination and Extension of Contract Time."

The Department and the Contractor shall execute a Change Order specifying the location and nature of the Work to be performed and the basis of payment before the Contractor is authorized to perform Extra Work. The Contractor shall perform Extra Work in accordance with the Specifications unless otherwise specified in the Change Order authorizing the Extra Work. The Change Order authorizing Extra Work shall not become effective until it has been fully executed and approved as required by law.

If the Contractor performs Extra Work before a Change Order is fully executed, the Department may consider this as unauthorized Work and as having been done at the Contractor's expense. The Department will compensate the Contractor for this Work only if the Engineer determines that the Work is acceptable and necessary, and the Change Order has been fully executed.

1402.6 ELIMINATED ITEMS

If the Department eliminates any Contract Items from the Contract, the Department will reimburse the Contractor for all costs incurred before notification that are not the result of unauthorized Work.

The Department will compensate the Contractor in accordance with 1905, "Compensation for Eliminated Items."

1403 NOTIFICATION FOR CONTRACT REVISIONS

1403.1 GENERAL

The following notification requirements apply to all potential Contract revisions including those defined in 1402, "Contract Revisions." The Engineer will consider requests for Contract revisions only if the notification procedures in this section are followed. Failure to follow the notification procedures in this section is deemed to be a waiver of the claim. The specified time limits may only be extended through a written, jointly-signed agreement between the Contractor and the Engineer. The Engineer will address the underlying issue prompting the notification in a timely manner.

1403.2 FIRST NOTICE, BY CONTRACTOR

The Contractor shall notify the Engineer as soon as a Contract revision appears necessary. The Contractor shall not start or continue with an Activity or Contract Item for which a Contract revision may be necessary without authorization from the Engineer.

1403.3 WRITTEN NOTICE, BY CONTRACTOR

If the Contractor disagrees with the Engineer's response or the Engineer does not respond to the first notice, the Contractor shall provide a written notice. Provide this written notice within 5 Business Days of first notice if Engineer has not responded or within 5 Business Days of receiving the Engineer's response to the first notice. The written notice shall include the following:

(1) A description of the situation
(2) The time and date the situation was first identified
(3) The location of the situation, if appropriate
(4) A clear explanation of why the situation represents a Contract revision, including appropriate references to the pertinent portions of the Contract or law
(5) A statement of the revisions deemed necessary in the Contract Unit Price(s), delivery schedule(s), phasing, time, etc. Because of the preliminary nature of this notice, the Department recognizes that this information may rely on estimates
(6) An estimate of the time by which the Engineer must respond to minimize cost or delay

(7) Anything else that will help achieve timely resolution

1403.4 WRITTEN ACKNOWLEDGEMENT, BY ENGINEER

The Engineer will provide a written acknowledgment of receipt of the Contractor's written notice.

1403.5 FINAL WRITTEN RESPONSE, BY ENGINEER

Within 10 Business Days of receiving the Contractor's written notice, the Engineer will provide a written response that includes one of the following:

(1) Confirmation of the need for a Contract revision. The Contractor shall pursue time extensions in accordance with 1806, "Determination and Extension of Contract Time," and compensation in accordance with 1904, "Compensation for Contract Revisions"

(2) Denial of the request for a Contract revision, in which case the Engineer will make clear, by reference to the Contract, why the issue does not represent a revision to the Contract

(3) A request for additional information, in which case the Engineer will state clearly what is needed and by when; the Engineer will respond within 10 Business Days of receiving the additional requested information

1403.6 CONTRACTOR'S RECOURSE

If the Contractor disagrees with the Engineer's final written response or the Engineer's response is untimely, the Contractor may pursue a claim in accordance with 1517, "Claims for Compensation Adjustment." The Contractor shall give the Engineer written notice of the intent to pursue a claim within 5 Business Days of receiving the Engineer's final written response.

1404 MAINTENANCE OF TRAFFIC

1404.1 GENERAL

Unless the Contract requires otherwise, the Contractor shall keep Roads undergoing improvements open to traffic at no additional cost to the Department. The Contractor shall direct traffic over a Department-approved Detour route as required by the Contract or as directed by the Engineer.

The Contractor shall maintain the portions of the Project being used by public traffic in a condition that accommodates the public traffic at all times. The Contractor shall provide and maintain temporary approaches, crossings, Intersections with trails, Roads, Streets; and abutments with businesses, parking lots, residences, garages, farms, and other property.

The Department will not require the Contractor to remove snow from Roads open to traffic.

1404.2 PLANNED DETOURS

The Department will maintain, without any cost to the Contractor, Detour Roads established by the Commissioner for through traffic diverted from the Project, if the Plans, Special Provisions, or the Engineer directs Project Road closures.

1404.3 CONTRACTOR'S REQUEST FOR DETOUR

The Contractor may request from the Engineer a Detour for through traffic. The Contractor shall specify the Detour routes and submit justification information with the Detour request. The Department will consider and may, at its sole discretion, approve the Detour request and establish a Detour in accordance with the following:

(1) The Contractor shall design, provide, install, maintain, and remove traffic control devices on the Detour Roads at no additional cost to the Department. The Contractor shall submit the proposed Detour layout to the Engineer for approval at least 7 Calendar Days before the Contractor begins to use the Detour.

(2) The Contractor shall maintain and restore Detour Roads at no additional cost to the Department. The Department will remove snow from Detour Roads at the Department's expense.

(3) The Contractor shall provide, install, and maintain traffic control devices and other traffic protection measures required to maintain local traffic.

1404.4 CONTRACTOR'S REQUEST FOR TEMPORARY BY-PASSES

The Contractor shall design, construct, maintain, and remove other Temporary By-Pass facilities requested by the Contractor and accepted by the Engineer at no additional cost to the Department.

1404.5 CONTRACTOR'S USE OF CROSSOVERS

Unless otherwise prohibited by the Engineer and in accordance with pertinent traffic laws and regulations, the Contractor may use freeway or expressway maintenance crossovers in or near the construction area to change the travel direction of the construction Equipment.

1404.6 TRAFFIC CONTROL DURING AND AFTER WINTER SUSPENSION

As directed by the Engineer during periods of winter suspension, the Contractor shall open the Project's Roads to traffic to eliminate the need to accommodate traffic on Detour Roads during the suspension period.

During authorized winter suspension, the Department will maintain traffic control devices in accordance with 1710, "Traffic Control Devices." If Contractor-owned traffic control devices are damaged or destroyed, the Department will pay the Contractor for the value of the traffic control device as determined by the Engineer.

The Contractor shall not suspend operations for the winter until meeting the requirements of 1710, "Traffic Control Devices," and 1803.4, "Temporary Suspensions."

When resuming Work after winter suspension, the Contractor shall remove and replace, or correct Work lost or damaged during the suspension, as directed by the Engineer, and must remove items used for Road maintenance in accordance with 1514, "Maintenance During Construction." The Department will pay for this Work at the Contract Unit Prices or as Extra Work in accordance with 1402, "Contract Revisions."

1405 USE OF MATERIALS FOUND ON THE PROJECT

The Contractor shall not destroy or use Materials found on the Right-of-way or on other land acquired for the Project for any other purposes than those specified in the Contract.

The Engineer may authorize the Contractor, in writing, to temporarily use Materials salvaged for the Department from existing Structures. The Contractor is responsible for all damage to the Materials used temporarily. The Contractor shall repair, replace, or otherwise correct by means acceptable to the Engineer the Materials damaged by the temporary use, or the Department will deduct, from any moneys due or becoming due to the Contractor, an amount equivalent to the reasonable value or replacement cost of the Material.

The Engineer may authorize the Contractor, in writing, to use acceptable Material found on the Project as a substitute for Material required by the Contract and provided by the Contractor from outside sources. Authorization to remove and use the substitute Material for unspecified purposes to the Contractor's advantage is at the sole discretion of the Engineer, subject to the conditions established by the Engineer and the requirements of the Contract.

The Department will make Material found on the Project available for use on the Project to the best advantage and without charge to the Contractor in the interest of providing maximum utilization of existing Materials. The Department will not incur additional costs resulting from the use of this Material. If Contractor

needs this Material for other construction purposes on the Project, the Contractor shall provide replacement Material acceptable to the Engineer, at no additional cost to the Department.

1406 PRESERVATION OF HISTORICAL OBJECTS

Immediately upon discovery of potential historical objects of an archeological or paleontological nature within the Project Site, the Contractor shall do the following:

(1) Restrict or suspend operations in the immediate area of the discovery to preserve the potential historical objects
(2) Notify the Engineer of the presence of potential historical objects

The Engineer will make arrangements for their disposition or record the desired relevant data.

The Contractor shall support the preservation and salvage effort directed by the Engineer. The Contractor shall not perform Work related to the preservation and salvage efforts that the Contractor considers Extra Work without the written approval of the Engineer.

The Department may restrict or suspend the Contractor's operations in the immediate area of the historical objects for a period not to exceed 72 hours, without a Contractor claim for damages. The Department will not impose restrictions over 72 hours, unless agreed by the Contractor and the Department in writing.

1407 FINAL CLEANUP

Before requesting final inspection in accordance with 1516.2, “Project Acceptance,” the Contractor shall remove the following from the Project Site and other locations outside of the Project Site used in performing the Work:

(1) Surplus and discarded Materials
(2) Equipment
(3) Rubbish
(4) Temporary Structures
(5) Other items not on the Project Site before execution of the Contract

The Contractor shall also leave the Project Site, including borrow pits, in a condition acceptable to the Engineer. The cost of final cleanup is included in the Contract Unit Prices of the Contract Items.

1408 VALUE ENGINEERING INCENTIVE

Value engineering provisions provide an incentive to the Contractor to initiate, develop, and present cost reduction Proposals involving changes in the Contract requirements to the Department for consideration.

Value engineering provisions only apply if the Contractor specifically submits a Proposal for consideration as a value engineering Proposal.

The cost reduction Proposals shall produce a net savings to the Contract by providing less costly items or methods than those specified in the Contract without impairing essential functions and characteristics.

The Contractor shall submit value engineering Proposals to the Engineer with the following information:

(1) A statement that the Contractor is submitting a value engineering Proposal
(2) A description of the Proposal
(3) An itemization of the proposed changes to the Contract requirements and a recommendation of how to make each change

(4) An estimate of the reduction in performance costs that will result from adoption of the Proposal
(5) A prediction of any effects the proposed changes would have on other costs incurred by the Department
(6) A statement of the time by which an agreement for adoption of the Proposal must be executed to obtain the maximum cost reduction during the remainder of the Contract, and the reasoning for this time schedule
(7) The dates of any previous submissions of the Proposal, including Contract numbers and the actions of the Department
(8) A statement as to the effect the Proposal would have on the time for completion of the Contract

The Department will not assume any liability for not meeting the statement of the time described in the Contractor's value engineering Proposal. The Contractor may withdraw, in whole or in part, any value engineering Proposal not accepted by the Department within the period identified in the proposal. The Department's acceptance or rejection decision on a value engineering Proposal shall be final and the provisions of 1517, "Claims for Compensation Adjustment," will not apply.

The Department will notify the Contractor in writing of its decision regarding each value engineering Proposal. Until the Department accepts the Proposal, the Contractor shall continue to perform Work in accordance with the requirements of the Contract. If the Department accepts the Proposal, the Department will execute a Change Order setting forth the terms, conditions, and costs of the Proposal. If the Contractor performs any Work performed in accordance with the value engineering Proposal before the execution of the Change Order, the Department will consider that "unauthorized Work" as specified in 1512, "Unacceptable and Unauthorized Work."

The Change Order will establish the Contract modifications and the agreed net savings. The Department will calculate the net savings by subtracting the Contractor's value engineering Proposal cost from the Contractor's original bid price for the work covered in the value engineering Proposal.

A - Contractor's value engineering Proposal cost.

B - Contractor's original bid price for the Work covered in the value engineering Proposal.

B - A= Net Savings.

The department reserves the right to reject any value engineering Proposal that does not reflect the reasonable costs to perform the Work covered in the value engineering Proposal.

The Department will provide a lump sum payment of 50 percent of the net savings from the value engineering Proposal to the Contractor as the Contractor's share of the value engineering incentive. The Department will not revise the lump sum payment even if the final accepted quantities vary. The Department may include conditions for consideration, approval, and implementation of the cost reduction Proposal in the Change Order.

The Contractor shall design and develop the Proposal at no additional cost to the Department.

The Department will not include the costs incurred for reviewing, approving, and implementing the Proposal in the net savings calculations.

After the Department accepts the cost reduction Proposal, any restrictions imposed by the Contractor on its use or disclosure of the information submitted shall be void, and the Department will have the right to use, duplicate, and disclose any data necessary to use the Proposal.

Control of Work

1501 AUTHORITY OF THE ENGINEER

1501.1 DECIDING QUESTIONS

The Engineer will, in the Engineer's sole discretion, make a final and conclusive decision with regard to any issue or question regarding:

(1) Quality and acceptability of Materials provided and Work performed
(2) Manner of performance and rate of progress of the Work
(3) Interpretation of the Contract, except for those provisions which expressly require or authorize a Department decision
(4) Measurement, control of quantities, and the amount of any payment deductions or adjustment
(5) Acceptable fulfillment of all Contract provisions on the part of the Contractor

The Engineer's acceptance does not waive the Department's right to pursue legal remedies for defective Work or Work performed by the Contractor in an unworkmanlike manner.

1501.2 SUSPENDING WORK

The Engineer may suspend the Work if the Contractor fails to complete any of the following:

(1) Correct conditions unsafe for the Project personnel or the general public
(2) Carry out the Contract provisions
(3) Carry out any lawful orders
(4) Comply with the requirements of all permits for the Project

The Engineer may also suspend work for any of the following:

(1) Unsuitable weather
(2) Conditions unsuitable for prosecution of the Work
(3) Other conditions or reasons deemed to be in the best public, State, Department, or national interest

1501.3 BASIS OF DECISION

The Engineer will make decisions based on the Engineer's judgment in accordance with the following:

(1) Facts and inferences
(2) Inherent variations of Materials and processes
(3) Risks associated with drawing inferences from test results on small samples that may not truly represent the Material or workmanship provided
(4) Past experiences relating to the question at issue
(5) Regulations, instructions, and guidelines established by the Department to administer the Work
(6) Other factors the Engineer determines to have a bearing on the issue

The Engineer may require additional tests to provide a statistically sound basis for judgment. The Engineer may accept satisfactory evidence of proper and adequate process control if the end result characteristics cannot be practically measured.

1502 PLANS AND WORKING DRAWINGS

The Department will provide the Plans showing details and directions to provide a comprehensive description of the construction contemplated. The Department will not provide all necessary detail drawings for Structures. The Department will include the following information in the Plans:

(1) Summary of all Contract Items
(2) General features
(3) Typical cross-sections
(4) Alignment and grades
(5) Structure locations and dimensions
(6) Layout diagrams
(7) Special details

The Department will provide supplemental drawings in the form of Standard Plans or Standard Plates. The Department may include earthwork cross-sections and contours with the Plans.

Before performing the Work, the Contractor shall prepare schedules, documents, and Working Drawings necessary to complete the Work, and shall submit to the Engineer for review. The Contractor's Progress Schedule shall anticipate sufficient time, not less than 14 Calendar Days, for the Engineer to review and comment on the submittal and to allow the Contractor to respond to the Engineer's comment(s) before starting the Work. The Contractor shall provide additional information, including permits, detail drawings, and calculations as necessary for the Engineer to complete the review. The Contractor shall provide submittal copies in the requested number to the Engineer for review and inspection of the Work. The Contractor shall not alter the submittals without written consent from the Engineer. After completing the Work, the Contractor shall provide digitally reproducible copies to the Engineer upon request. The Contract Unit Prices for the relevant Contract Items include the cost of preparing and submitting the submittals.

The Engineer's review of the submittals does not relieve the Contractor of responsibility for the following:

(1) Accuracy of dimensions and details
(2) Agreement and conformity with the Contract
(3) Successful completion of the Work
(4) Proper and safe design
(5) Proper and safe construction of the Work
(6) Means and methods of performing the Work

1503 CONFORMITY WITH CONTRACT DOCUMENTS

The Contractor shall perform all Work, including providing all Materials, in accordance with the requirements of the Contract.

Dimensions and values required by the Contract are target dimensions or values. The Department will accept deviations from these targets within the tolerances required by the Contract. Materials and workmanship shall be uniform in character and shall conform to the target or to the middle portion of the tolerance range. The purpose of the tolerance range is to accommodate occasional minor variations from the target or middle portion of the tolerance range that are unavoidable for practical reasons. If the Contract requires a maximum or minimum dimension or value, the Contractor shall control the production and processing of Material and the performance of the Work so that the Material or workmanship is not of borderline quality or dimension. If the Contract does not specify a tolerance for a requirement, the Engineer will accept an Industry Standard tolerance. If the Engineer determines that Materials or workmanship are consistently of borderline quality, the Engineer may direct the Contractor to suspend operations and may declare future Work of borderline quality to be unauthorized Work in accordance with 1512, "Unacceptable and Unauthorized Work."

In constructing temporary facilities that do not become a part of the permanent improvement, the Engineer may waive requirements that the Engineer considers unnecessary in fulfilling the intended service or function of the facility. The Engineer may accept alternative designs from those required for temporary construction provided that costs to the Department do not exceed those that the Department would have incurred with the design required by the Contract.

1504 COORDINATION OF CONTRACT DOCUMENTS

A requirement appearing in one of the Contract documents is as binding as though the requirement appears in all. If discrepancies exist between the Contract documents, the following order of precedence applies:

(1) Addenda
(2) Special Provisions
(3) Project-Specific Plan Sheets
(4) Supplemental Specifications
(5) Standard Plans and Standard Plates
(6) Standard Specifications

If discrepancies exist between dimensions in the Contract documents, the following order of precedence applies:

(1) Plan dimensions
(2) Calculated dimensions
(3) Scaled dimensions

The Department and Contractor shall inform each other as to any discrepancy or defect they discover. Neither the Contractor nor the Engineer shall take advantage of any discrepancy or defect. The Engineer will review the alleged discrepancy or defect to determine if a Contract revision is necessary in accordance with 1402, “Contract Revisions.” The Engineer will decide all issues concerning a discrepancy or defect.

1505 COOPERATION BY CONTRACTORS

The Department may authorize Work by other contractors and agencies within the Project Site during the Contract Time. The Contractor shall cooperate with the Engineer, utility owners, and other contractors concurrently performing Work on the Project.

The Contractor shall coordinate Work with utility owners for the following:

(1) Allow removal and rearrangement operations to progress in a reasonable manner
(2) Minimize duplication of Work
(3) Avoid unnecessarily interrupting services rendered by those parties

When performing Work of separate Contracts within the limits of a Project, each Contractor shall avoid interfering and hindering the progress or completion of the Work being performed by other contractors. Contractors working on the same Project shall cooperate with each other as required by their respective Contracts. The Contractor shall assume the risk of delay, inconvenience, or loss resulting from the presence and operations of other contractors working within the same Project Site, and shall make no claim for such delay, inconvenience, or loss.

1506 SUPERVISION BY CONTRACTOR

The Contractor is responsible for the following:

(1) Keeping a complete set of the Contract documents on the Project while Work is in progress
(2) Assuming full responsibility for supervising the Work irrespective of the quantity of Work subcontracted

(3) Facilitating the Work progress and ensuring Project completion as required by the Contract

At the preconstruction meeting, the Contractor shall designate in writing a competent Superintendent and a competent individual (if different) for the Project. The competent Superintendent and the competent individual may be the same person, if constantly available in person on the Project and qualified in accordance with the requirements in this section.

The Contractor may change the designated competent Superintendent or designated competent individual during the Project by submitting an authorized change in writing to the Engineer. The Engineer must receive the authorized change in writing before the designated Superintendent or competent individual performs Work on the Project.

1506.1 COMPETENT SUPERINTENDENT

For the duration of the Contract, the Contractor shall act as a competent Superintendent or provide a competent Superintendent to act on the Contractor's behalf. Ensure availability of the competent Superintendent on the Project within 24 hours' notice to perform the following:

(1) Conduct business with the Subcontractors
(2) Negotiate and execute Change Orders
(3) Execute the orders and directions of the Engineer without delay
(4) Promptly supply the Materials, Equipment, tools, labor, and Incidentals necessary to complete the Work

1506.2 COMPETENT INDIVIDUAL

For the duration of the Contract, the Contractor shall provide a competent individual on the Project during the Work who is:

(1) Authorized and capable to manage, direct, and coordinate the Work in progress
(2) Experienced in the type of Work being performed
(3) Capable of reading and understanding the Contract
(4) Authorized to receive instructions from the Engineer

If the Contractor does not employ the competent individual, the Contractor shall authorize the competent individual, in writing, to perform the functions of the competent individual specified in this subsection.

1507 UTILITY PROPERTY AND SERVICE

1507.1 GENERAL

The Contract will specify the utilities affected by the Project. The Department will direct the utility owners affected by the Project to relocate or adjust their facilities and related appurtenances within the Project Site at no additional cost to the Contractor, unless the Contract makes the Contractor responsible for relocating or adjusting designated utility facilities.

The Department expects utility owners to complete utility relocations and adjustments as indicated in the Contract. The Contractor shall provide adequate notification of the scheduled Work to utility owners relocating or adjusting facilities during construction to prevent conflict with the Contractor's schedule of operations.

By submitting a Proposal for the Project as a Bidder, the Contractor has acknowledged that it has considered the following:

(1) Temporary and permanent utility facilities identified in the Contract

(2) Existing location and the designed relocations of all utility facilities as shown on the Plans

(3) Precautions required to protect utility facilities in the Project Site during construction Activities

If utility owners fail to relocate or adjust their facilities as required by the Department and the Contractor sustains losses that could not have been avoided by the judicious handling of forces, Equipment, and plant, or by reasonable revisions to the schedule of operations, the Engineer will adjust the Contract in accordance with 1402, “Contract Revisions.”

All utilities related to this Project are classified as "Level D." This utility quality level was determined according to the guidelines of *CI/ASCE 38-02*, entitled "Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data."

The Contractor agrees that it shall use the Plan to identify the location of Department storm water drainage facilities in order to meet the requirements of MN Statutes Ch. 216D and Minnesota Administrative Rule 7560.0250 which apply to MnDOT storm water drainage facilities.

1507.2 NOTIFICATION

The Contractor shall fulfill all the obligations of an excavator in MN Statutes Chapter 216D and rules adopted to implement that statute. The Contractor's obligations include but are not limited to marking the proposed excavation, contacting “Gopher State One Call” at least 48 hours before starting excavation operations (excluding Saturdays, Sundays, and Holidays), and providing support and protection for underground facilities in and near the construction area.

When the Contractor works near electric power lines, the Contractor must provide for protection of personnel and the electrical power lines. The Contractor may work with the lines energized if the Work can be done safely, otherwise the Contractor must:

(1) Make arrangements with the power company, at no expense to the Department, to:

(a) temporarily shut off the power
(b) temporarily insulate the power line(s)
(c) bypass the power from the Work area

(2) Make other arrangements necessary for a safe Work place.

The Department makes no promises or representation as to whether the utility will temporarily shut off power, insulate its line(s), or charge the Contractor a fee for preparing a safe Work area for the Contractor.

The Contractor shall employ special Equipment or construction methods, and hand labor if necessary, to accomplish the planned Work adjacent to utility facilities without damaging them.

Any Work performed by the Contractor that does not comply with 1507.2, “Notification,” may be considered unauthorized Work in accordance with 1512.2, “Unauthorized Work.”

1507.3 LIABILITY

If the existence and approximate location of utility property was available to the Contractor before the damage occurred, the Contractor shall reimburse the utility owner for damage to the utility property caused by the Contractor’s operations at no additional cost to the Department.

1508 CONSTRUCTION STAKES, LINES, AND GRADES

The Engineer will set construction stakes to establish lines, slopes, elevations, and continuous Profile Grades for grading, base, and pavement construction to establish the field control for the Project. The

Engineer will also set construction stakes to establish location, line, and grade controls for drainage facilities, traffic control and protection devices, and other accessory Structures and appurtenances.

For Bridge construction, the Engineer will set stakes to establish the field control and working points as shown on the Bridge layout sheet in the Plans. The Engineer will set at least one bench mark in the vicinity of each Substructure unit for the Contractor's reference when excavating these units. The Engineer will set grade points for the Substructure and Superstructure forms, and provide beam stool heights as deemed necessary for performance of the Work.

From the field control, the Contractor shall establish other necessary controls, detail dimensions, and measurements required for proper layout and performance of the Work. The Contractor shall assume full responsibility for all measurements made from the stakes and marks established by the Engineer.

The Contractor shall preserve all stakes and marks. If the Contractor carelessly or willfully destroys or disturbs any of the field control stakes or marks, the Engineer will deduct the Department's cost for replacing the damaged stakes or marks from the payment for the Work.

The Department is responsible for the accuracy of lines, slopes, grades, and other engineering Work performed by the Department's personnel as specified in this section. The Contractor shall not knowingly take advantage of errors or omissions and shall report any discovered errors or omissions to the Engineer immediately upon discovery.

1509 AUTHORITY OF THE PROJECT ENGINEER AND PROJECT SUPERVISOR

Project Engineers are delegated all duties and authorities of the Engineer except for those delegated under 1512, "Unacceptable and Unauthorized Work."

Project Supervisors are delegated all duties and authorities of the Engineer except for those delegated under 1512, "Unacceptable and Unauthorized Work," and any duty or authority which would require licensure as a Professional Engineer in the State of Minnesota.

1510 AUTHORITY AND DUTIES OF THE INSPECTOR

Inspectors have the authority to do the following:

(1) Inspect the Work and the preparation, fabrication, or manufacture of Materials
(2) Notify the Contractor of non-conforming Work
(3) Reject non-conforming Material
(4) Suspend portions of the Work for any of the following reasons that require a decision by the Engineer:

    (a) Interpretation of requirements in the Contract
    (b) Performance of unacceptable or unauthorized Work in accordance with 1512, "Unacceptable and Unauthorized Work"
    (c) Safety

Inspectors do not have authorization to alter or waive requirements of the Contract or to issue instructions contrary to the Contract.

Inspectors do not have an obligation or authorization to provide direction, superintendence, or guidance to the Contractor, its crews, its Subcontractors, or suppliers to accomplish the Work.

Any action or inaction of the Inspector does not waive the Department's right to pursue any and all legal remedies for defective Work or Work performed by the Contractor in an unworkmanlike manner.

1511 INSPECTION OF WORK

The Engineer may inspect Materials and the Work. The Contractor shall provide the Engineer or the Engineer's representative access to the Work, information, and assistance necessary to conduct a complete inspection. The Contractor shall notify the Engineer at least 24 hours before required inspections.

The purpose of Department inspections is to determine whether the Work meets the requirements of the Contract. The Department inspections do not supplement or replace the Contractor's own Quality Control and do not relieve the Contractor of its responsibility to correct nonconforming Work.

If directed by the Engineer, the Contractor shall remove or uncover completed Work for inspection. After the Engineer's inspection, the Contractor shall restore the Work as required by the Contract. If the inspected Work meets the Contract requirements, the Department will consider the Work to uncover or remove and restore the Work as Extra Work in accordance with 1402, "Contract Revisions." If the inspected Work does not meet the Contract requirements, the Department will not pay for the Work to uncover or remove and restore the Work. The Department is not responsible for Contractor losses if the removals or uncovering of completed Work revealed nonconforming Work or Materials.

The Department will determine the level of inspection for any item of Work. The Contractor is responsible for the quality of Work and compliance with the Contract requirements regardless of the Department's level of inspection.

The Department will consider any Work performed or Materials used without the required certification, testing, or inspection by the Department as unauthorized Work in accordance with 1512.2, "Unauthorized Work."

The Engineer's failure to reject nonconforming Work or Materials, from lack of discovery of the nonconforming Work or Materials or for any other reason, will not:

(1) Prevent the Department from rejecting the nonconforming Work or Materials upon later discovery
(2) Obligate the Department to issue final acceptance of the Contract in accordance with 1516.4, "Final Contract Acceptance"

Inspection of Work may include inspection by representatives of other government agencies, railroad companies, or utility owners that pay a portion of the cost of the Work. This inspection will not make these other government agencies, railroad corporations, or utility owners a party to the Contract and will not interfere with the rights of the Contractor or Department.

1512 UNACCEPTABLE AND UNAUTHORIZED WORK

1512.1 UNACCEPTABLE WORK

The Department will consider all Work and Materials that do not meet the Contract requirements, or do not meet generally accepted industry standards if the Contract does not provide specific standards, to be unacceptable.

For unacceptable Work resulting from poor workmanship, use of nonconforming Materials, damage through carelessness, or any other cause existing before final acceptance of the Work, the Department will take one of the following actions, at the Engineer's sole discretion:

(1) Require the Contractor to acceptably correct the Work and Materials, immediately upon receipt of written order to do so
(2) Allow the Work to remain in place and apply a monetary deduction to the Contract Unit Price
(3) Decide the extent of acceptance for the Work to remain in place if a Contract Item fails to meet Contract requirements but is adequate to serve the design purpose, and

document the basis of acceptance by Change Order to adjust the Contract Unit Price; the adjusted Contract Unit Price will be determined at the Engineer's sole discretion

(4) Require the Contractor to remove and replace the unacceptable Work at the Engineer's sole discretion

The Department may provide notice of default in accordance with 1808, "Default of Contractor," after the Contractor has been given proper notice to acceptably correct the Work and Materials, and has failed to do so.

The Contractor shall remove and replace the unacceptable Work, or correct the Work, at no additional cost to the Department if a Contract Item does not meet specified requirements and results in Work that does not serve the design purpose.

1512.2 UNAUTHORIZED WORK

The Department will consider Work performed contrary to the direction of the Engineer, or in a manner that is not in compliance with Contract requirements, or any Work performed beyond that specified in the Contract or directed by the Engineer, to be unauthorized.

The Department may consider any of the following as unauthorized Work:

(1) Work performed before the Engineer provides lines or grades or required inspections of Materials
(2) Work performed before the Department's approval of the Contract as required by law
(3) Extra Work performed before Engineer approval of a Change Order
(4) Work performed that prevents or impedes investigation, verification testing, or resolution of unacceptable Work

The Contractor shall remove unauthorized Work upon receipt of a written order to do so, at no additional cost to the Department.

The Department may pay for unauthorized Work only if the Engineer determines the Work to be acceptable or the Work is authorized in a Change Order.

1512.3 NON-COMPLIANCE

If the Contractor fails to comply immediately with any order issued by the Engineer in accordance with the requirements in this section, the Engineer may direct the following and deduct the costs from moneys due or becoming due to the Contractor under the Contract or any other Contract with the Department:

(1) Correction or removal and replacement of unacceptable Work
(2) Removal of unauthorized Work

1513 RESTRICTIONS ON MOVEMENT AND STORAGE OF HEAVY LOADS AND EQUIPMENT

The Contractor shall haul Materials and move and store Equipment in accordance with the *Minnesota Highway Traffic Regulation Act,* MN Statutes, Chapter 169 and applicable provisions of Minnesota Rules when using public Roads or completed Structures, base courses, and pavements within the Project that are open to traffic and becoming a part of the permanent improvement.

The Contractor shall comply with legal load restrictions and with special restrictions required by the Contract when hauling or storing Materials and moving or storing Equipment on Structures, completed Subgrades, base courses, and pavements within the Project, under construction or completed but not yet open to traffic.

The Contractor shall complete and place a cab card in each vehicle used for hauling bituminous mixture, Aggregate, batch concrete, or grading Material (including borrow and excess), before starting Work. This

cab card shall identify the truck or tractor and trailer by Minnesota or prorated license number and shall contain the tare, maximum allowable legal gross mass, supporting information, and the signature of the owner. The Contractor shall make the card available to the Engineer upon request. The Contract Unit Prices include Contractor-related costs in providing, verifying, and spot checking the cab card information, including weighing empty and loaded trucks on certified commercial Scales.

The Contractor shall not operate Equipment mounted on crawler tracks or steel-tired wheels on or across concrete or bituminous surfaces.

When construction operations require crossing an existing pavement, Bridges, or completed portions of the Pavement Structure with otherwise prohibited Equipment or loads, the Contractor shall submit methods of load distribution or bridging in writing and obtain the Engineer's written approval. This approval does not relieve the Contractor of responsibility for any damages to the Work.

The Contractor will not be relieved of liability for damages resulting from the operation and movement of construction Equipment because of the issuance of a special permit, or by adherence to any other restrictions imposed.

The Contractor may temporarily store or park construction Materials and Equipment on a Bridge deck during Bridge construction. Storage of Materials and Equipment shall be limited as follows:

(1) No stockpiles weighing greater than 65,000 pounds per 1,000 square feet
(2) No individual stockpiles of Materials (including pallets of products, reinforcing bar bundles, and Aggregate piles) weighing greater than 25,000 pounds per 100 feet squared
(3) No single vehicle or Equipment exceeding 80,000 pounds
(4) No combination of more than 200,000 pounds of vehicles, Materials, and other Equipment per span with lengths greater than 40 feet

1514 MAINTENANCE DURING CONSTRUCTION

At the Contractor's own expense and initiative, the Contractor must maintain Project Roadway on which it has performed Work when the Contract requires placing Materials on or the use of constructed Subgrade, base course, pavement, or Structure. This responsibility for maintenance includes not only Roadway where construction is complete, but also temporary, unfinished Roadway surface used by traffic where the existing pavement has been removed but the final surface has not yet been placed. The Contractor must maintain this Work such that the surface is reasonably smooth, dust free, not rutted or potholed, and provides for the safe and convenient use by the travelling public. For Roadway on which the Contractor has performed Work, the Engineer will notify the Contractor, in writing, of maintenance deficiencies. The Contractor must correct deficiencies within 24 hours of receipt of written notice from the Engineer, or within 24 hours of when the Contractor independently encounters deficiencies requiring repair, whichever is earlier. If the Contractor fails to do so, the Department may immediately proceed to maintain the Work and deduct the cost of maintenance from money due or becoming due to the Contractor under the Contract or any other Contract with the Department.

For maintenance Work on all other Highways and Roads, the Contractor must perform maintenance Work or provide dust control as directed by the Engineer. The Contractor must promptly notify the Engineer if the Contractor encounters a deficiency that must be repaired to maintain the Road such that the surface is reasonably smooth, dust free, not rutted or potholed, and provides for the safe and convenient use by the travelling public. The Contractor must comply with an Engineer's directive to maintain the Road within 24 hours after receipt of written notice. The Department will pay for the Engineer-directed Work at Contract Unit Prices or as Extra Work in accordance with 1402, "Contract Revisions." The Department will not pay for Contractor maintenance Work performed on Contractor-requested Detours and Contractor-selected haul Roads.

During periods of authorized winter suspension, the Department will perform routine maintenance on Project Roads. When resuming Work after winter suspension, the Contractor must remove, to the

extent directed by the Engineer, any temporary construction or Materials that the Department used in Road maintenance during the suspension. The Department will pay for this Work at the Contract Unit Prices or as Extra Work in accordance with 1402, "Contract Revisions."

If the Engineer partially accepts Work under 1516.1, "Partial Acceptance," then the Contractor is relieved of responsibility for maintenance of that portion of the Work that has been partially accepted, except as directed by the Engineer. The Department will pay for the Engineer-directed Work at Contract Unit Prices or as Extra Work in accordance with 1402, "Contract Revisions."

1515 CONTROL OF HAUL ROADS

A Designated Haul Road is a public Road (other than a trunk Highway) that the Contractor may use for the purposes specified in 2051.1A, "Definitions."

A Designated Haul Road does not include a connection between a natural Material source and a public Road. The Contractor must secure the Rights-of-way for, construct, and maintain such connections between a Material source and a public Road, without compensation from the Department other than payment received for the Contract Items.

The Department may, but is not required to, designate a haul Road in accordance with MN Statutes §161.25. If the Department has made a written designation of a haul Road, then the Department will have jurisdiction over the public Roads and Streets included in such designation. The requirements of 2051, "Haul Road Maintenance and Restoration," will govern the maintenance and restoration of the Designated Haul Roads.

If the Department has not made a written designation of a haul Road, the Contractor will be responsible for the following:

(1) Arranging for the use of Roads not under the jurisdiction of the Department
(2) Performing any maintenance and restoration as required by the applicable Road authority as a condition of use of such Road as a haul Road
(3) Paying any fees, charges, or damages assessed by the applicable Road authority as a condition of using such Road as a haul Road

All actions and costs with respect to a non-designated haul Road will be without compensation from the Department, other than payment received for the Contract Items.

In preparing its Proposal, the Contractor is not entitled to assume that the Department will designate a haul Road, or that the Designated Haul Road will be the most convenient and direct route or not subject to reduced weight limits. The Department will not consider its decision to designate or not designate a requested haul route as a basis for a Contract revision.

1516 ACCEPTANCE

1516.1 PARTIAL ACCEPTANCE

After completing a substantial and discrete portion of Work, the Contractor may request the Engineer to inspect that portion. If the Engineer determines that the portion of the Work is complete in accordance with the Contract requirements, the Engineer may accept the completed portion in writing. Partial acceptance relieves the Contractor of further responsibility for maintenance of that portion of Work, but does not invalidate or alter the terms of the Contract.

1516.2 PROJECT ACCEPTANCE

After completing the Work, the Contractor shall notify the Engineer and request a final inspection. If the Engineer determines that the Project is complete, the inspection will constitute the final inspection and the Engineer will promptly provide written notice of Project acceptance effective on the date of the final inspection. The notice of Project acceptance relieves the Contractor of further responsibility for the Work.

If the Engineer finds unacceptable or incomplete Work, the Contractor shall immediately correct the deficiencies as directed by the Engineer. After correcting the deficiencies, the Contractor shall again request a final inspection.

Acceptance of the Project does not relieve the Contractor of financial liabilities imposed on the Contractor by statute and does not constitute final acceptance of the Contract.

1516.3 COMPLETION OF THE WORK

The Department will consider the Work in all things completed when the Contractor has completed and submitted required documents, certifications, and affidavits including, but not limited to, the following:

(1) MN IC134 Withholding Affidavit, certified by Minnesota Department of Revenue, demonstrating compliance with MN Statute § 290.92
(2) Material certifications and warranties
(3) Written Department confirmation that known outstanding prevailing wage complaints have been resolved as approved by the Department
(4) Final Clearance Letter for DBE participation, TGB participation, or Veteran's participation
(5) Payment of moneys owed to the Department, if applicable
(6) Termination of NPDES Permit, if applicable
(7) All other forms required by the Contract

1516.4 FINAL CONTRACT ACCEPTANCE

The Department will make final Contract acceptance when the following occur:

(1) Work has been in all things completed to the satisfaction of the Department
(2) All parties have executed the Certificate of Final Acceptance

1517 CLAIMS FOR COMPENSATION ADJUSTMENT

The Contractor shall not file a claim unless the Contractor has exhausted the requirements of 1402, "Contract Revisions," and 1403, "Notification for Contract Revisions" including the notice requirements in 1403, "Notification for Contract Revisions." Failure to comply with the notice requirements of 1403, "Notification for Contract Revisions," is deemed to be a waiver of the claim. The Contractor is not entitled to compensation or time extensions for disputed Work under this section (1517) unless the compensation or time extension is required or provided for elsewhere in the Contract.

1517.1 NOTIFICATION

The Contractor must notify the Engineer in writing of any intent to file a claim for compensation or time extension. The Contractor shall not be entitled to compensation or a time extension if:

(1) The Contractor fails to notify the Engineer.
(2) The Contractor's actions or inactions prevent the Department from keeping strict account of the impacts and costs of the disputed Work.
(3) The Contractor's actions or inactions prevent the Department from mitigating the impacts and costs of the disputed Work.

1517.2 CLAIM SUBMITTALS

A Entitlement

The Department requires that the Contractor establish entitlement for all claims before the Department will consider impact and cost. The Contractor must submit the following to the Engineer as a minimum to determine entitlement:

(1) A detailed factual statement of the claim providing a description of the claim issues and all relevant facts, including the events, dates, locations, and a description of what Work was affected and how this Work was affected by the claim.
(2) A narrative that identifies all of the specific Contract provisions that support the claim, why they support the claim, and how the details of the factual statement in item (1) above establish entitlement based on the referenced Contract provisions.
(3) All pertinent documents, electronic files, and the substance of any oral communications related to the information provided in item (1) and (2) above.

B Impact and Cost

If the Department determines that the Contractor has established entitlement, the Contractor must submit the following to the Department as a minimum to determine impact and cost:

(1) If a delay is alleged, submit a narrative, all documentation (including applicable Project Schedules substantiating the delay), and a schedule analysis in accordance with 1806.1, "Determination and Extension of Contract Time, General."
(2) If additional costs are alleged, submit a narrative and all documentation that substantiates the claimed costs. The Contractor must submit cost documentation for the claim submittal in a format that allows the Department to perform an audit under the authority of 1721, "Audits."

The Contractor may not submit a claim that fails to establish the causal link between the Department's responsibility and the Contractor's impacts and costs.

1517.3 REQUIRED CERTIFICATION OF CLAIMS

The Contractor shall certify the claim attesting to the following:

(1) Claim is made in good faith, based on documented fact and the value is not knowingly overstated
(2) Supportive data is true, accurate, and complete to the Contractor's best knowledge and belief

In complying with this requirement, the Contractor's claim submittal shall include the following fully executed certification:

Under the penalty of law for perjury or falsification, the undersigned,

_____,
(Name)

_____ of
(Title)

_____
(Company)

hereby certifies that the claim for compensation and time, if any, made herein for Work on this Contract is, to the best of the Contractor's knowledge and belief, a true statement of the costs incurred and time sought, and is fully documented and supported under the Contract between the parties.

Dated_____/s/_____

Subscribed and sworn before me this ____day of_____, 20__.

Notary Public _____

My commission Expires _____

A Impact and Cost

If the Department determines that the Contractor has established entitlement, the Contractor shall submit the following to the Department as a minimum to determine impact and cost:

(1) If a delay is alleged, submit a narrative, all documentation (including applicable Project Schedules substantiating the delay), and a schedule analysis in accordance with 1806.1, "Determination and Extension of Contract Time, General."

(2) If additional costs are alleged, submit a narrative and all documentation that substantiates the claimed costs. The Contractor shall submit cost documentation for the claim submittal in a format that allows the Department to perform an audit under the authority of 1721, "Audits."

The Contractor may not submit a claim that fails to establish the causal link between the Department's responsibility and the Contractor's impacts and costs.

1517.4 REVIEW OF CLAIM SUBMITTALS

All claim submittals filed will be subject to review by the Department at any time following the filing of the claim submittal. The Contractor, Subcontractor(s), or supplier(s) shall cooperate with the Department and shall provide the Department access to the following relevant documents, including, but not limited to:

(1) Daily time sheets and foreman's daily reports
(2) Union agreements, if any
(3) Subcontracts
(4) Insurance, welfare, and benefits records
(5) Payroll register
(6) Earnings records
(7) Payroll tax returns
(8) Material invoices, purchase orders, and all Material and supply requisition Contracts
(9) Material cost distribution worksheets
(10) Equipment records (usage reports, list of company Equipment, rates, etc.)
(11) Vendor rental agreements and Subcontractor invoices
(12) Subcontractor payment certificates
(13) Canceled checks (payroll and vendors)
(14) Job cost report
(15) Job payroll ledger
(16) General ledger, general journal, and all subsidiary ledgers and journals together with all supporting documentation pertinent to entries made in these ledgers and journals
(17) Cash disbursements journal
(18) Financial statements for all years reflecting the operations on this Project
(19) Income tax returns whether such records are maintained by the company involved, its accountant, or others for the years reflecting operations on the Project
(20) Depreciation records on all company Equipment
(21) All other documents used to develop costs for the Contractor's internal purposes in establishing the actual cost of owning and operating Equipment

(22) All documents that reflect the Contractor's actual profit and overhead during the time the Project was being performed and for each of the five years before the commencement of this Project

(23) All documents related to the preparation of the Contractor's Proposal including the final calculations on which the Proposal was based, unless the documents are placed in escrow as a provision of the Contract

(24) Worksheets used to prepare the claim submittal, establishing the cost components of the claim, including, but not limited to, labor, benefits and insurance, Materials, Equipment, Subcontractors, and all documents that establish the time periods, individuals involved, the hours and the rates for the individuals

Control of Material

1601 SOURCE OF SUPPLY AND QUALITY

The Contractor shall provide Materials for the Work from sources capable of producing and delivering uniformly acceptable Materials in accordance with 1503, "Conformity with Contract Documents," and the Progress Schedule. The Contractor shall notify the Engineer of intended sources of supply after award of the Contract and before Material delivery or use for the Engineer to inspect and test the Materials before delivery or use.

Unless otherwise specified, the Contractor shall provide new Materials of the specified grade and type or kind.

The Contractor shall not use multiple Material sources to provide one kind or class of Material, unless otherwise approved in writing by the Engineer. If the Engineer approves the use of Material from more than once source, the Engineer will set the conditions for each source change.

The Contractor shall provide Materials from alternative sources capable of producing uniformly acceptable Material as approved by the Engineer if, during production, the Engineer finds either of the following:

(1) Supply sources of previously approved Materials do not produce uniformly acceptable Materials

(2) Conditions require extraordinary inspection and testing by the Department to prevent delivery of unacceptable Material

1602 NATURAL MATERIAL SOURCES

The Department may list possible sources of natural Materials in the Contract, but does not warrant or imply the availability of sufficient quantities of acceptable Material in those sources. The Department may also list the same sources as a possible source for other existing or future Contracts. The Contractor shall acknowledge the Department's inability to ascertain from samples the limits for an entire deposit and shall consider variations as usual and expected. The Contractor shall determine the Equipment and Work necessary to produce a Material meeting the Contract requirements.

The Contractor has the right to take Materials from those sources that the Contract lists as specified in the lease.

The Contractor shall notify the Engineer in writing within 15 Calendar Days after Approval of the Contract if the Contractor intends to obtain Material from those sources. The Contractor may not remove Material from the source until the Engineer receives this notice.

For all sources where the Department owns the Material or where the Contractor elects to obtain Material under the terms of a Department lease or permit, the Contractor shall remove the Material in accordance with the following requirements and conditions:

(1) The Contractor shall procure Material from the portion of the source as directed by the Engineer. The Engineer may reject unacceptable portions of the source.
(2) The Contractor must use the Material exclusively on the Contract Project.
(3) The Contractor will perform clearing and grubbing as necessary, in accordance with 2101, "Clearing and Grubbing," at no additional cost to the Department.
(4) If others are operating concurrently in a pit used as a source of Materials for the Project, the Contractor must cooperate in accordance with 1505, "Cooperation by Contractors."
(5) If the Contractor's operations necessitate the relocation, adjustment, rearrangement, or other Work on impacted drainage facilities or utility properties, the Contractor shall perform this Work at no additional cost to the Department.
(6) The Contractor shall blend Materials from various Layers and areas within the source as directed by the Engineer, even to the extent of blending Materials from the top of the deposit with those from the bottom of the deposit.
(7) Within the areas owned or leased by the Department, the Contractor shall spread or stockpile the strippings and rejected Materials as directed by the Engineer.
(8) If the Contract includes a Material price table(s), the Contractor can only produce the Materials listed in the table(s). The Contractor shall not use Material suitable for the production of Class 5 or Class 6 base Aggregate as borrow Material unless otherwise approved in writing by the Engineer.
(9) If the Contract does not contain a separate "Rock Price," the Contractor may not screen off a coarse fraction (+No. 4) of Material and blend it with Material from a different source to produce an Aggregate product (the Contractor may not use rock from a source and blend it with sand from a different source to produce concrete, bituminous, or base, etc.). If the Contract contains a separate "Rock Price," the Contractor may screen off Material and will pay the indicated price for the rock fraction. In addition, the Contractor may not produce riprap, unless there is a separate "Rock Price" for riprap included in the Contract.
(10) After removing the Material and after completing the Work, the Contractor shall leave the site in a condition acceptable to the Engineer. The Contractor shall level waste piles, trim slopes and pit bottoms, replace the stripping, and perform other cleanup work at no additional cost to the Department.

The Department will provide the Contractor with statements showing the quantities of Material removed and the payment due. The Department will require full reimbursement before making final payment on the Contract.

1603 MATERIALS: SPECIFICATIONS, SAMPLES, TESTS, AND ACCEPTANCE

1603.1 SPECIFICATIONS

The Department will sample, test, and inspect all Materials in accordance with the Contract at any time before being permanently incorporated in the Work. The Department will approve or reject Materials based on the results of this sampling, testing, and inspection. The Material requirements that describe Material sampling, testing and inspection are normally referenced in Division II, "Construction Details," the plans, or the special provisions. In the absence of a specific Material reference, the governing Material specifications, in order of precedence, will be Division III, "Materials," AASHTO, ASTM, and the applicable Industry Standard.

Unless otherwise required, if the Contract cites specifications, standards, methods, tests, or practices from outside associations, societies, or governmental agencies, the Department is referring to the

versions of these references that are current at the date of the Advertisement for Bids. If the Contract refers to other procedures, practices, or allowances established or approved by the Department, the Department will refer to the versions of these references that are current at the date of the Advertisement for Bids. The Department and Contractor may mutually agree to update the referenced provisions to the version current at the time of application.

1603.2 SAMPLING AND TESTING

Refer to the *Schedule of Materials Control* for sampling and testing of Materials on State and Federal-aid Projects. The *Schedule of Materials Control* sets the size of Material samples and the rate of testing. The *Schedule of Materials Control* does not set Contract requirements for the Material. The *Schedule of Materials Control* is included with the Proposal Package.

The Contractor shall provide all required samples at no additional cost to the Department and shall provide such facilities and assistance as the Engineer directs for collecting and forwarding samples. If required by the Engineer, the Contractor shall submit representative preliminary samples to the Engineer in accordance with the specified methods, for examination and testing. The Contractor shall label submitted preliminary samples with the following information:

(1) Contractor's name
(2) Project number
(3) The Material source
(4) Supplier's name
(5) Where the Material fits into the Work

For soil and Aggregate samples, the Contractor shall provide the following additional information: legal description of the property where the samples were taken and pit numbers for single source bituminous and concrete Aggregate products

The Department will provide special instructions for sampling upon request from the Contractor.

1603.3 CERTIFICATION OF COMPLIANCE

The Engineer may accept Industry Standardized products by a Certificate of Compliance in lieu of the required sampling and testing, subject to the following:

(1) The Certificate of Compliance must state that the provided Material meets the Specification requirements, identify the Specification number, and include the Project number.
(2) Attach the Certificate of Compliance to the invoice, weigh bill, or other shipping document, and identify the supplier, manufacturer, product, and quantities covered.
3) Deliver a copy of the Certificate of Compliance with the shipment of the covered Material.
(4) Provide Certified Test Reports to the Materials Engineer if requested. Keep certified test results on file with the supplier and available to the Engineer for inspection upon request.
(5) The Certificate of Compliance must be signed by a representative authorized to bind the company supplying the Material covered by the certification.

The Department may require samples and test the Material for compliance regardless of prior certification by the supplier.

When the Contractor uses a Certificate of Compliance in lieu of required sampling and testing, the Engineer will withhold 100 percent of the Contract Unit Price of Work until the Contractor submits the Certificate of Compliance to the Engineer.

1603.4 ACCEPTANCE

Department approval of preliminary samples will not constitute acceptance of the Material represented.

The Department will only consider the Materials actually delivered to the Project for acceptance. The Department will base Material acceptance or rejection on the results of the tests and inspections made by the Engineer. The Engineer will make final inspection and acceptance of Material at the Project.

The Department will not allow use of Material that must meet definite Contract requirements until completion of all required acceptance inspections and tests show the Material complies with the Contract requirements.

Pending determination of test results, the Contractor may use Material having a satisfactory record of compliance with the test requirements at the Contractor's risk, with the understanding that the Department will apply the provisions of 1503, “Conformity with Contract Documents,” and 1512, “Unacceptable and Unauthorized Work,” if the Material fails to meet the Contract requirements subsequent to placement.

1604 PLANT INSPECTION — COMMERCIAL FACILITY

1604.1 GENERAL

The Engineer may perform plant inspection and test Material at the source before delivery to determine compliance with those test requirements and process controls required by the Contract during production. The Engineer may retest Material at the site regardless of approvals given before final inspection and acceptance. The Engineer will base Material acceptance on compliance with Contract requirements at the time of incorporation in the Work.

The Engineer may retest Material after delivery and will reject Material that fails to meet the Contract requirements.

The cost of facilities and assistance provided by the Contractor required for inspection of Materials at the source will be considered as part of the production costs and are included in the Contract Unit Prices applying to the Work involved.

1604.2 INSPECTION PROCEDURES

The Contractor shall meet the following conditions when the Engineer performs a plant inspection:

(1) At least 14 Calendar Days before starting production, notify the Engineer of the date and place of production to allow for arrangements for the plant inspection
(2) Notify the Engineer of the production schedule and other related information concerning inspection arrangements
(3) In partnership with the producer, cooperate with and assist the Engineer in the inspection. The Department’s inspectors will not handle the Materials being inspected
(4) Arrange, store, and handle the Material as directed by the inspector
(5) Provide the Engineer with office space as defined in 1604.3, “Plant Inspection – Commercial Facility, Requirements For Facilities,” at commercial production plants and other facilities, tools deemed necessary for inspection, and free entry to the plant locations where manufacturing or production occur
(6) Provide and maintain safety measures. The Engineer will terminate inspection at the source if conditions are deemed hazardous by the Engineer

1604.3 REQUIREMENTS FOR FACILITIES

Commercial plants producing bituminous mixture, structural concrete, or graded Aggregates for State Projects shall have in-plant inspection facilities meeting the following requirements:

(1) Floor area of at least 120 square feet, with weatherproof exterior construction, adequate natural lighting, and convenient accessibility
(2) Equipped with at least one suitable table or workbench, at least one stool and one chair, an approved fire extinguisher for use intended, and a suitable storage cabinet with lock
(3) Provided with adequate electric lighting and electrical outlets, adequate heating system, conveniently located sanitary facilities, and convenient access to running water supply
(4) Furnished with at least a 3-burner natural gas or electric stove for sample drying and with effective forced-air ventilation
(5) Provided with an electrically powered mechanical sieving apparatus to determine particle size distribution of fine Aggregate (less than No. 4 Sieve) capable of accommodating six full height No. 200 round Sieves with pan and cover provided by the Department. The Engineer will approve the apparatus after verifying that the sieving meets the requirements of *AASHTO T 27,* "Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates"

The producer shall make the in-plant inspection facilities available to the Engineer before beginning production.

The producer shall maintain the in-plant inspection facilities until the termination of production, at no additional cost to the Department. If the facilities do not meet the requirements specified in this subsection, the Contractor shall provide an equivalent field laboratory unit at the plant site as directed by the Engineer and at no additional cost to the Department.

1605 SUBSTITUTE MATERIALS

When the Department classifies Material to be incorporated in the Work according to size, strength, type, or other design classification for separate units, courses, sections, or installations, the intent is to specify the acceptable level of compliance, quality, or service. The Contractor may provide Material exceeding the specified class, quality, service life, or other Contract requirements to facilitate the Work.

The Contractor may use substitutions only as approved by the Engineer, at no additional cost to the Department. The Engineer will approve the substitution and establish the revised basis for acceptance in writing.

1606 STORAGE OF MATERIALS

The Contractor shall store Materials in a manner that preserves the quality and fitness of the Materials for the Work. The Department may inspect the stored Materials before use in the Work, even though the Department may have inspected the Materials before storage. The Contractor shall store Materials to facilitate inspection.

The Contractor may use portions of the Project Site for storing Materials and for placing plant and Equipment. The Contractor shall provide needed additional space at no additional cost to the Department. The Contractor shall restore all portions of the Project Site used for storage or operations to an acceptable condition, at no additional cost to the Department, before the Department will grant final acceptance of the Project.

The Contractor shall not use private property for storing Materials or Equipment without written permission of the owner or lessee. The Contractor shall provide the Engineer evidence of the written permission to use private property upon request.

The Department will only allow stockpiling within the Project Site of Materials that the Contractor will incorporate into the Work. This Specification applies to manufactured and natural Materials, including Materials stockpiled for crushing.

1607 HANDLING MATERIALS

The Contractor shall handle Materials to preserve quality and fitness for the Work. The Contractor shall transport Materials in vehicles constructed to prevent loss of Material after loading and measuring. The Contractor shall ensure the quantities of Materials as loaded are the same as the quantities received on the Project.

The Contractor shall use methods and Equipment to load and haul bulk Materials that prevent contamination or loss of Material after measurement and acceptance for the Work.

1608 UNACCEPTABLE MATERIALS

The Department considers Materials that do not meet the Contract requirements before being incorporated into the Work as unacceptable. The Engineer will reject unacceptable Material. The Contractor shall remove unacceptable Material from the Project, unless otherwise directed by the Engineer as allowed by 1603, "Materials: Specifications, Samples, Tests, and Acceptance."

The Contractor may use Material that the Department determined was unacceptable if the Contractor brings the Material into compliance.

1609 DEPARTMENT-PROVIDED MATERIAL

The Department will deliver or make available Department-provided Material at the locations shown on the Plans or in the Special Provisions. The Contract Unit Price for the relevant Contract Items includes the costs of handling, transporting, and placing the Materials.

The Contractor shall take responsibility for Department-provided Material after the Department delivers or makes the Material available to the Contractor. The Department will deduct from moneys due the Contractor for shortages, deficiencies, or damage to the Material occurring after taking possession and for demurrage charges.

Legal Relations and Responsibility to the Public

1701 LAWS TO BE OBSERVED

The Contractor shall observe and comply with the following, relating to the conduct of Work on the Project or to individuals engaged in Work for the Project or employed on the Project:

(1) All applicable State and Federal laws and regulations
(2) Orders and decrees of bodies and tribunals with lawful jurisdiction over the Work
(3) Such local ordinances as are applicable to the Work, as determined by the Department

The Contractor shall hold harmless and indemnify the Department and its representatives against all claims and liabilities arising from or based on violations committed by the Contractor or anyone subject to the control of the Contractor.

The Contractor shall immediately report to the Engineer in writing any Contract requirements that are contrary to or inconsistent with any law, regulation, order, decree, or applicable ordinance.

The Contractor shall endeavor to comply with relevant and significant ordinances, in consultation with the Engineer. Work on the State Trunk Highway system is generally not subject to regulation by political subdivisions of the State.

1701.1 DATA PRACTICES

Bidders are advised that all data created, collected, received, maintained, or disseminated by the Contractor and any Subcontractors in performing the Work contained in the Contract are subject to the requirements of MN Statutes Chapter 13, Minnesota Government Data Practices Act (MGDPA). The Contractor shall comply with the requirements of the MGDPA in the same manner as the Department. The Contractor does not have a duty to provide access to public data to the public, if the public data are available from the Department, unless otherwise required by the Contract.

1701.2 WORKER CONDUCT

Bidders are hereby reminded of the Department's policy to provide a workplace free of violence, threats of violence, harassment, and discrimination. The Department has established a policy of zero tolerance for violence in the workplace. Contractors performing Work on Department construction Projects, or local government entities or public agencies utilizing State funds on Highway construction Projects, must maintain a workplace free of violence, harassment, and discrimination. The Contractor must immediately remove from the Project any employee of the Contractor or a Subcontractor in violation of the Department's "Harassment Guidelines" and/or "Zero Tolerance of Violence in the Workplace" policy document until such time as the appropriate authority can complete an investigation.

1701.3 FALSE CLAIMS ACT

The provisions of the Minnesota "False Claims against the State" Act (MN Statutes Chapter 15C) apply to any claim by the Contractor under this Contract. For the purpose of this subsection, 1701.3, Laws to be Observed, False Claims Act" claim is defined in MN Statutes § 15C.01 Subd. 2.

1701.4 CERTIFICATION OF NONDISCRIMINATION AGAINST ISRAEL

By signing this Contract, Contractor certifies it does not engage in and has no present plans to engage in discrimination against Israel, or against persons or entities doing business in Israel, when making decisions related to operating the Contractor's business. For purposes of this subsection, "discrimination" includes, but is not limited to, engaging in refusals to deal, terminating business activities, or taking other actions that are intended to limit commercial relations with Israel, or persons or entities doing business in Israel, when such actions are taken in a manner that in any way discriminates on the basis of nationality or national origin and is not based on a valid business reason.

1701.5 PROMPT PAYMENT AND RETAINAGE

A Prompt payment of Subcontractors is required by MN Statutes §16A.1245.

The Contractor must pay a Subcontractor no later than ten days after receiving payment from the Department for undisputed Work provided by that Subcontractor. If the Contractor fails to pay a Subcontractor on time, then the Contractor must pay interest, at the rate of 1.5 percent per month, to the Subcontractor on the undisputed amount not paid on time. For an unpaid amount under $100, the Contractor must pay the actual interest penalty (calculated at 1.5 percent per month). For an unpaid amount over $100, the Contractor must pay the actual interest penalty (calculated at 1.5 percent per month) or $10, whichever is greater.

MN Statutes §16A.1245 also provides that a Subcontractor who prevails in a civil action to collect interest penalties from a prime Contractor must be awarded its costs and disbursements, including attorney's fees, incurred in bringing the action.

B Payment of retainage for federal-aid Projects is governed by MN Statutes §337.10, §15.72, and 49 C.F.R. 49 §26.29.

State law does not require retainage to be withheld. The Contractor may not withhold more than 5 percent in retainage from a Subcontractor, as provided by MN Statutes §337.10 Subd. 4 (b). If the Contractor holds retainage from a Subcontractor, the Contractor must fully pay out that retainage no later than 30 Calendar Days after the Subcontractor's work is satisfactorily completed, or 10 Calendar Days after the Contractor receives payment of retainage from the Department, whichever is earlier, unless there is a dispute

about the Work under a subcontract. If there is a dispute about the Work under a subcontract, the Contractor must pay out retainage to any Subcontractor whose Work is not involved in the dispute, and must provide a written statement detailing the amount and reason for the withholding to the affected Subcontractor.

For purposes of paying out retainage, a Subcontractor's Work is satisfactorily completed when all of the tasks called for in the subcontract have been accomplished and documented as required by the Contract. When the Department has made an incremental acceptance of a portion of the prime Contract, the Work of a Subcontractor covered by that acceptance is deemed to be satisfactorily completed.

C Payment of retainage for State Projects is governed by MN Statutes §337.10, and §15.72.

State law does not require retainage to be withheld. The Contractor may not withhold more than 5 percent in retainage from a Subcontractor, as provided by MN Statutes §337.10 Subd. 4 (b). The Contractor must pay any retainage no later than 10 Calendar Days after the Contractor receives payment of retainage from the Department, unless there is a dispute about the Work under a subcontract. If there is a dispute about the Work under a subcontract, the Contractor must pay out retainage to any subcontractor whose Work is not involved in the dispute, and must provide a written statement detailing the amount and reason for the withholding to the affected Subcontractor.

1702 PERMITS, LICENSES, AND TAXES

The Contractor shall obtain the licenses and permits required by State and Federal laws and regulations. The Contractor shall pay all charges, fees, and taxes, and give all notices necessary and Incidental to the due and lawful prosecution of the Work. If requested by the Department, the Contractor shall provide the Engineer with evidence of compliance with the permit, license, notice, and tax requirements.

1703 PATENTED DEVICES, MATERIALS, AND PROCESSES

The Contract Unit Prices include the cost of all royalties and costs from patents, trademarks, and copyrights needed to complete the Work.

If the Contractor employs any design, device, Material, or process covered by letters of patent or copyright, the Contractor shall indemnify and save harmless the Department and any political subdivision, department, or third-party affected from all claims for infringement by reason of its use.

1704 RESTORATION OF SURFACE OPENED BY PERMIT

The Department may issue permits to individuals, firms, public utilities, or corporations wanting a surface opening, trench, or boring in the Highway. The Contractor shall only allow parties with valid permits to make openings in the Highway, as authorized by the Department.

The Department may:

(1) Allow proper authorities of a political subdivision to construct or reconstruct any utility service in the Highway at any time
(2) Issue permits for the construction or reconstruction of any utility service

If the Proposal Package contained the permit and related work, the Department will not pay the Contractor for damages or delays resulting from the related work.

If the Proposal Package did not contain the permit and related work and the related work impacts the Work, the Engineer may revise the Contract in accordance with 1402, "Contract Revisions."

1705 FEDERAL-AID PROVISIONS

The Contractor and all Subcontractors shall observe Federal laws, rules, and regulations if the Federal government pays for any portion of the cost of a Project. The Federal requirements of a Federal-aid Project will supersede conflicting provisions of State or local laws, rules, or regulations. The Department will inspect the Work on Projects funded by the Federal government. Inspection by the Department will not make the Federal government a party to the Contract or interfere with the rights of the parties to the Contract.

1706 EMPLOYEE HEALTH AND WELFARE

The Contractor shall provide and maintain sanitary and safety accommodations for the use and protection, and health and welfare of the Contractor's employees and suppliers in accordance with the following applicable safety and health codes and regulations:

(1) Federal
(2) State
(3) Local
(4) Other bodies and tribunals having jurisdiction

The Contractor shall refer to the employee safety and sanitation regulations as specified in 29 C.F.R. 1926, Occupational Safety and Health Administration (OSHA), Construction Industry Standards; MN Statutes Chapter 182; and Minnesota Department of Labor & Industry, OSHA Division, and MN Administrative Rules Chapters 5205 to 5215 inclusive.

The Contractor shall provide, install, maintain, and remove required safety and health related Equipment and provisions, at no additional cost to the Department. The safety and health related Equipment and provisions shall comply with the applicable codes and regulations, be in operable condition, and allow Department personnel to perform required duties at the appropriate time.

The Contractor shall allow the entry of Federal, State, and local safety and health inspectors to perform inspections or investigations.

The Contractor shall perform construction operations in accordance with applicable laws, regulations and Industry Standards as specified in this section. The Contractor is responsible for the development, implementation, and enforcement of safety requirements on the Project, regardless of any actions the Department may take to help ensure compliance with these requirements.

The Contractor shall submit a written safety program to the Engineer at the preconstruction meeting addressing safety issues for all Project Activities. The Contractor shall include the name(s) of the person(s), identified as the "Contractor's Designee(s)," in the safety program. Responsibilities of the "Contractor's Designee(s)" include the following:

(1) Safety requirements
(2) Availability during performance of the Work
(3) Correction of violations on the Project as observed by the Engineer

1707 PUBLIC CONVENIENCE AND SAFETY

The Contractor shall conduct operations and perform the Work in a manner that causes the least possible obstruction to traffic. The Contractor shall provide for the safety of the general public and for the residents living beside the Highway.

The Contractor shall provide temporary facilities to allow pedestrian travel over or through obstructions at public walkways and at other locations designated by the Engineer. The Contractor shall adequately fence and post conspicuous warning signs around hazardous open excavations or open excavations that contain water.

If performing Work in a municipality, the Contractor shall notify the local fire and police chiefs to allow time to rearrange routes of emergency vehicles before blockading a street. The Contractor shall keep the local fire and police chiefs informed about the status and removal of street blockades affecting emergency vehicle travel. The Contractor shall not obstruct access to fire hydrants without the approval of the local fire chief.

1708 RAILROAD HIGHWAY PROVISIONS

1708.1 GENERAL

The Contractor shall perform Work in accordance with the Contract requirements in this section for the following:

(1) Work within the railroad Right-of-way
(2) Work adjacent to the railroad Right-of-way if Materials or Equipment may extend into the railroad Right-of-way
(3) Work that includes a Contractor crossing across the railroad Right-of-way and tracks for the movement of Equipment and Materials

The Contractor shall coordinate railroad-Highway requirements with each railroad company and implement the railroad requirements and the requirements in this section before beginning the Work on railroad property.

The Contractor shall ensure each person providing labor, Material, supervision, or services connected with the Work on railroad property meets the Railroad Company's safety and security requirements before entering the railroad property.

Before entering the railroad property, the Contractor shall prepare and implement a safety action Plan if required by and as approved by the railroad company. The Contractor shall also audit compliance with that safety action Plan during the Work. The Contractor shall keep a copy of the safety action Plan and audit results at the Project Site. The Contractor shall allow the railroad company to inspect the safety action Plan at all reasonable times.

The Contractor shall not perform Work infringing on the statutory clearances in accordance with MN Statutes §219.45 to §219.46 without a clearance exception as may be granted in MN Statutes §219.47. Variances to the statutory clearance requirements must be applied for and approved by the Commissioner before performing the Work. Clearances for temporary obstructions within 8-1/2 feet horizontal of the centerline of the track and 22 feet 0 inches vertical as measured from the top of the rail are subject to MN Statutes §219.47. This does not preclude railroad company approval for any construction Work taking place on railroad company property

Unless specifically approved by the railroad company before commencement of the Work, the Contractor shall not perform Work that interferes with the constant, continuous, and uninterrupted use of the tracks, property, and facilities of the railroad company, its lessees, licensees, or others. The Contractor shall not impair the safety of the tracks, property, and facilities of the railroad company, its lessees, licensees or others.

When not in use, the Contractor shall keep Equipment and Materials at least 50 feet from the centerline of the nearest track, unless the Railroad Company approves otherwise before commencement of the Work. The Contractor shall not allow vehicles to cross the railroad track, except at a crossing approved by the railroad company before commencement of the Work, or at existing open public crossings.

The Contractor is responsible for arranging with the railroad company any temporary suspension of train traffic required to construct the Project. Work windows requested by the Contractor to temporary suspend train traffic for construction purposes are granted at the sole discretion of the railroad company.

The Contractor shall be responsible for damages from unscheduled delays of freight or passenger trains caused by the Contractor. If the Contractor's operations cause the railroad company to perform extra work to maintain railroad traffic, the Contractor shall reimburse the railroad rompany for the cost of the extra work and damages associated with delays to trains.

The railroad company may inspect Work on the railroad Right-of-way at any time to ensure that the Work will not adversely impact train traffic or safety.

1708.2 STRUCTURAL PLANS AND CONSTRUCTION METHODS

The Contractor shall not perform Work affecting railroad traffic, embankment, drainage, property or train crews before the railroad company approves the Contractor's construction methods and protective measures.

The Department will consider costs resulting from compliance with the requirements of this section as Incidental.

The Contractor shall prepare detailed Plans indicating the construction methods and protective measures intended for use adjacent to the railroad company's tracks or at any Structures that are part of the Project. The detailed Plans shall indicate the protective measures used to safeguard railroad property, embankment, traffic, and trainmen from damage and accident during construction operations adjacent to and over or under the railroad rompany's track. The detailed Plans and methods shall include the following:

(1) Before excavating for any Structure Work adjacent to the railroad rompany's track, the Contractor shall construct a railing, approved by the railroad rompany before construction, between the tracks and the Structure excavation and at the ends of the excavation as approved by the railroad rompany.

(2) If using sheeting for excavation adjacent to the railroad company's track, the Contractor shall drive the sheeting before excavating for the Structure. The Contractor shall cut off the sheeting at or slightly below the ground level immediately after driving the sheeting. The Contractor shall install and remove sheeting as approved by the railroad company.

(3) The Contractor shall immediately backfill any excavation adjacent to railroad company's tracks after completion of Structure construction. The Contractor shall keep the railing in place until the completion of the backfill.

(4) Any Structure Work, including demolition or falsework placement that occurs above the tracks, Contractor Plans and methods shall include track structure and train protection as approved by the railroad company.

(5) Any Structure or boring Work that occurs under the tracks, Contractor Plans and methods shall include track structure and train protection as approved by the railroad company.

(6) Any de-watering Activities on railroad company property shall be approved by the railroad company.

The Contractor shall submit the detailed Plans to the Engineer. The Engineer will secure Department approval prior to submitting the Plans to the MnDOT Office of Freight and Commercial Vehicle Operations. The Office of Freight and Commercial Vehicle Operations will coordinate railroad company approval. The Contractor must allow 45 Calendar Days for railroad company Plan review. If Contractor Plans are required to be revised or modified by the railroad company, the revised Contractor Plans are again subject to 45 Calendar Day review.

Contractors may not deviate from the approved engineered Plans as approved by the railroad company without Department and railroad company approval.

For Plans requiring modification for approval, the Contractor must resubmit revised Plans to the Engineer. The Engineer will provide the final approved Plans to the Contractor.

1708.3 RAILROAD PROTECTIVE LIABILITY INSURANCE

If performing Work on the railroad Right-of-way or hauling Material across a railroad company approved temporary crossing, the Contractor shall provide Railroad Protective Liability Insurance in accordance with the following:

A Minimum Limits of Liability

The Contractor shall provide the following minimum limits of liability:

(1) $2,000,000 each occurrence
(2) $6,000,000 annual aggregate

B Coverages

The Contractor shall provide the following types of coverage:

(1) Bodily Injury Liability
(2) Property Damage Liability
(3) Physical Damage to Property

The Contractor shall provide an insurance certificate showing that the required insurance is in full force and effect before beginning Work. The Contractor shall not cancel the insurance until the Engineer has accepted the Work requiring the insurance. The Contractor shall submit one true and correct copy of the insurance policy to the Engineer and to each affected railroad company at least 10 Calendar Days before beginning Work.

1708.4 FLAGGING, PROTECTIVE SERVICES, AND DEVICES

The railroad company will provide flagging and other protective services and devices for Contract-required Contractor Work to protect railroad facilities, personnel, Equipment, and traffic. The Contractor shall arrange with the railroad company for flagging and protective services and devices if performing Work in accordance with the following:

(1) On the railroad Right-of-way including Work performed at-grade, over the railroad, or under the railroad
(2) For Materials hauled across railroad tracks over a temporary crossing approved by the railroad company
(3) If using cranes or construction Equipment positioned outside of the railroad Right-of-way having component parts that, if tipped or dropped, could damage the railroad company facilities and Equipment
(4) If performing excavation below the bottom of the track elevation and if the railroad company representative determines that the track or other railroad facilities may move or settle
(5) If Work interferes with the safe operation of trains at timetable speeds
(6) If the presence of persons, Materials, Equipment, or blasting operations present hazards to railroad track, communications, signal, electrical, or other facilities

The Contractor shall notify the railroad company and the Engineer at least 30 Calendar Days before the need for flagging and other protective services and devices. The Contractor shall notify the railroad company and the Engineer at least 7 Calendar Days before the date flagging and other protective services and devices will no longer be necessary to allow the railroad company to remove the flagger position, as required by railroad company-union agreements.

The Contractor shall obtain special permission from the railroad company before moving heavy or cumbersome objects or Equipment across a temporary crossing that could damage the track structure.

Unless the Contract requires otherwise, the Department will reimburse the railroad company for the costs of necessary flagging, other protective services and protective devices required to protect the railroad company's facilities, personnel, equipment, and traffic.

1709 NAVIGABLE WATERWAYS

The Contractor shall not interfere with free navigation of waterways or impair existing navigable depths when performing Work on navigable waters, unless authorized by permit. For information regarding permits that are required for this Work, contact the MnDOT Office of Freight and Commercial Vehicle Operations.

1710 TRAFFIC CONTROL DEVICES

1710.1 GENERAL

The Contractor shall provide traffic control devices and methods meeting the requirements of the *MN MUTCD*, Part I and Part II of the *Standard Signs and Markings Manual*, and the applicable Material Specifications. The Contractor shall also provide traffic control devices and methods in accordance with the following:

(1) Reflectorize all signs, paddles, and other traffic control devices, including those used for daytime operations

(2) Signs shall meet the crash testing requirements of the *Manual for Assessing Safety Hardware* (MASH)

The Project Engineer may require the Contractor to provide a Letter of Compliance stating that all of the Contractors devices meet the requirements of MASH. A Letter of Compliance must include approved drawings of the different signs and devices.

1710.2 PROVIDE, MAINTAIN, AND REMOVE

The Contractor shall provide and maintain traffic control devices as required by the Department in accordance with the Contract and the *MN MUTCD* that perform the following functions:

(1) Advise, warn, and alert the traveling public of construction in advance of the Project termini and on all Roads, Streets, and public trails approaching or crossing the Project

(2) Control and guide traffic through the Project, which may include using flag persons and pilot vehicles as required by the Contract

(3) Protect, warn, and exclude traffic and protect workers at all Work sites

If the Contractor fails to properly provide, install, maintain, or remove any of the required traffic control devices, the Department reserves the right to correct the deficiency and to deduct the costs from any moneys due or becoming due to the Contractor in accordance with 1512, “Unacceptable and Unauthorized Work.”

1710.3 PLANNED DETOURS

The Department, at its expense, will design traffic control devices necessary to control and guide traffic over planned Detours required by the Contract.

1710.4 TEMPORARY BY-PASSES

The Contractor shall construct, maintain, and remove traffic control devices on other Temporary By-Passes requested by the Contractor and approved by the Engineer at no additional cost to the Department.

1710.5 CONTRACTOR’S RESPONSIBILITY

The Engineer’s approval of the traffic control devices and the Contractor's method of application of traffic control measures as specified in this section will not relieve the Contractor of responsibility for protecting the Work, the workers, and the traveling public in accordance with 1511, “Inspection of Work.”

The Contractor shall protect traffic signs not removed or relocated by the Department before construction in their original location for the duration of the Work, except as otherwise approved by the Engineer. The Contractor may adjust or remove and reset a sign interfering with construction to a temporary location, if approved by the Engineer and if the original location is not critical and the Contractor resets the

sign at the permanent location as soon as construction operations allow. The Contractor shall notify the Engineer before removing or disturbing a traffic sign.

The Department will make no direct payment for removing, protecting, and replacing traffic signs as specified in this section unless provided for elsewhere in the Contract. The Department will not provide additional compensation to the Contractor for delays, inconvenience, or damage from special construction required performing the Work in the presence of traffic signs.

1710.6 ENGINEER'S AUTHORITY

In accordance with 1501, "Authority of the Engineer," the Engineer will accept or reject a traffic control device provided by the Contractor, but not incorporated in the final construction, based on acceptable day and night performance.

If requested by the Engineer, the Contractor shall provide representative samples or remove traffic control devices for testing at no additional cost to the Department.

1711 USE OF EXPLOSIVES

If using explosives to complete the Work, the Contractor shall not endanger life, property, or new Project Work. The Contractor is responsible for property damage, personal injury, and death resulting from the use of explosives.

The Contractor shall use explosives, securely store explosives, and mark explosive storage locations in accordance with applicable laws. If laws do not identify storage requirements, the Contractor shall store explosives at least 1,000 feet away from the Road or from places of human occupancy.

The Contractor shall notify property owners and public utility companies in the vicinity of the proposed detonation before using explosives to allow the property owners and public utility companies to protect property.

The Department advises the Contractor of the potential hazard of premature explosion of electric blasting caps due to propagation of radio frequency energy by transmitters of radio and related services such as television, radar, and wireless communications. The Contractor shall provide advance notification of blasting operations and any other precautions in accordance with MN Administrative Rule 7500.1200.

1712 PROTECTION AND RESTORATION OF PROPERTY

1712.1 PROPERTY

The Contractor is responsible for the preservation of all public and private property of any character in performing the Work.

A Monuments

The Contractor shall preserve all land and property corner monuments, Right-of-way monuments, and vertical and horizontal control point monuments indicated in the Contract or provided in writing by the Engineer before the start of Work in the vicinity of the monument. If the Engineer determines that a monument designated for preservation was disturbed during construction Activities, the Department will deduct a charge of $1,000.00 per monument from the moneys due or becoming due the Contractor. The Engineer will determine the number of monuments disturbed or destroyed by the Contractor. If the Engineer determines that a monument requires removal to allow construction, the Department will not deduct the charge of $1,000.00 per monument from moneys due or becoming due the Contractor.

1712.2 ADVANCE NOTICE

The Contractor shall give advance notice to the owners of all private property where the Contractor's operations will interfere with the property. The notice shall advise the private property owners of the nature of the interference and indicate the Contractor's intention to arrange for the protection of their property.

1712.3 GENERAL LIABILITY

The Contractor is responsible for all damages to property of any character, resulting from any act, omission, neglect, or misconduct in the execution or non-execution of the Work. The Contractor will not be responsible for property within the Project Site if both of the following conditions are met:

(1) The Contract did not specify the existence and approximate location of the underground property
(2) The Contractor fulfilled its obligations under MN Statutes Chapter 216D

The Contractor shall restore property damaged by the Contractor's act, omission, neglect, or misconduct to a condition equal to or better than that existing before the damage occurred by repairing, rebuilding, replacing the property, or otherwise correcting the damage to the satisfaction of the Engineer, at no additional cost to the Department. Denial of a claim by the Contractor's insurance carrier does not relieve the Contractor of its obligations in this regard.

1713 FOREST PROTECTION

If performing Work within or adjacent to State or National Forests, the Contractor shall comply with all regulations of the USDA Forest Service, State Fire Marshal, Department of Natural Resources, Division of Forestry, or other authority having jurisdiction, governing the protection of forests and the performance of Work within forests. The Contractor shall keep the areas in an orderly condition, dispose of all refuse, and obtain permits for the construction of field offices and other Structures in accordance with the requirements of the forest supervisor.

The Contractor shall take all reasonable precautions to prevent and suppress forest fires and shall require employees and Subcontractors to take all reasonable measures within their power to prevent and suppress forest fires. The Contractor shall make every possible effort to notify a forest official at the earliest possible moment of the location and extent of a fire.

1714 RESPONSIBILITY FOR DAMAGE CLAIMS; INSURANCE

1714.1 GENERAL

The Contractor shall defend, indemnify, and save harmless the Department, and the Department's officers and employees, to the maximum extent permitted by law, from all claims, lawsuits, damages, expenses, and costs related to bodily injury, property damage, or other damages, arising or in any way resulting from:

(1) Contractor acts and omissions. Negligent, intentional, or reckless acts, omissions, and misconduct by the Contractor or its agents, employees, Subcontractor, or others for whom the Contractor is responsible. This includes any third-party claim arising from Contractor's breach of this Contract.
(2) Vicarious Claims. The Department's vicarious liability arising from the acts, omissions, and operations of the Contractor or as a consequence of Contractor's neglect in safeguarding the Work.
(3) Legal Duties. Any Contractor obligation for paying a license fee, tax, penalty imposed by a government agency, withholding tax, social security, unemployment insurance,

workers compensation insurance, disability insurance, or similar items, including interest and penalties.

(4) Unacceptable Materials. Use of unacceptable Materials in constructing the Work.

(5) Intellectual Property. Claims arising from alleged infringements of patent, trademark, or copyright.

Costs and expenses covered by this indemnity include court costs, expert fees, and reasonable attorney's fees incurred by the Department. The Department may retain money due to the Contractor under this or any other Contract with the Department as the Department deems necessary, in its sole discretion, to protect the Department's interests with respect to suits, actions, or costs subject to this indemnity provision. If no money is due to the Contractor, the Department may hold the Contractor's Sureties liable until the Department receives evidence that suits, actions, or claims have been settled.

The Contractor must identify a contact person for damage complaints from the public, and maintain a log of all complaints and the Contractor's response to each. The Contractor must provide the log to the Engineer upon request. When the Contractor's act or omission, neglect, or misconduct causes property damage, or when the Contractor's failure to act in accordance with 1514, "Maintenance During Construction," causes property damage, the Contractor must accept monetary responsibility for the property damage and promptly resolve the complaint.

1714.2 WORKERS' COMPENSATION INSURANCE

The Contractor must provide workers' compensation insurance for all employees and must require Subcontractors to provide workers' compensation insurance in accordance with the Minnesota statutory requirements and must include the following:

(1) Part 2, Employers' Liability including Stop Gap Liability for monopolistic states. Provide the following minimum limits unless otherwise stated in the Special Provisions:

(a) $100,000 – Bodily Injury by disease per employee
(b) $500,000 – Bodily Injury by disease aggregate
(c) $100,000 – Bodily Injury by accident

(2) Coverage C: All States Coverage

(3) If applicable, USL&H, Maritime, Voluntary, and Foreign Coverage

(4) Waiver of subrogation in favor of the Department

If the Contractor is self-insured for its obligation under the Workers' Compensation Statutes in the jurisdiction where the Project is located, the Contractor must provide the Department with a Certification of the Authority to Self-Insure.

1714.3 COMMERCIAL GENERAL LIABILITY INSURANCE

The Contractor must provide and maintain insurance to cover claims arising from operations under the Contract, whether such operations are by the Contractor, Subcontractor, lower-tier subcontractor or by anyone directly or indirectly employed under the Contract.

A Minimum Limits of Liability

The Contractor must provide the following minimum limits of liability:

(1) $2,000,000 – Per occurrence

(2) $2,000,000 – Annual aggregate applying per Project or location

(3) $2,000,000 – Annual aggregate applying to Products and Completed Operations

(4) $50,000 – Fire damage (any one fire)

(5) $5,000 – Medical expense (any one person per occurrence)

The liability limits specified above are the minimum limits required, and any and all additional limits provided to the Contractor will be available on an excess, umbrella, or other basis to the additional insured for any and all covered claims.

B Coverages

The Contractor shall provide the following types of coverage:

(1) Premises and Operations Bodily Injury and Property Damage
(2) Personal and Advertising Injury
(3) Products and Completed Operations Liability
(4) Contractual Liability as provided in ISO form CG 00 01 12 04 13 or its equivalent
(5) Pollution exclusion with standard exception as per ISO Commercial General Liability Coverage Form – CG 00 01 12 04 13 or equivalent
(6) Independent Contractors – Let or Sublet Work
(7) Waiver of subrogation in favor of the Department
(8) Department named as an Additional Insured, to the extent permitted by law, for claims arising out of the Contractor's negligence or the negligence of those for whom the Contractor is responsible, for both ongoing and completed operations
(9) Coverage under the General Liability Policy(ies) of the Contractor will be as broadly construed for the owner as is available to the Contractor

Contractor agrees its coverage will not contain any restrictive endorsement(s) excluding or limiting Broad Form Property Damage (BFPD) or Explosion, Collapse, Underground (XCU)

1714.4 AUTOMOBILE LIABILITY INSURANCE

A Coverage

The Contractor must provide and maintain insurance to cover liability arising out of the operations, use, or maintenance of all owned, non-owned, and hired automobiles. The following coverages must be included:

(1) Owned automobiles
(2) Non-owned automobiles
(3) Hired automobiles
(4) Waiver of subrogation in favor of the Department

B Minimum Limit of Liability

The Contractor must provide a minimum limit of liability of at least $2,000,000 Per Occurrence Combined Single Limit for Bodily Injury and Property Damage.

1714.5 AIRCRAFT LIABILITY INSURANCE

A Coverage

If the Contractor uses aircraft (including "Unmanned Aerial Vehicles") to perform the Work, then the Contractor must provide Aviation (aircraft) insurance protecting it from claims for bodily injury and property damage whether the operations are by Contractor or by a subcontractor or by anyone directly or indirectly employed under the Contract. The insurance must cover the Contractor and its employees as well as the Department and the Department's employees as additional insureds.

B Minimum Limit of Liability

The Contractor must provide a minimum of liability of at least $2,000,000 per occurrence for bodily injury and property damage.

1714.6 UMBRELLA OR EXCESS LIABILITY INSURANCE

The Contractor may use an umbrella or excess liability insurance policy to supplement the Contractor's policy limits to meet the full policy limits as required by the Contract.

1714.7 ADDITIONAL CONDITIONS

The Contractor's insurance policies must be primary and non-contributory insurance policies to any other valid and collectible insurance available to the Department or self-insurance maintained by the Department with respect to any claim arising out of the Contract.

The Contractor must file certificates of insurance including evidence of Subcontractor insurance.

The Contractor is responsible for paying for Contract-related insurance premiums and deductibles.

The Contractor must provide policies from insurance companies meeting all of the following requirements:

(1) AM Best rating of at least "A–"
(2) Financial Size Category of at least VII
(3) Authorized to do business in the State of Minnesota, or be domiciled in the State of Minnesota and have a Certificate of Authority/Compliance from the Minnesota Department of Commerce if the insurance company is not rated by AM Best

If the Contractor receives a cancellation notice from an insurance carrier affording coverage herein, the Contractor agrees to notify the Department within five Business Days with a copy of the cancellation notice, unless the Contractor's policy(ies) contain a provision that coverage afforded under the policy(ies) will not be cancelled without at least 30 Calendar Days advance written notice to the Department.

The required insurance and insurance limits will not be deemed a limitation on the Contractor's liability with regard to the indemnities granted to the Department under this Contract.

The Contractor's insurers must waive their rights to assert the immunity of the State or Department as a defense to any claim arising out of this Contract.

The requirements above are minimum insurance requirements. The Contractor is solely responsible for determining the need for, and procuring, additional insurance that the Contractor may need in connection with this Contract.

1714.8 NOTICE TO THE CONTRACTOR

If the Contractor fails to provide the Department with certificates of insurance for the policies or renewals, or if the insurance company fails to notify the Department of cancellation of policies as required by the Contract, that failure will not constitute a waiver by the Department of the Contractor' obligation to provide insurance.

The Department reserves the right to terminate the Contract in accordance with 1808, "Default of Contractor," if the Contractor is not in compliance with the insurance requirements, and the Department retains all rights to pursue any legal remedies against the Contractor. All insurance policies must be open to inspection by the Department, and the Contractor must submit copies of policies to the Department's authorized representative when requested by the Department in writing.

1715 OPENING SECTIONS OF THE ROADWAY TO TRAFFIC BEFORE COMPLETION OF THE PROJECT

The requirements of this section shall not relieve the Contractor of obligations for maintenance of traffic over Roads undergoing improvements, as specified in 1404, "Maintenance of Traffic." Opening of a section of the Roadway to traffic shall not constitute acceptance of the incomplete portions of the Project, nor

shall opening a section of the Roadway to traffic before the completion of the entire Contract waive any provisions of the Contract.

The Special Provisions may require, or the Engineer may direct, the Contractor to open sections of the Roadway to traffic before the completion of that section or the entire Project. When the Contractor is required to do so, the following applies:

(1) On sections of the Roadway that the Department requires the Contractor to open to traffic before completion of the entire Project, the Department will relieve the Contractor of any expense for actions required under 1404, "Maintenance of Traffic." The Contractor is responsible for repair of damage to the Work not attributable to traffic. The Contractor must perform Highway maintenance work in accordance with 1514, "Maintenance During Construction."

(2) If a section of the Roadway is opened to traffic as directed by the Engineer, for unforeseen reasons not the fault of the Contractor, the Department will pay the Contractor for additional expenses incurred in completing the remaining Work under traffic. The Department may extend the Contract Time, if justified, with a Change Order executed in advance of the traffic opening, describing the agreed conditions.

(3) If a section of the Roadway is opened to traffic before its completion, as a requirement of the Contract or as directed by the Engineer as a result of failure or negligence by the Contractor, the Contractor shall perform remaining construction operations with the least possible obstruction to traffic. The Department will not provide the Contractor any additional compensation or extension of time due to increased costs or changed working conditions resulting from opening the Road to traffic before its completion.

1716 CONTRACTOR'S RESPONSIBILITY FOR WORK

The Contractor is responsible for the Work until the Engineer issues Project acceptance in writing under 1516.2, "Project Acceptance." The Contractor shall protect the Work against injury or damage from weather or other causes arising from the execution or non-execution of the Work. The Contractor shall rebuild, repair, and correct injuries or damage to the Work at no additional cost to the Department before the Engineer will accept the Project under 1516.2, "Project Acceptance," unless either of the following is true:

(1) The Contract specifies otherwise

(2) The damage to the Work was caused by unforeseeable causes beyond the control of and without the fault or negligence of the Contractor, including acts of God such as earthquake, tidal wave, flood, tornado, hurricane, other cataclysmic phenomenon of nature, or acts of a public enemy or of governmental authorities

If the Engineer suspends the Work, the Contractor shall perform the following functions at no additional cost to the Department:

(1) Take precautions to prevent damage to the Project

(2) Provide for normal drainage in accordance with 2573, "Storm Water Management," and 2575, "Establishing Vegetation and Controlling Erosion"

(3) Erect necessary temporary Structures, signs, or other facilities in accordance with 1404, "Maintenance of Traffic," and 1710, "Traffic Control Devices"

(4) Take precautions to protect new tree growth and other vegetative growth against injury as specified in 2571, "Plant Installation and Establishment," 2572, "Protection and Restoration of Vegetation," and 2575, "Establishing Vegetation and Controlling Erosion"

If the Contractor fails to comply with these provisions, the Engineer will notify the Contractor in writing of the unacceptable Work. If the Contractor fails to take action as directed by the Engineer, the Department may have the Work performed by others and will deduct the costs for this Work from moneys due the Contractor under this Contract or any other Contract with the Department.

1717 AIR, LAND, AND WATER POLLUTION

1717.1 GENERAL

The Contractor shall schedule and conduct construction operations to prevent, control, minimize, or abate pollution of air, land, and water in accordance with 1701, "Laws to be Observed." The Contractor shall obtain permits in accordance with 1702, "Permits, Licenses, and Taxes."

A Discovery of Contaminated Materials and Regulated Waste

If during the course of the Project, the Contractor encounters any of the following conditions indicating the possible presence of contaminated soil, contaminated water, or regulated waste, the Contractor shall immediately stop Work in the vicinity, notify the Engineer, and declare a differing site condition in accordance with 1402.2, "Differing Site Conditions."

The Engineer will conduct a documented inspection and evaluation before resumption of Work. The Contractor shall not resume Work in the suspected area until approved in writing by the Engineer.

A.1 Contaminated Soil

Some indicators of contaminated soil, ground water, or surface water include any of the following:

(1) Odor, including gasoline, diesel, creosote, railroad ties, mothballs, or other chemical odor
(2) Soil stained an unusual color, such as green or black, for reasons other than organic content; or soil with a dark, oily appearance, or any unusual texture
(3) A rainbow colored sheen on water or soil

A.2 Regulated Wastes

Some indicators of regulated wastes include any of the following:

(1) Cans, bottles, glass, scrap metal, and wood
(2) Concrete and asphalt rubble
(3) Roofing materials, shingles, siding, vermiculite, floor tiles, transite or fibrous material, possible indicators of demolition waste that could contain asbestos, lead, or other chemicals
(4) Culverts or other pipes with tar-like coating, insulation or transite, possible indicators of asbestos
(5) Ash, possibly from burning of regulated materials that may contain lead, asbestos, or other chemicals
(6) Sandblast residue that could contain lead
(7) Treated wood including, but not limited to products referred to as green treat, brown treat, and creosote
(8) Chemical containers such as storage tanks, drums, and filters
(9) Old basements with intact floor tiles or insulation that could contain asbestos, sumps that could contain chemical waste, waste traps that could contain oil wastes, cesspools, or any other underground structure that could contain chemical or oily wastes

B Water Protection

The Contractor shall take all practical precautions and actions necessary to prevent pollution of ground water and surface water with any particulate or liquid matter that may be harmful to fish, wild life, or public health or cause a public nuisance.

The Contractor shall avoid the crossing of streams and rivers unless approved by the regulatory authority. The Contractor shall minimize water pollution from haul Roads, Work platforms, temporary

earth fills, and other temporary staging areas used for construction. The Contractor shall restore all temporary crossings to pre-existing conditions or as shown in Plan.

C Land Protection

The Contractor shall implement practical actions to minimize erosion on the Project. The Department will consider all areas within the grading construction limits, exclusive of Roadbed areas, that grading or grubbing operations have rendered natural vegetation ineffective as being exposed to probable erosion until such time that the Contractor completes final topsoil finishing and turf establishment operations.

D Air Protection

The Contractor shall implement practical actions to minimize air pollution that may harm public health, safety, or the environment. The Contractor shall comply with Best Management Practices in accordance with 1103, "Definitions," to control dust appropriate for the Work.

1717.2 STORMWATER MANAGEMENT AND EROSION CONTROL

The Contractor shall schedule and conduct construction Activities in a manner to minimize soil erosion and protect surface waters.

The Contractor shall install Temporary Sediment Control Measures in areas that contribute flow to surface waters.

The Contractor shall:

(1) Schedule, install, and maintain Temporary and Permanent Sediment and Erosion Control Measures
(2) Construct permanent and temporary storm water treatment basins
(3) Construct drainage facilities
(4) Phase and complete earthwork operations
(5) Implement good housekeeping measures
(6) Implement dewatering operations
(6) Establish vegetation

The Contractor shall minimize vehicle tracking of soil where vehicles exit the Project Site onto paved surfaces or off Right-of-way. The Contractor shall remove tracked soil from paved surfaces leaving the Project Site daily, or more frequently to allow for safe passage of the traveling public.

The Contractor shall retrieve soil that has left the Right-of-way unless the Department has received landowner and/or regulatory approval, as required, for depositing fill into adjacent properties or surface waters.

The Contractor shall remove deltas and sediment deposited in drainage ways, pipes, treatment areas, or catch basins, and stabilize the areas where sediment removal results in exposed soil.

The Contractor shall stabilize exposed slopes within 14 Calendar Days after Work in that area has ended or:

(1) Stabilize slopes within 7 Calendar Days if the Project area is within 1 mile of and drains to an impaired or special water
(2) Stabilize slopes and temporary or permanent ditches/swales within 24 hours when that area of the Project discharges into surface waters, or off the Project limits

The Contractor shall provide energy dissipation within 24 hours when connecting pipe outlets to surface waters.

A Quality Control Program

The Contractor shall submit a Quality Control program including the following:

(1) The name of the individual responsible for the Quality Control program at the preconstruction meeting

(2) Once construction has commenced, the Contractor shall:

(a) Submit a weekly Erosion Control Schedule

(b) Submit Site Management Plan if applicable

(c) Conduct a weekly erosion control walkthrough including:

(i) Schedule the walkthrough and invite watershed district(s) and other permitting authorities

(ii) Submit corrective action report, or equivalent as accepted by the Engineer, that identifies, locates, and describes the following in text and picture:

1) Surface waters
2) Turbid or brown water locations
3) High-risk pollution-generating Activities
4) Documentation on how deficiencies were corrected from previous week

(iii) Amending the Plans

(d) Report sediment discharges to the appropriate regulatory authority, including the State duty officer

(e) Incorporate Temporary or Permanent Erosion Control Measures into the Work and stabilize disturbed areas on a section-by-section basis

(f) Ensure temporary erosion controls are kept in functional condition

(g) Maintain temporary sediment control devices

(h) Remove temporary sediment control devices after use

(i) Ensure that permanent treatment facilities are functioning as per Plan

The Engineer may review the Contractor's Quality Control procedures. The Contractor shall maintain the Quality Control records at the Project Site.

B Erosion and Sediment Control Schedule

The Contractor shall submit a weekly schedule of proposed erosion and sediment control Activities including the following:

(1) Proposed erosion and sediment control installations and timeline

(2) Permanent turf establishment Plan and timeline

(3) Incorporating grading operations into the erosion control Plan

(4) Corrective action plans from previous week's corrective action report

(5) Proposed erosion control measures during work suspensions

C Site Management Plan

The Contractor shall provide a Site Management Plan, in accordance with 1103, "Definitions," as shown in the Plans, or within 10 Calendar Days of receipt of written notice from the Engineer. Site Management Plans are for specific construction operations in areas within 200 feet of, and drains to surface waters or Areas of Environmental Sensitivity (AES). The Site Management Plan shall:

(1) Submit a schedule of Work, including Work pursuant to forecasted weather events

(2) Provide a list of Materials and Equipment

(3) Provide staging Plans or procedures that describe the locations of storm water and pollutant management Best Management Practices (BMPs) in accordance with 1103, "Definitions"
(4) Provide additional details of BMPs proposed for use

The Contractor shall not start Work in the affected areas until the Engineer accepts the Site Management Plan document and all Material and Equipment are on site.

1718 FURNISHING RIGHT-OF-WAY

The Department will provide the required Right-of-way for the Project before scheduled construction Work begins, except as otherwise required by the Contract.

1719 PERSONAL LIABILITY OF PUBLIC OFFICIALS

The Commissioner and other Department personnel are acting solely as agents of the Department in administering this Contract. Neither the Commissioner nor any other Department personnel assume any personal liability or responsibility in connection with this Contract.

1720 NO WAIVER OF LEGAL RIGHTS

The Department may correct measurements, estimates, or certificates made before or after completion and acceptance of Work, after final acceptance of the Contract in accordance with 1516.4, "Acceptance, Final Contract Acceptance." The Department may recover overpayments and damages sustained from the Contractor's failure to fulfill the obligations as required by the Contract from the Contractor or the Contractor's Sureties. The Contractor shall not consider a waiver from the Department for any breach of any part of the Contract as a waiver of any other or subsequent breach.

Notwithstanding final acceptance of the Contract, the Contractor shall remain responsible for false claims, latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the Department's rights under any warranty or guaranty.

1721 AUDITS

In accordance with MN Statutes § 16C.05, Subd. 5, the Department and the Legislative Auditor or the State Auditor may examine and audit the following for at least 6 years after the end of the Contract:

(1) Books
(2) Records
(3) Documents
(4) Accounting procedures
(5) Accounting practices of the Contractor, Subcontractors, or suppliers

Prosecution and Progress

1801 SUBLETTING OF CONTRACT

The Contractor must not sublet, sell, transfer, delegate, or assign the Contract or any portion of the Contract without the Engineer's consent. The Contractor may, with the Engineer's consent, sublet a portion of the Contract as long as the Contractor self-performs Work amounting to at least 40 percent of the total original Contract Amount.

The Contractor may subcontract Contract Items designated in the Contract as "specialty items" and the Department will deduct the cost of any specialty items performed by subcontract from the total original Contract Amount before calculating the 40 percent of Work that the Contractor must self-perform.

On Contracts with Disadvantaged Business Enterprise (DBE), Targeted Group Business (TGB) or Veteran-Owned Small Business (VET) established goals, or any combination thereof, the Contractor's organization shall perform Work amounting to not less than 30 percent of the total original Contract Amount. The Department will deduct specialty items from the total original Contract Amount before calculating the amount of Work that the Contractor shall perform.

No Subcontractor is permitted to further sublet its portion of the Work without the Engineer's consent. If it has obtained the Engineer's consent, a first tier Subcontractor may sublet up to 50 percent of that Subcontractor's work. The Department will not allow second tier Subcontractors to sublet any portion of the Work.

The Contractor must request consent to sublet portions of the Contract using the online system designated by the Department, unless the Department requires the Contractor to use a paper "Request to Sublet" form provided by the Department. The Contractor must file this request at least 10 Business Days before the Subcontractor intends to start Work. If requested by the Department, the Contractor must provide one signed copy of each subcontract. The Contractor may omit subcontract prices when providing the required copy of a subcontract.

The Department will consider Work subcontracted without the Engineer's consent and subcontracted Work exceeding the percentages specified in this section as unauthorized Work in accordance with 1512, "Unacceptable and Unauthorized Work."

The Engineer's consent does not constitute the Engineer's or Department's endorsement of the subcontract, the Subcontractor, or the Subcontractor's ability to complete the Work in a satisfactory manner.

The Engineer's consent to sublet a portion of the Work does not relieve the Contractor of: (1) any responsibility to complete the Contract; or (2) any other obligations or liability under the Contract and the Contractor's Contract Bonds. The Engineer will conduct all transactions with the Contractor. The Engineer will recognize Subcontractors only in the capacity of employees or workers, subject to the Contract requirements regarding character and competence. The subcontract does not create a contractual relationship between the Department and the Subcontractor; or convey to the Subcontractor any rights against the Department.

The Contractor must ensure that the subcontracts at least contain the following:

(1) Federal, State Special Provisions, Division A, or all
(2) Federal, State certified prevailing wage determinations, or both
(3) State certified truck rental rates

For Projects in excess of $50,000, the Contractor may sublet Work only to Subcontractors that meet the definition of "responsible Contractor" in MN Statutes §16C.285, Subd. 3. The Contractor shall obtain verifications of compliance with §16C.285 from Subcontractors using a form provided by the Department. The Contractor must provide such verifications to the Department upon the Department's request.

1802 QUALIFICATIONS OF WORKERS

The Contractor shall provide workers with sufficient skill and experience to perform the Work assigned to them. Upon request by the Engineer, the Contractor shall submit evidence of qualification for any person engaged in special Work requiring professional training or certification. If any Subcontractor employed by the Contractor or any person employed by the Contractor or by a Subcontractor fails to perform assigned Work in a proper and skillful manner, or becomes intemperate, disorderly, abusive, or harassing, the Contractor shall remove that Subcontractor or person from the Project as directed in writing by the Engineer. The Contractor shall not employ that Subcontractor or person again on any portion of the Project unless approved in writing by the Engineer. If the Contractor fails to remove a Subcontractor or person as directed by the Engineer, or fails to provide suitable and sufficient personnel for the proper prosecution of the Work, the Engineer may suspend the Work until the Contractor complies with the direction from the Engineer.

1803 PROGRESS SCHEDULES

1803.1 ALL SCHEDULES

A General

The Contractor shall prepare the Progress Schedule as specified in 1803.2, "Bar Chart Schedules," or 1803.3, "Critical Path Method (CPM) Schedules." If the Engineer determines that the Progress Schedule or any necessary Update Schedule does not provide the required information, then the schedule will be returned to the Contractor for correction and resubmittal.

The Contactor shall give the Engineer at least 72 hours advance notice before beginning any construction, and at least 24 hours advanced notice before beginning each major construction operation. The Contractor shall inform the Department of the number of hours the Contractor intends to be working each day; and provide 24 hours advance notice of any changes to workday hours, Equipment, forces, or sequence of operations.

A.1 Acceptance

The Department allocates its resources to a Contract based on the total time allowed in the Contract. The Engineer may accept a Progress Schedule indicating an early physical Completion Date but cannot guarantee the Department's resources will be available to meet an accelerated schedule. No additional compensation will be allowed if the Contractor is not able to meet their accelerated schedule due to the unavailability of the Department's resources or for other reasons beyond the Department's control.

Review by the Department of a portion of a schedule or an incomplete schedule submittal will not indicate acceptance of the entire schedule; the Department will return the accepted schedule to the Contractor as "Accepted-As-Noted" or "No Exceptions Taken."

The Engineer's acceptance of any schedule shall not transfer any of the Contractor's responsibilities to the Department. The Contractor alone shall remain responsible for adjusting forces, Equipment, and Work schedules to ensure completion of the Work within the time(s) specified in the Contract.

A.2 Early Completion

For purpose of the Work specified in section 1802, "Qualifications of Workers," Early Completion Schedule is defined as an initial schedule, Baseline Schedule, or Update Schedule which anticipates completion of all Work prior to the Completion Date established by the Contract documents and the Contractor submits as an Early Completion Schedule. In the event that an Early Completion Schedule is accepted, the Engineer will initiate a Change Order amending the Completion Date to the finish date shown on the accepted Early Completion Schedule. The amended Completion Date will be effective upon execution of that Change Order and all Contract provisions concerning the Completion Date such as Incentives, Disincentives, excusable delays, compensable delays, and liquidated damages will be measured against the amended Completion Date. The Contractor may elect not to execute the Change Order amending the Completion Date; however, in so doing, the Contractor waives its rights to delay damages in meeting the projected early Completion Date.

A.3 Non-Compliance

It is the Contractor's responsibility to ensure that the schedule submitted meets the requirements of 1803.2, "Bar Chart Schedules" or 1803.3, "Critical Path Method (CPM) Schedules" and accurately reflects the Work progress. The Engineer may suspend Work under 1803.4A, "Suspension of Work Ordered by the Engineer," if the schedule does not accurately reflect the actual progress of the Work; the suspension may continue until accurate schedules are submitted.

The Department will withhold each monthly progress estimate for failure to submit an original or updated schedule on time and in the manner required. Payment withheld for violation of the schedule requirements will be included in the next progress estimate following the Contractor's submission of the required schedules. The Project Engineer's approval does not attest to the validity of the schedule.

1803.2 BAR CHART SCHEDULES

A General

The Contractor shall submit a Bar Chart Progress Schedule as specified in 1803.2B, "Required Schedules." The Contractor shall plan and execute the Work to meet the Contract-required interim Completion Dates and the specified Contract Time or Completion Date. The Engineer will use the schedule to monitor the progress of the Work.

B Required Schedules

B.1 Initial Bar Chart Progress Schedule

At least 7 Calendar Days before the preconstruction meeting, the Contractor shall submit to the Engineer for review, an initial Bar Chart Progress Schedule conforming to the following minimum requirements:

(1) Include Activities that describe essential features of the Work and Activities that might potentially delay Contract completion. Identify Activities that are controlling items of Work.

(2) Identify the contemplated start and Completion Dates for each Activity. Provide a duration, ranging from 1 to 15 Working Days, for each Activity. Break longer Activities into 2 or more Activities distinguished by the addition of a location or some other description. Specify the sequencing of all Activities.

(3) Provide the quantity and the estimated daily production rate for controlling items of Work.

(4) Provide a Narrative Report that includes:

- (a) The proposed Work process sequence describing the Relationship of the Work Activities listed in 1803.2B.1, "Initial Bar Chart Progress Schedule" required to complete the Contract, including shop drawing submittals, permits (including estimated maximum waiting periods for all required permits), fabrication and delivery Activities.
- (b) A detailed description and the progress time of each Work Activity listed in 1803.2B.1, "Initial Bar Chart Progress Schedule," measured by Working Day or Calendar Day, as appropriate.
- (c) A detailed description of the Bar Chart Progress Schedule, including Holidays, planned Work Days per week, number of shifts per day, hours per shift, size of Work crews and resources used.

(5) Show completing the Work within interim Completion Dates and the specified Contract Time or Completion Date.

In addition to the required Activities, the Contractor is encouraged to include other Activities such as: the procurement of Materials, Equipment, articles of special manufacture, etc.; the furnishing of drawings, Plans, and other data required in the Contract for the Engineer's review; the Department's inspections of Structural steel fabrication, etc.; third-party Activities related to the Contract.

The Engineer will review the schedule and within 7 Calendar Days of receipt will either accept the schedule or provide the Contractor with comments. If the Contractor develops the initial schedule with scheduling software, the Contractor is encouraged to provide the Engineer an electronic file of the schedule and the name of the scheduling software used.

B.2 Weekly Look-ahead Schedule

For each week that Work will be performed, the Contractor shall submit a weekly look-ahead schedule showing the Contractor's and all Subcontractors' proposed Work Activities for the next 14 Calendar Days. The Weekly Look-ahead Schedule shall include the description, duration, and sequence of Work, along with the planned hours of Work. This schedule may be a network schedule, Bar Chart, or other standard schedule format. The Weekly Look-ahead Schedule shall be submitted to the Engineer by the midpoint of the week preceding the scheduled Work or some other mutually agreed upon submittal time.

B.3 Monthly Progress Meetings and Bar Chart Progress Schedule Updates

The Contractor and the Engineer will meet monthly to assess progress and jointly add update information to the initial schedule. At a minimum, updates will include the actual start and finish of each Activity, percentage complete, and Remaining Durations of Activities started but not yet completed.

B.4 Revised Schedule

The Engineer may request a Revised Schedule when any of the following events occur:

(1) The Project has experienced a change that affects controlling items of Work
(2) The sequence of Work is changed from that in the approved schedule
(3) The Project is significantly delayed
(4) The Engineer has granted an extension of Contract Time

The Contractor shall submit the Revised Schedule within 7 Calendar Days of receiving a written request, or when an update is required by any other provision of the Contract.

In addition to the other requirements of this section, Revised Schedules shall reflect the following information:

(1) The actual duration and sequence of as-constructed Work Activities, including revised Work
(2) Approved time extensions
(3) Any construction delays or other conditions that affect the progress of the Work
(4) Any modifications to the as-planned sequence or duration of remaining Activities
(5) The physical completion of all remaining Work in the remaining Contract time

B.5 Recovery Schedule

If the Progress Schedule projects a finish date for the Project more than 7 Calendar Days later than the Completion Date, the Contractor shall submit a Revised Schedule showing a Plan to finish by the Completion Date. The Engineer will use the schedule to evaluate time extensions and associated costs requested by the Contractor.

C Weather and Duration Contingency

The Contractor shall allow for normal weather delays when developing the Progress Schedule. The Department will extend the Contract Time, except as limited by 1806.4, "Extension of Contract Time Due to Weather on Calendar Day and Completion Date Contracts," for delays in excess of the anticipated Work Days lost to inclement weather as specified in Table 1803.2-1; the days in Table 1803.2-1 are

cumulative and prorated when Contract Time starts or ends mid-month. For example, if Contract Time starts May 15 and there are Work Days lost to weather in May or June, then the Contract must lose 7 Work Days to weather (2 Work Days from May and 5 Work Days from June) in addition to the anticipated Work Days in July before a time extension would be considered due to weather days lost in July.

Table 1803.2-1
Anticipated Work Days Lost Due to Weather per Time Period

Time Period	Anticipated Work Days Lost
January	20
February	15
March	9
April 1-15	3
April 16-30	2
May	4
June	5
July	4
August	3
September	3
October	3
November 1-14	2
November 15-30	5
December	17

1803.3 CRITICAL PATH METHOD (CPM) SCHEDULES

A General

If the Contractor intends to use Critical Path Method (CPM) schedules, or when the Department specifies the Work under this Contract shall be scheduled using CPM, the Work shall be planned, accomplished, and reported using CPM for the Contractor's Progress Schedules.

A.1 Software

The Department uses "Primavera Project Manager (P6)." If the Contractor uses software other than P6, the Contractor is responsible for any conversion discrepancies.

A.2 Schedule Calculations, Codes, and Settings

The Contractor shall not prepare a schedule with User Defined Fields. The Contractor shall use Project-level calendars, not global or resources calendars. The Contractor shall use Project-level codes, not global- or EPS-level codes.

A.3 File-Naming Convention

The Contractor shall use a file-naming convention as modeled in Table 1803.3-1. If the schedule in not accepted, the Contractor shall resubmit under the file name as modeled for the 2nd version, etc. The ####-### indicates a placeholder for the State Project number.

Table 1803.3-1
Progress Schedule Filename Convention

Schedules	1st Version	2nd Version	3rd Version
1st Baseline Schedule (All schedules until it is accepted as Baseline)	####-###-BS-1	####-###-BS -2	####-###-BS -3
1st update to Progress Schedule	####-###-1BSU-1	####-###-1BSU-2	####-###-1BSU-3
2nd update to Progress Schedule, etc.	####-###-2BSU-1	####-###-2BSU-2	####-###-2BSU-3
1st Revised Schedule	####-###-1RE-1	####-###-1RE-2	####-###-1RE-3
1st update to Revised Schedule	####-###-1REU-1	####-###-1REU-2	####-###-1REU-3
2nd Revised Schedule, etc.	####-###-2RE-1	####-###-2RE-2	####-###-2RE-3
1st Impact Schedule	####-###-1IS-1	####-###-1IS-2	####-###-1RE-3
2nd Impact Schedule, etc.	####-###-2IS-1	####-###-2IS-2	####-###-2IS-3

A.4 Float Suppression / Sequestered Float

The Contractor shall not suppress or sequester Float. Examples of prohibited Float suppression or sequestration include, but are not limited to:

(1) Logic Relationships that provide no tangible or sequential value between unrelated Activities
(2) Logic Relationships that demand completion of an Activity that could otherwise continue beyond a Successor's start or finish dates
(3) Excessively long durations

The Contractor shall obtain the Engineer's approval before using Lags or leads. The Contractor shall remove any Lags or leads and replace with an Activity identifying the Lag or lead upon the request of the Engineer, regardless of whether the Department allowed the Lag or lead in a previous Progress Schedule.

The Contractor shall not be entitled to compensation or a time extension for delays that could have been avoided by revising Activity durations or Logic used to sequester Float.

A.5 Use of Float

The Contractor acknowledges that all Float is a shared commodity available to the Project and is not for the exclusive benefit of any party; Float is an expiring resource available to accommodate changes in the Work, however originated, or to mitigate the effect of events that may delay performance or completion of all or part of the Work.

It is understood that identified contingencies, as described in 1803.3D, "Weather and Duration Contingenc," become available Float as time elapses and the contingency is not used.

B Required Schedules

B.1 Preliminary Schedule

Acceptance of the first Preliminary Schedule is a condition of NTP1. A delay in submitting the Preliminary Schedule is a non-excusable delay under 1806.2C, "Non-Excusable Delays," and the Contractor is not entitled to an extension of the Contract Time.

All schedules submitted before the Department accepts the Baseline Schedule will be considered Preliminary Schedules until the Preliminary Schedule is accepted as the Baseline

Schedule in accordance with 1803.3B.2, "Baseline Schedule" the Contractor shall continue to improve upon the Preliminary Schedules and show the status of Work actually completed by incorporating actual start and finish dates and by reasonably estimating the Remaining Duration for each incomplete Activity.

At a minimum, the Contractor shall include the following level of detail in the Preliminary Schedules:

(1) First Preliminary Schedule: show all Milestone dates are understood and provide a detailed schedule for a 30 Calendar Day look-ahead period
(2) Subsequent Preliminary Schedules: show all Milestone dates are understood and provide a detailed schedule for a 45 Calendar Day look-ahead period
(3) Changes to the first Preliminary Schedule in subsequent submissions shall be closely coordinated with the Engineer and are subject to the Engineer's review and acceptance

B.2 Baseline Schedule

Baseline Schedule acceptance is a condition of NTP2. The Baseline Schedule shall include the entire scope of Work and how the Contractor plans to complete all Work contracted. The Engineer may review the resource allocations using historical data, *Means Productivity Standards*, or equivalents to determine if the schedule is practicable.

The Baseline Schedule shall indicate the following:

(1) Actual dates of Work performed if the Contractor chooses to perform any Work prior to the Baseline Schedule being accepted
(2) All Contract Time dates, Milestones, and staging restrictions are understood and scheduled to complete within the Contract Time
(3) Each Activity shall:

    (a) Possess a unique Activity description and include a VOL (Verb, Object, and Location) for each description
    (b) Be expressed in Working Days with duration of not more 20, or less than 5 Working Days, unless otherwise authorized by the Engineer
    (c) Have at least one Predecessor Activity except for the first Activity in the schedule
    (d) Have at least one Successor Activity except for the last Activity in the schedule

(4) No more than 20 percent Critical Activities, nor more than 30 percent Near-Critical Activities, unless otherwise authorized by the Engineer
(5) The minimum following level of detail:

    (a) Mobilization
    (b) Work to be performed by the Contractor, Subcontractors, and suppliers
    (c) Work to be performed by the Department, other Contractors, and third parties such as government agencies and authorities, permitting authorities, or other entities
    (d) The Project Milestones (start or finish dates specified in the Contract), Project highlights (i.e. traffic switches and phases) availability dates specified in the Contract

(e) Submittal, review, and acceptance Activities when applicable, including time periods for the Department's acceptance as specified in the Contract
(f) Fabrication, delivery, installation, testing, and similar Activities for Materials, plants, and Equipment
(g) Settlement or surcharge periods
(h) Utility notification and relocation
(i) Installation, erection and removal, and similar Activities related to temporary systems or Structures such as temporary electrical systems or shoring
(j) Durations for receipt of permits
(k) Substantial completion
(l) Final completion

B.3 Update Schedule

The Contractor shall update the last accepted schedule to create the Update Schedule. The Contractor shall update the Progress Schedule by incorporating actual start and finish dates and by reasonably estimating the Remaining Duration for each incomplete Activity. The Contractor shall minimize the number of changes. The Contractor shall describe the reason for changes to the schedule in the Narrative Report submitted with the Update Schedule. If the changes are significant, then the Contractor shall submit the schedule as a Revised Schedule.

A significant schedule revision is defined as a revision that results in one of the following:

(1) Alters the Critical Path(s) or Near-Critical Path(s)
(2) Extends the scheduled Milestone date(s) compared to the dates shown on the Progress Schedule
(3) Disrupts the integrity or comparative Relationship between the Progress Schedule and the Update Schedule. An example of such a revision would be the renaming of Activities or changing Activity descriptions

The requirements for the Update Schedule are otherwise the same as the Baseline Schedule.

B.4 Look-ahead Schedule

The Contractor shall submit a detailed Two-Week Look-ahead Schedule to the Engineer each week until all Work is completed. The Contractor shall prepare the schedule in the Bar Chart format by hand or by using a computer. This schedule shall span a forward-looking, rolling period of at least 14 Calendar Days. This schedule is intended to represent the Contractor's best effort to fully communicate the Work planned for the rolling 14-day period and shall not contain extraneous information. The Work Activities included in the Two-Week Look-ahead Schedule shall specifically reference the applicable Activity IDs in the Progress Schedule.

The Two-Week Look-ahead Schedule shall include, at a minimum, the following level of detail:

(1) Bridges

(a) Test piling
(b) Test holes
(c) Embankment for each abutment location
(d) Fabrication and delivery of piling
(e) Structural steel fabrication and delivery, per Structure

(f) Pile installation, per bent, per Structure
(g) Drilled shaft installation, per pier, per Structure
(h) Pile caps, per bent, per Structure
(i) Footings, per pier, per Structure
(j) Columns, per pier, per Structure
(k) Caps, per pier, per Structure
(l) End bents, per Structure
(m) Beam or girder erection, per Structure
(n) Diaphragms
(o) Deck placement, per Structure
(p) Parapets, per Structure
(q) Erection and removal of falsework and shoring

(2) Roadway

(a) Traffic switches
(b) Submission of job mix formula for asphalt pavement
(c) Delivery schedule for items such as drainage pipe, guardrail, sign Structures and signs, permanent lighting facilities, and permanent traffic signals
(d) Internal access and Designated Haul Roads (location and duration in-place)
(e) Clearing and grubbing by stationing and Roadway
(f) Excavation
(g) Embankment placed for each Roadway
(h) Drainage – by run with Structures for each Roadway
(i) Retaining walls per location
(j) Subgrade for each Roadway
(k) Base for Roadway
(l) Curb, barrier wall, and Sidewalks for each Roadway
(m) Pavement (asphalt and/or concrete) for each Roadway
(n) Bridge approach slabs per location
(o) Guardrail for each Roadway
(p) Slope pavement or riprap
(q) Roadway lighting for each Roadway
(r) Signing for each sign Structure location and for each Roadway
(s) Striping for each Roadway
(t) Traffic signals per location
(u) Topsoil, sodding, seeding and mulching for each Roadway
(v) Landscaping
(w) Finishing Roadway and final cleanup

B.5 Revised Schedule

The Contractor shall not perform Work substantially different than depicted on the approved Progress Schedule in accordance with 1804.1, "Prosecution Control" and shall seek an accepted Revised Schedule to become the new Progress Schedule.

The Contractor shall submit a Revised Schedule upon one of the following:

(1) The Contractor desires to substantially deviate from the current Progress Schedule sequence or durations of planned Work. An example would include but not be limited to an altered Critical Path
(2) Department's request

(a) Where the Department requires the Contractor to demonstrate how to recover any scheduled Milestone date(s) that differ from any dates established by the Contract or the Contract Time

(b) The Department concludes that there is a substantial difference between the actual sequence or actual duration of the Work, and the Work as depicted in the Progress Schedule

(3) The issuance of a Contract revision document that changes the planned sequence of Work or the method and manner of its performance

The requirement to prepare a Revised Schedule is not a directive by the Department to accelerate the Work but rather a directive for the Contractor to seek the Department's acceptance of a proposal to revise the accepted Progress Schedule, which may or may not include acceleration. The requirements of the Revised Schedule are otherwise the same as the Baseline Schedule.

B.6 Impact Schedule

The Contractor shall prepare an Impact Schedule:

(1) To quantify the effects of any contemporaneous or prospective impacts to the Progress Schedule

(2) To establish the need for a time extension to a Milestone

(3) At the Department's request. An example of a reason, is the negotiation of a potential Contract Revision document that changes the planned sequence of Work or the method and manner of its performance

The standard for preparation of the Impact Schedule is specified in 1806, "Determination and Extension of Contract Time," concerning the analysis of delays using a prospective time impact analysis. The requirement to prepare an Impact Schedule is not a directive by the Department to accelerate the Work but rather a directive for the Contractor to provide a proposal to demonstrate the effects of impacts to the accepted Progress Schedule. The requirements of the Revised Schedule are otherwise the same as the Baseline Schedule.

C Schedule Submission Requirements

The Contractor shall include the following with the CPM schedule in its schedule submission:

C.1 Narrative Reports

The Contractor shall include a narrative for each schedule submittal to include the following and discuss:

(1) Baseline, Revised, or Impact Schedules will include:

(a) Explanation of the overall plan to complete the Project, including where the Work will begin and how Work and crews will flow through the Project

(b) The Working Days per week, number of shifts per day, number of hours per shift, the Holidays to be observed, and how the schedule accommodates adverse weather days for each month or Activity

(c) A statement describing the status of required permits

(d) The quantity and estimated production rates for Critical Activities

(e) Activities requiring coordination with the Department and/or third parties (i.e. utilities)

(f) A statement identifying Constraints and an explanation of the reason for and purpose of each Constraint

(g) A statement describing the reason for the use of each Lag or lead

(2) Update Schedules will include:

(a) A description of the reasons for any changes made to the schedule
(b) A statement describing the status of permits
(c) Status of Activities requiring coordination with The Department and/or third parties (i.e. utilities)
(d) A description of the status of the scheduled Milestone dates; elaborate on any differences from the previous submission
(e) A statement explaining why the scheduled Milestone dates are forecast to occur before or after the Contract Milestone date
(f) A description of unusual labor, shift, Equipment, or Material conditions or restrictions encountered or anticipated since the previous Update Schedule
(g) A statement identifying any new Constraints and an explanation of the reason for and purpose of each Constraint
(h) A statement describing the reason for the use any new Lag or lead

C.2 Gantt Chart

C.2.a Gantt Chart Names

The Contractor shall include the following Gantt charts with each schedule submission. Each schedule shall be sorted by early start. The Engineer may require the Contractor to submit a .pdf version as well as a hard copy.

(1) "All Activities Chart"; all activities with the Longest Path indicated in red
(2) "Milestone Chart(s)"; each Milestone's Critical Path
(3) "Near-Critical Chart"; all Near-Critical Activities
(4) Any chart requested by the Department

C.2.b Gantt Chart Information

Each Gantt Chart shall contain the following information:

(1) Activity ID
(2) Activity Description
(3) Early start
(4) Late start
(5) Duration (Working Days)
(6) Late finish
(7) Total Float
(8) Progress bar

(a) Current Schedule Progress Bar
(b) Baseline progress bar (The Engineer may require this to be any past accepted schedule)

(9) Title block

(a) Data Date
(b) Run date
(c) Gantt Chart name

C.3 Electronic File

Compressed format (.xer files).

C.4 Submission Timeline

It is the Contractor's responsibility to meet with the Engineer as often as necessary to satisfy the Department's comments with the time frame stated in Table 1803.3-2.

Table 1803.3-2
CPM Submission Timelines

Schedule Type	Section	Data Date	Submission Due Date	Department Review Length	Resubmission Due Date
First Preliminary	1803.3B.1	Letting date, or as directed by the Department.	–	7 Calendar Days after submitted	–
Subsequent Preliminary	1803.3B.1B.1	No later than the 15th of the month following the last accepted Preliminary Schedule.	4 Business Days after Data Date	7 Calendar Days after submitted	7 Calendar Days
Baseline*	1803.3B.2	*See Note	*See Note	*See Note	*See Note
Update	1803.3B.3	15th of every month	4 Business Days after Data Date	7 Business Days after submitted	3 Business Days
Revised	1803.3B.5	As needed or directed by the Department.	4 Business Days after Data Date	7 Business Days after submitted	7 Calendar Days
Impact	1803.3B.6	No earlier than last accepted schedule's Data Date	7 Business Days after Data Date	7 Business Days after submitted	As directed by Department
*The Preliminary Schedule becomes the Baseline Schedule after Baseline Schedule criteria is met.					

If the Department does not accept the Update Schedule, the Contractor shall correct the comments and resubmit to the Department within the time frame indicated in Table 1803.2-1.

D Weather and Duration Contingency

It is the responsibility of the Contractor to estimate a sufficient amount of contingency to account for normal weather. The duration of each Activity shall only include the necessary Working Days to actually complete the Work defined by the Activity; weather or any other contingency shall not be built into the durations but shall be accounted for within the Project calendars.

Each Activity shall be assigned an appropriate calendar. The Project calendars shall indicate planned Working and nonworking days. Each calendar, with the exception of the calendar used for tracking Calendar Days, shall include contingent nonworking days. The Contractor shall indicate contingent nonworking days on Monday through Friday only. The Engineer reserves the right to accept or reject the estimated amount of contingency in accordance with "Acceptance of Schedule" section contained herein.

The schedule shall use a minimum of the following calendars:

(1) Calendar to indicate Calendar Days (cure time, etc.)
(2) Calendar for Work that can progress year round
(3) Calendar for each major item of Work affected by weather or seasonal limitations; the Contractor shall include a minimum of 15 percent Weather Contingency

Weather Contingency will be the numbers of indicated nonworking days compared to a description of the duration (in hours) of the normal Working Day, as indicated in the Narrative Report, of the Work week, e.g., Monday-Friday (10 hours) and Saturday (6 hours) for every calendar.

1803.4 TEMPORARY SUSPENSIONS

A Suspension of Work Ordered by the Engineer

The Engineer will issue all suspension-of-work orders in writing specifying the effective start date and end date of the suspension, the operations to be suspended, and the reasons for the suspension. The Contractor may not resume Work until so authorized in writing by the Engineer and shall resume Work within a reasonable time upon the Engineer's direction. The Engineer will order the resumption of Work upon determining that the conditions that caused the suspension no longer exist.

If the Engineer issues a temporary suspension-of-work order because of any action or inaction by the Department, or because of incomplete Work under other contracts, and if the Contractor has not been advised in the Contract that such a suspension may be necessary, the Contractor shall refer to 1402.4, "Suspensions of Work Ordered by the Engineer," regarding compensation and extension of Contract Time.

If the Engineer issues a temporary suspension-of-work order due to the Contractor's fault or negligence, such suspension is a non-excusable delay as specified in 1806.2C, "Non-Excusable Delays," and is non-compensable.

B Suspension of Work Requested by the Contractor

The Contractor shall send a written request for the temporary suspension of Work to the Engineer. The Contractor's request shall include the proposed effective start and end dates, the operations to be suspended, and the reasons for requesting the suspension. The Contractor shall not suspend all or any part of the Work without the Engineer's written authorization. Suspension of the Work for any cause whatsoever shall not relieve the Contractor of the responsibility for maintenance of traffic, except as otherwise provided in 1404, "Maintenance of Traffic," or by written agreement between the Contractor and the Department.

The Engineer will not authorize the Contractor to temporarily suspend operations until the following conditions are met:

(1) The Roads that are being used by traffic and any temporary approaches or crossings and Intersections with trails, Roads, Streets, businesses, parking lots, residences, garages, and farms are in such condition that only routine maintenance will be required to adequately accommodate through and local traffic during the anticipated period of suspension.
(2) The Contractor has performed such Work as is necessary to protect all completed or partially completed Work during the anticipated suspension period.
(3) The Contractor has placed all traffic control devices as specified in 1710, "Traffic Control Devices."

Should the Contractor fail to perform any of this Work before suspension, the Department reserves the right to have the Work performed by others and to deduct the associated costs from any moneys due or becoming due the Contractor.

1804 PROSECUTION OF WORK

1804.1 PROSECUTION CONTROL

The Contractor shall commence and prosecute the Work with forces and Equipment adequate to complete the Controlling Activity(s) of the Progress Schedule within the planned duration. The Contractor shall

prosecute the Work continuously and diligently from as many different points and in such parts and sequences as will ensure progress in accordance with the Progress Schedule.

The Contractor shall prosecute the Work substantially in the same sequence as the Progress Schedule. The Engineer will provide written notice to the Contractor when the Engineer deems Work is being performed substantially out of sequence; any Work the Contractor continues to perform out of sequence will be considered unauthorized Work in accordance with 1512, "Unacceptable and Unauthorized Work."

Should the Contractor fail to maintain satisfactory progress, in accordance with 1803, "Progress Schedules," the Engineer will require that the Contractor provide additional resources (e.g., labor, Materials, Equipment) as necessary to bring the Work up to the level of progress required in the current accepted Progress Schedule to ensure completion of the Work within the time(s) specified in the Contract. The Department will consider any failure by the Contractor to adhere to the accepted Progress Schedule as a failure to provide sufficient resources to ensure completion of the Work within the Contract Time. The Department may issue a notice of default to the Contractor in accordance with 1808, "Default of Contractor" if the Contractor fails to do either of the following:

(1) Adhere to the current accepted Progress Schedule
(2) Take action as ordered to remedy unsatisfactory progress

The Contractor shall mitigate the effects of any delay to the extent practicable, and demonstrate recovery through submission of a Revised Schedule, in accordance with 1803.2B.4, "Revised Schedule," or 1803.3B.5, "Revised Schedule," as appropriate.

1804.2 LIMITATION OF OPERATIONS

The Contractor shall conduct the Work in a manner and sequence that will ensure the least interference with traffic, with due regard given to the location of Detours and to the provisions for handling traffic. The Contractor shall not open up Work to the prejudice or detriment of Work already started. The Engineer may require the Contractor to finish a section on which Work is in progress before starting Work on any additional sections if the opening of that section to traffic is essential for public convenience.

The Contractor shall not perform Work during the hours of darkness without the prior approval of the Engineer. When the Engineer authorizes night Work the Contractor shall furnish sufficient artificial lighting to permit proper and safe inspection, as well as to ensure quality workmanship equal to that achievable during daylight hours.

The Contractor shall not perform Work on Sundays or Holidays unless specifically allowed for in the Contract. The Contractor shall suspend construction operations for a period of 24 hours from approximately 6:00 a.m. on each Sunday or Holiday until 6:00 a.m. on the following day. The Engineer may allow slight changes in these hours, but the Contractor shall comply with the intent of this policy. The Contractor does not have to obtain the Engineer's permission to perform minor operations on Sundays and Holidays that may be necessary to protect the Work or to maintain and protect traffic.

1805 METHODS AND EQUIPMENT

The Contractor shall use methods and Equipment capable of performing the Work specified in the Contract. The Contractor shall ensure the Equipment does not damage the Roadway, adjacent property, or other Highways.

When methods and Equipment are specified in the Contract, the Contractor shall request permission from the Engineer, in writing, to use alternate methods and Equipment. The Contractor shall describe the proposed methods and Equipment and the reasons for the change. The Contractor shall perform the Work in accordance with the original basis of payment and Contract Time.

When methods and Equipment are not specified in the Contract, the Contractor may use any methods and Equipment that complete the Work in accordance with the Contract requirements.

The Contractor shall discontinue performing the Work using alternate methods or Equipment, if the Work does not meet the Contract requirements. The Contractor shall remove and replace or repair unacceptable Work at no additional cost to the Department.

1806 DETERMINATION AND EXTENSION OF CONTRACT TIME

1806.1 GENERAL

The Proposal Package will specify the Contract Time. The Contractor shall prosecute the Work continuously and effectively, with the least possible delay, to the end that all Work is completed within the Contract Time.

If the Department issues a Notice to Proceed, the Contract Starting Date established in the Notice to Proceed takes precedence over the Contract Starting Date specified in the Proposal Package.

The Department will not consider a plea by the Contractor that the Contract Time was not sufficient as a valid reason for an extension of the Contract Time.

If the Department grants an extension of the Contract Time, the extended time for completion will be in full force and effect as though it was originally specified.

The Department will only extend the Contract Time if an excusable delay, as specified in 1806.2A, "Excusable, Non-Compensable Delays," or 1806.2B, "Excusable, Compensable Delays," delays Work on the Critical Path as described in items 1, 2, 3, and 4, below.

Mitigation of delay, whether caused by the Department, Contractor, a third-party, or an event, is a shared Contract and legal requirement. Mitigation efforts include, but are not limited to, resequencing Work Activities, acceleration, and continuation of Work through an otherwise planned shutdown period. The Contractor and Engineer will explore and discuss potential mitigation efforts promptly and agree upon costs or cost-sharing responsibilities prior to the implementation of mitigation efforts.

The Department will not evaluate a request for extension of the Contract Time unless the Contractor notifies the Engineer as specified in 1403, "Notification for Contract Revisions," and provides the required analysis as follows.

The Contractor shall evaluate delays and calculate the appropriate time extension due based on the following:

(1) The Contractor shall base all evaluations of delay and all calculations of the appropriate time extensions due on the schedules submitted to and accepted by the Department. The Contractor shall not use schedules that did not exist on the Project or create schedules after the delay has occurred to demonstrate entitlement to a time extension.

(2) The Contractor shall base evaluations and calculations related to the determination of extensions of time on the Critical Path as established by the schedules submitted to and accepted by the Department. The Contractor is not entitled to a time extension for delays that do not delay the Critical Path.

(3) The evaluations and calculations required to establish entitlement to a time extension will vary depending on the nature and timing of the delay and whether the Contract Time is measured in Working Days, Calendar Days, or based on a fixed Completion Date. It will also vary depending on whether the Contract requires a Bar Chart or CPM Schedule.

(4) The schedules relevant to the evaluation and calculation of time extensions are the most current schedules submitted to and accepted by the Department. For example, if

the Department determines that Extra Work is required and the Change Order adding this Work will be dated June 2, then the determination of the time extension due the Contractor will be based on the last schedule submitted and accepted by the Department prior to June 2 of the same year.

(5) The Contractor's evaluations and calculations shall comply with the following Recommended Practices published by the Association for the Advancement of Cost Engineering:

(a) Recommended Practice No. 52R-06, Prospective Time Impact Analysis - As Applied in Construction. The Contractor shall use this Recommended Practice for delays that are in the future (prospective). The Contractor shall not use this recommended practice to evaluate delays that have already occurred (retrospective).

(b) Recommended Practice No. 29R-03, Forensic Schedule Analysis, MIP 3.4 Observational/ Dynamic/Contemporaneous Split approach. The Contractor shall use MIP 3.4 when evaluating delays that have already occurred.

The Engineer will review the Contractor's evaluations and calculations and determine the time extension due, if any. The Engineer will measure extensions to the Contract Time in Working Days for Working Day Contracts and in Calendar Days for Completion Date and Calendar Day Contracts.

The Department will relieve the Contractor from associated liquidated damages, as specified in 1807, "Failure to Complete the Work on Time," if the Department extends the Contract Time under this section.

1806.2 TYPES OF DELAYS

A Excusable, Non-Compensable Delays

Excusable, non-compensable delays are delays that are not the Contractor's or the Department's fault or responsibility, and that could not have been foreseen by the Contractor. The Department will not compensate the Contractor for excusable, non-compensable delays.

Excusable, non-compensable delays include, but are not limited to:

(1) Delays due to fires, floods, tornadoes, lightning strikes, earthquakes, or other cataclysmic phenomena of nature

(2) Delays due to epidemic, pandemic, public health emergency, or government-ordered quarantine

(3) Delays due to weather if the Contractor is entitled to a time extension for weather as specified in 1806.3, "Determination of Charges on Working Day Contracts," and 1806.4, "Extension of Contract Time Due to Weather on Calendar Day and Completion Date Contracts"

(4) Extraordinary delays in Material deliveries the Contractor or its suppliers cannot foresee or avoid resulting from freight embargoes, government acts, or regional Material shortages

(5) Delays due to civil disturbances

(6) Delays due to acts of the public enemy

(7) Delays due to labor strikes that are beyond the Contractor's, Subcontractor's, or supplier's power to settle and are not caused by improper acts or omissions of the Contractor, Subcontractor, or supplier

(8) Delays due to acts of the government or a political subdivision other than the Department

(9) All other delays not the Contractor's or Department's fault or responsibility and which could not have been foreseen by the Contractor

B Excusable, Compensable Delays

Excusable, compensable delays are delays that are not the Contractor's fault or responsibility, and are the Department's fault or responsibility, or are determined by judicial proceeding to be the Department's sole responsibility.

Excusable, compensable delays include, but are not limited to:

(1) Delays due to revised Work as specified in 1402.2, "Differing Site Conditions," 1402.3, "Significant Changes to the Character of Work," and 1402.5, "Extra Work"
(2) Delays due to utility or railroad interference on the Project Site that are not anticipated as a concurrent move or Activity by the Contract
(3) Delays due to an Engineer-ordered suspension as specified in 1402.4, "Suspensions of Work Ordered by the Engineer"
(4) Delays due to the neglect of the Department or its failure to act in a timely manner

C Non-Excusable Delays

Non-excusable delays are delays that are the Contractor's fault or responsibility. All non-excusable delays are non-compensable.

Non-excusable delays include, but are not limited to:

(1) Delays due to the Contractor's, Subcontractor's, or supplier's insolvency or mismanagement
(2) Delays due to slow delivery of Materials from the supplier or fabricator when the Material was available in warehouse stock, or when delivery was delayed for reasons of priority, late ordering, financial considerations, or other causes
(3) Delays due to the Contractor's failure to provide sufficient forces and Equipment to maintain satisfactory progress in completing the Controlling Activities
(4) Delays caused by plant and Equipment failure or delays due to the Contractor's failure to provide and maintain the Equipment in good mechanical condition or to provide for immediate emergency repairs
(5) Delays caused by conditions on the Project, including traffic conditions that could be foreseen or anticipated before the date of bid opening

Weather delays are addressed in 1806.3, "Determination of Charges on Working Day Contracts," and 1806.4, "Extension of Contract Time Due to Weather on Calendar Day and Completion Date Contracts."

D Concurrent Delays

Concurrent delays are independent sources of delay that occur at the same time. When a non-excusable delay is concurrent with an excusable delay, the Contractor is not entitled to an extension of Contract Time for the period the non-excusable delay is concurrent with the excusable delay. When a non-compensable delay is concurrent with a compensable delay, the Contractor is entitled to an extension of Contract Time, but not entitled to compensation for the period the non-compensable delay is concurrent with the compensable delay.

1806.3 DETERMINATION OF CHARGES ON WORKING DAY CONTRACTS

A Working Day Determination

The Department will determine Working Day charges as follows:

(1) One whole day for each day of Work that the Contractor makes progress or could have made progress during a Working Day on one or more Critical Activities for at least 6 continuous hours

(2) One whole day when the Engineer orders a Work suspension for reasons of Contractor's fault or negligence
(3) One whole day for non-excusable delays as specified in 1806.2C, "Non-Excusable Delays"
(4) One half (1/2) day for each day of Work that the Contractor makes progress or could have made progress during a Working Day on one or more Critical Activities for at least 2 continuous hours

B Working Day Charges

The Department will not charge a Working Day:

(1) When the Contractor could not effectively prosecute Critical Activities for at least 2 continuous hours during a Working Day due to:

(a) Excusable, non-compensable delays as specified in 1806.2A, "Excusable, Non-Compensable Delays"
(b) Excusable, compensable delays as specified in 1806.2B, "Excusable, Compensable Delays"
(c) Concurrent delays as specified in 1806.2D, "Concurrent Delays"

(2) On Saturdays, Sundays, and Holidays
(3) During the inclusive period from November 15 through April 15, except if operations result in traffic restrictions
(4) During Suspensions of Work Ordered by the Engineer as specified in 1402.4, "Suspensions of Work Ordered by the Engineer," except for Work suspensions ordered by the Engineer for reasons of Contractor's fault or negligence

C Working Day Addition or Subtraction

The Department will add or subtract Working Days via Change Order to the Contract. The number of Working Days to be added or subtracted will be determined as specified in 1806.1, "Determination and Extension of Contract Time, General":

(1) For Differing Site conditions as specified in 1402.2, "Differing Site Conditions"
(2) For significant changes in the character of the Work as specified in 1402.3, "Significant Changes to the Character of Work"
(3) For Extra Work as specified in 1402.5, "Extra Work"

The Engineer will furnish the Contractor a weekly statement showing the Working Days charged to the Project, except during periods when the Engineer determines that Working Day charges will not be made. The statement will include an accounting of all delays affecting the Critical Path. The Engineer will classify each of these delays as excusable, non-compensable; excusable, compensable; or non-excusable, in accordance with 1806.2, "Types of Delays," or weather-related in accordance with 1806.3, "Determination of Charges on Working Day Contracts," and 1806.4, "Extension of Contract Time Due to Weather on Calendar Day and Completion Date Contracts."

The Engineer will commence assessing Working Day charges on the Contract Starting Date and cease when the Contractor has completed all Work, including maintenance and final cleanup operations. However, assessments will be made for Work conducted before the Contract Starting Date when the operations in progress result in traffic restriction. In that case, the Work causing the traffic restriction will be considered Critical Path Work and Working Days will be assessed.

Objections by the Contractor as to an improper or excessive assessment of Working Day charges shall be in the form of a written protest to the Engineer, within 10 Calendar Days of receipt of statement, setting forth the specific dates and justifications for reduced charges. If the Engineer finds the Contractor's

protest to be valid or if the Department detects an error, the Engineer will issue corrected weekly statements. Once accepted by the Contractor, whether explicitly or as a result of the Contractor's failure to file a timely protest, the weekly statement is final and the Contractor waives entitlement to an extension of Contract Time or compensation for any delays not explicitly identified by the weekly statement. In case of disagreement, the Contractor may request an administrative review of contested charges by the State Construction Engineer.

1806.4 EXTENSION OF CONTRACT TIME DUE TO WEATHER ON CALENDAR DAY AND COMPLETION DATE CONTRACTS

The Department will not consider weekends or Holidays as eligible for extensions of Contract Time due to weather unless the Engineer directs the Contractor to Work those days, or the Contractor's accepted Progress Schedule in place at the time the delay occurred indicated that the Contractor intended to perform Critical Path Work on those days. Unless modified in the Special Provisions, the Department will not consider any days between November 15 and April 15, inclusive, as eligible for extensions of Contract Time due to weather unless the Engineer directs the Contractor to Work those days. The Contractor may propose to Work between November 15 and April 15 with the Engineer's written approval, but any delays to Work due to weather in this time frame will be considered non-excusable in accordance with 1806.2C, "Non-Excusable Delays."

1807 FAILURE TO COMPLETE THE WORK ON TIME

The Department is entitled to damages for failure of the Contractor to complete the Work within the Contract Time. In view of the difficulty in making a precise determination of actual damages incurred, the Department will assess a daily charge not as a penalty but as liquidated damages to compensate the Department for the additional costs incurred.

In suits involving assessment or recovery of liquidated damages, the reasonableness of daily charges will be presumed and the amount assessed will be in addition to every other remedy enforceable at law, in equity, by statute, or under the Contract.

1807.1 ASSESSMENT OF LIQUIDATED DAMAGES

The Department will deduct liquidated damages from money due the Contractor for each Calendar Day that the Work remains incomplete after the Contract Time expires. The Engineer will deduct liquidated damages based on the original Contract amount and Table 1807.1-1.

Table 1807.1-1
Schedule of Liquidated Damages

Original Contract Amount		Liquidated damage charge per Calendar Day, $
From more than, $	To and including, $	
0	25,000	300
25,000	100,000	400
100,000	500,000	900
500,000	1,000,000	1,200
1,000,000	2,000,000	1,500
2,000,000	5,000,000	2,500
5,000,000	10,000,000	3,000
10,000,000	—	3,500

1807.2 WAIVER OF LIQUIDATED DAMAGES

The Department may waive all or any portion of liquidated damages after the date the Work is substantially completed if the Engineer determines that the Work is in a condition that no longer requires ongoing inspection by the Department.

The Department will not deduct liquidated damages during periods of authorized suspension.

The Department does not waive any of its rights under the Contract by allowing the Contractor to continue and finish the Work or any part of the Work after the Contract Time expires. The Department does not waive its rights to recover liquidated damages from the Contractor or its Surety by either:

(1) Taking over the Work
(2) Terminating the Contract

1808 DEFAULT OF CONTRACTOR

The Commissioner, after giving due notice to the Contractor and its Sureties, will have full power and authority to take the prosecution of the Work out of the hands of the Contractor without violating the terms of the Contract if the Contractor commits any of the following events of default:

(1) Fails to start the Work by the Contract Starting Date and any intermediate starting date, as required in 1806, "Determination and Extension of Contact Time"
(2) Fails to perform the Work with sufficient workers and Equipment or with sufficient Materials to ensure prompt completion of the Work as required in 1804.1, "Prosecution Control"
(3) Fails to perform the Work satisfactorily as required by 1512, "Unacceptable and Unauthorized Work"
(4) Suspends the prosecution of Work without permission of the Engineer as required in 1803.4, "Temporary Suspensions"
(5) Neglects or refuses to remove Materials or reconstruct Work rejected as defective or unacceptable as required in 1512, "Unacceptable and Unauthorized Work"
(6) Fails to resume suspended Work within a reasonable time after notice to do so, as required by 1803.4, "Temporary Suspensions"
(7) Becomes insolvent, is declared bankrupt, or is the subject of a voluntary or involuntary bankruptcy petition
(8) Makes an assignment for the benefit of creditors
(9) Fails to comply with the labor provisions required by the Contract
(10) Fails to carry on the Work in an acceptable manner for any other cause whatsoever
(11) Repeatedly fails to make payment in accordance with the Contract to Subcontractors or suppliers for labor or Materials
(12) Fails to procure or maintain insurance coverage required by the Contract

The Engineer will give the Contractor and Sureties written notice of any default, and will identify the facts of the events of default together with a demand that the Contractor correct such events of default to the satisfaction of the Engineer. If within a period of 10 Business Days after such notice the Contractor and Sureties fail to correct the identified events of default, the Commissioner will exercise any lawful authority and take any lawful action with respect to such default and with respect to securing performance of the Work.

The Contractor and Department acknowledge the following:

(1) A notice of default is duly served when it is delivered in person or by registered mail to the Contractor and Sureties or to their authorized representatives, including persons in charge of their offices
(2) The service of the notice is complete and sufficient when a properly addressed and stamped envelope containing the notice is registered and deposited in any post office or U.S. letter box in the State

The Commissioner's authority to take the prosecution of the Work out of the hands of the Contractor shall include the right to appropriate or use any or all Materials and Equipment on the ground as may be suitable and acceptable, and to enter into an agreement with others for completion of the Work according to the terms and provisions of the Contract, or to use such other methods as may be required to complete the Work in an acceptable manner.

The Department will deduct all costs and charges incurred by the Department, together with the cost of completing the Work under Contract, from any moneys due the Contractor or that would have become due the Contractor under the Contract if the Contractor had completed the Work. If the cost and charges incurred by the Department exceed the amount that would have been payable under the Contract, the Contractor and the Sureties shall be liable for the excess.

If a default of the Contractor is later determined to be without cause, the default of the Contractor will revert to a termination of the Contract in the best public interest as allowed in 1809, "Termination of Contract."

1809 TERMINATION OF CONTRACT

The Department may terminate the Contract, or any portion of the Contract, for any of the following reasons:

(1) If the Department determines that the Contractor is prevented from proceeding with or completing the Work within a reasonable period of time for any reason including, but not limited to:

- (a) Labor or Material shortage
- (b) Limitations imposed by law, rule, regulation, or order of the local, State, or Federal government
- (c) Actions of the public enemy, including those related to priorities and third-party actions

(2) If the Department determines it is in the best interest of the Department, public, State, or Nation for any reason including, but not limited to:

- (a) Lack of funding or a funding reallocation that prevents the completion of the Work as planned
- (b) Discovery of significant hazardous Material problems
- (c) Right-of-way acquisition problems
- (d) Utility conflicts that would cause substantial delays or expense to the Contract

If the Department terminates all or any portion of the Contract, the termination will relieve the Contractor of its obligation to perform such portions of the Contract. The termination will not relieve the Contractor of its responsibilities for the Work performed prior to termination, or relieve the Contractor's Surety of its responsibilities for any just claims arising out of Work performed prior to termination.

The Department may direct the Contractor to complete certain elements of the Work before termination of the Contract. The Department will compensate the Contractor for eliminated Contract Items in accordance with 1904, "Compensation for Contract Revisions," and 1905, "Compensation for Eliminated Items."

Measurement and Payment

1901 MEASUREMENT OF QUANTITIES

Unless otherwise specified, the Engineer will measure in accordance with this section.

The Engineer will determine quantities of acceptable Work using one of the following methods:

(1) Plan dimensions — for Contract Items or portions of Contract Items designated as (P) in the Statement of Estimated Quantities on the Plans, the Department will use the Plan Quantities for payment

(2) Field measurement — for Contract Items with no (P) designation shown on the Plans, the Engineer will field measure quantities of Work performed
(3) A combination of Plan dimensions and field measurements

The Engineer may adjust quantities for portions of the Work or the entire Project. The Engineer will not adjust quantities if a difference results from use of commonly accepted dimensional approximations.

The Engineer will determine quantities using the US Customary System of weights and measures. The units and the methods of measurement in the Contract for each class of Work will supplement or modify the provisions in this section by any of the following:

(1) Imposing measurement limitations
(2) Describing measurements or computation procedures
(3) Establishing conversion factors or adjustment conditions
(4) Providing for the determination of accurate and representative pay quantities

Item names for pay quantities may include designated terms to indicate the basis for unit measurements, such as where or when the Engineer will take the unit measurements or make computations. Unless otherwise required by the Contract, the Engineer will make measurements and computations as specified in this section.

The Contractor may dispute the Engineer's determination of pay quantities by submitting a written request to the Engineer. The Contractor shall state the Contract Item and sections of the Project disputed and provide details to justify the Engineer's review of the pay quantity. The request must be consistent with conditions governing the Contract Item. The Engineer will not review quantities unless the Contractor provides evidence substantiating that the quantity is incorrect.

1901.1 (P) QUANTITIES

If the Department places a (P) designation on individual Contract Items or specific portions of Contract Items in the Statement of Estimated Quantities on the Plans, the Department will use the Plan dimensions to calculate the pay quantity for that Contract Item. The Department will limit use of the (P) designated quantities to Contract Items with specified dimensions and controlled by field checks during or after construction.

The purpose of the Department’s use of (P) designated quantities is to avoid the expense of measuring dimensions, if original Plan dimensions remain valid. The Engineer will determine the quantities of Contract Items that do not have a (P) designation, using the methods of measurement required by the Contract, unless otherwise agreed in writing. The Engineer will use Plan dimensions as applicable for completed Work. The Engineer will only use field dimensions if required by the Contract or as necessary to accurately dimension completed Work.

The Engineer will adjust a (P) designated quantity if the Engineer revises the dimensions of the Work or decides the (P) designated quantity is incorrect. The Engineer will only adjust quantities for the revised or corrected portions of the (P) designated Contract Item.

1901.2 AREAS

For longitudinal measurements, the Engineer will measure horizontally for computing an area and will not make deductions for Structures with an area less than 1 square yard. For transverse measurements, the Engineer will use the neat line dimensions shown in the Plans or ordered by the Engineer.

1901.3 STRUCTURES

The Engineer will measure Structures using the neat line dimensions shown on the Plans, or the dimensions as altered to fit field conditions.

1901.4 LENGTH

The Engineer will measure Contract Items requiring a linear unit of measure, such as pipe Culverts, guardrail, and underdrains, parallel to the base or foundation on which the Structure is placed.

1901.5 VOLUME

A Excavated Volume (EV) — Cubic Yard

The Engineer will determine the cubic yards of Excavated Volume (EV) using the cross-section method or digital surface model method to measure the Material in its original position.

B Compacted Volume (CV) — Cubic Yard

The Engineer will determine the cubic yards of Compacted Volume (CV) using the cross-section method or digital surface model method to measure the compacted Material in its final position, in accordance with the placement dimensions required by the Contract or directed by the Engineer.

C Loose Volume in Vehicular Measure — Cubic Yard

The Engineer will determine the cubic yards of Loose Volume (LV) using the vehicular measure method. The Engineer will measure the Material at the point of delivery to the nearest 0.10 cubic yard. The Contractor may use vehicles for hauling Material to the Project of any size or type if the Engineer can easily determine the vehicle body capacity and view the contents. The Engineer will determine the struck capacity for each vehicle. The Contractor shall mark the struck or level perimeter line on the inside of the box of each vehicle.

The Contractor shall load the vehicle and level the load as directed by the Engineer. The Contractor shall provide over-allowance for settlement of the load during transit. The Engineer may direct the Contractor to level any load upon its arrival at the point of delivery. The Engineer will not measure Material heaped above the struck capacity of the vehicle. The Engineer will make deductions in 0.5 cubic yard increments on loads that contain less than the struck capacity. The Contractor shall provide hauling vehicles with a conspicuous, legible identification mark that is acceptable to the Engineer.

D Stockpiled Volume (SV) — Cubic Yard

The Engineer will determine the cubic yards of Stockpiled Volume (SV) using the cross-section method or the digital surface model method to measure Material in the stockpiled position. The Contractor shall shape the stockpile to a condition directed by the Engineer before measurement.

1901.8 MASS

For measuring or proportioning Material by mass, the Contractor shall provide certified weights or weigh Material on calibrated, approved Scales. The Department will not allow the use of front-end loader Scales. The Contractor shall give the Engineer a copy of the inspection certificate.

The Contractor shall provide an automated weighing device for Materials hauled in trucks and paid for by mass.

A Certified Weights

The Contractor is not required to weigh Materials in the presence of the Engineer if the Contractor delivers the Material in original containers marked with the certified weight. If the Engineer suspects a loss of Material, the Engineer will require the Contractor to reweigh the Material.

B Scale Testing and Calibration

The Contractor shall ensure an authorized person tests and calibrates Scales before use on the Project. The Contractor shall provide test weights, accessories, and assistance required for testing and calibrating the Scales. The Contractor shall test and calibrate the Scales in accordance with the frequency, criteria, tolerances, and sensitivity requirements in this section.

B.1 Authorized Person

An authorized person, as defined by one of the following descriptions, shall test and calibrate the Scales:

(1) A Scale service person with a valid placing-in-service registration issued by the Minnesota Department of Commerce
(2) The Contractor, with written approval of the Engineer and under the supervision of the Engineer

B.2 Frequency

The Contractor shall test and calibrate the Scales in accordance with the following:

(1) Inspect, test, and calibrate the Scales each year before use on the Project
(2) Spot check Scales for accuracy and sensitivity at the discretion of the Engineer as Work progresses
(3) Check the vehicle tare and gross mass at a frequency directed by the Engineer for Materials weighed in the hauling vehicle
(4) Test and calibrate Scales at three-month intervals for the duration of the Project
(5) Test and calibrate Scales as specified by these Standard Specifications

B.3 Testing and Calibration Criteria

The authorized person shall test and calibrate the Scales with calibrated test weights. The Contractor shall provide calibrated test weights certified by the Minnesota Department of Commerce within the preceding 12 months, unless otherwise allowed by the Engineer. The authorized person may weigh the supplemental mass of Material or Equipment on the Scales after initial calibration and use to supplement the calibrated test weights.

The Contractor shall verify commercial Scales have current certification from the Minnesota Department of Commerce before the Engineer will allow use on the Project.

B.3.a Testing and Calibration by Registered Scale Service Person

If a registered Scale service person performs testing and calibrating, the service person shall test Scales up to the maximum expected load weighed on the Project. The Contractor shall provide evidence to the Engineer that Scales meet the Contract requirements.

B.3.a(1) Truck Scales

The registered Scale service person shall use at least 22,050 pounds of calibrated test weights along with the supplemental mass.

B.3.a(2) Batch Scales

The registered Scale service person shall use at least 1,100 pounds of calibrated test weights along with the supplemental mass.

B.3.b Testing and Calibration by the Contractor

If the Contractor tests and calibrates the Scales, the Contractor shall perform a comparison test. The Contractor shall perform the comparison test at the minimum and maximum expected loads weighed during the Project.

B.3.b(1) Truck Scales

The Contractor shall weigh an empty truck and a loaded truck of the size and capacity the Contractor will use on the Project on a certified

commercial Scale, then, weigh the same empty truck and loaded truck on the Scale the Contractor will use on the Project.

B.3.b(2) Batch Scales

The Contractor shall make calibrated test weights available at each Scale installation, at all times to provide a total test mass of 30 percent of the net load the Contractor will weigh not exceeding 1,100 pounds of test weights. The Engineer may allow the Contractor to weigh a load, or series of loads, in a hopper then drop the load into a truck that has been weighed on a certified commercial Scale. The Contractor shall weigh the loaded truck on the same certified Scale.

B.4 Scale Tolerance

B.4.a Calibration with Calibrated Test Weights

The Contractor shall use Scales with Scale indications within 1 percent of the value of the calibrated and supplemental test weights applied to the Scale.

B.4.b Calibration with a Certified Commercial Scale

Indicated loads on the calibrated Scale shall agree within 1 percent with the indicated loads on the certified commercial Scale.

B.5 Scale Sensitivity

B.5.a Weighbeam Indicators

The Scale indicator, at the normal minimum and maximum loads, shall sense a change in load equal to 0.2 percent of the load on the Scale.

B.5.b Dial or Digital Indicators

A sensitivity test is not applicable, but the dial or digital indicator shall respond uniformly and smoothly to changes in loads on the Scale.

C Automated Weighing Device

If the Department pays for Materials, hauled in trucks, by mass, the Contractor shall provide Scales integrated with a ticket printer. Tickets shall include the date, Project number, Contract Item number, truck or tractor and trailer identification, truck tare, and net mass. The truck driver shall give the ticket to the Inspector on the Project.

1901.9 BITUMINOUS MATERIALS

The Engineer will measure bituminous Materials by the gallon or ton, and make corrections for loss, waste, foaming, and quantities not incorporated in the Work. The Engineer will make volumetric measurements of bituminous Materials at 60°F or will correct the amount based on a volume at 60°F, using the *Bituminous Manual*.

The Engineer will determine the volumetric content of transport and storage tanks using the tank manufacturer's calibrated measuring devices and outage tables, based on the computed or certified tank capacity, or the Engineer will compute the content from the density factors derived from tests.

1901.10 OTHER BASIS OF MEASUREMENT

If the Contractor and Engineer mutually agree in writing, the Engineer may measure Materials in units other than the units of measure specified as the basis of payment. The Engineer will convert the measured quantities to the unit of measure specified in the method of measurement section. The Engineer will establish the factors for conversion from one unit of measurement to another as mutually agreed.

1901.11 TIMBER AND LUMBER

The Engineer will measure timber and lumber by at least one of the following:

(1) Each
(2) Lump sum
(3) Area in square feet
(4) Volume in cubic yards in the Structure based on the Nominal width, thickness, and the extreme length of each piece in the finished Structure

1901.12 LUMP SUM

If used as a unit of measure, the term "lump sum" shall mean complete payment for the Contract Item as described in the Contract.

1901.13 INDIVIDUAL UNIT OR EACH

If a complete Structure, Contract Item, or lump sum unit is specified as the unit of measure, the Engineer will measure the unit based on physical count and will include fittings and accessories.

1901.14 RENTAL EQUIPMENT

The Engineer will measure rental Equipment based on time in hours of actual working time and traveling time of the Equipment within the Project.

1901.15 STANDARDS AND TOLERANCES ..... 1503 & 1603

If the Contract specifies standard manufactured items, such as fencing, wire, plates, rolled shapes, pipe conduit, the Engineer will consider the identification of unit mass and section dimensions as Nominal.

1902 SCOPE OF PAYMENT

The Contractor shall receive compensation provided for in the Contract as full payment for providing Materials and performing Work in accordance with the Contract requirements. This includes compensation for all risk, loss, damage, and expense incurred by the Contractor for performing the Work required by the Contract subject to 1720, "No Waiver of Legal Rights."

1903 COMPENSATION FOR ALTERED QUANTITIES

If the Department pays for the Work of a Contract Item on an actual quantity basis and the accepted quantities of Work vary from the quantities in the Contract but do not meet the requirements established for significant changes in 1402.3, "Significant Changes to the Character of Work," the Department will pay for the Work of the Contract Item as follows:

(1) The Department's payment based on the Contract Unit Prices is payment in full for the quantities of Work performed by the Contractor and accepted by the Engineer.
(2) The Department will not pay for increased expenses, loss of expected reimbursement, or loss of anticipated profits or overhead suffered or claimed by the Contractor due to differences between the actual quantities of Work and the quantities in the Contract.
(3) The Department will not pay for loss of expected reimbursements from unbalanced allocation of costs among the Contract Items due to differences between the actual quantities of Work and the quantities in the Contract.

1904 COMPENSATION FOR CONTRACT REVISIONS

1904.1 GENERAL

If the Department revises the Contract as provided in 1402, "Contract Revisions," the Department will compensate the Contractor for the Contract revision following the sequence specified in 1904.2, "Contract Unit Prices," through 1904.4, "Force Account." Such compensation for the Contract revision constitutes final and full compensation for performing the revised Work, delay costs, and all other costs not

expressly precluded by 1904.5, "Non-Allowable Charges." The Engineer will determine the pricing method following the sequence specified in 1904.2, "Contract Unit Prices," through 1904.4, "Force Account," before directing the Contractor to perform the Work in the Contract revision.

If the Contract revision includes a time extension for compensable delays as provided by 1806, "Determination and Extension of Contract Time," the Department will compensate the Contractor for the costs associated with the time extension in accordance with 1904.6, "Compensation for Delay."

1904.2 CONTRACT UNIT PRICES

Before proceeding to another pricing method, the Engineer will attempt to price and pay for the Contract revision using Contract Unit Prices.

1904.3 NEGOTIATED PRICES

If the Engineer and Contractor are unable to agree on compensation in accordance with 1904.2, "Contract Unit Prices," they will attempt to negotiate unit or lump sum prices using one or more of the following methods:

(1) Original Contract Unit Prices for similar Contract Items adjusted for increased or decreased Material costs
(2) Representative historical Unit Prices of similar Work and quantity
(3) Unit Prices computed by the Department
(4) Cost analysis of labor, Material, Equipment, and mark-ups as allowed in 1904.4, "Force Account"

Negotiated mark-up for Subcontractor work may not exceed that provided for in 1904.4H, "Contractor Mark-up."

Within 5 Business Days of the Department's request, the Contractor shall submit a written quote that includes pricing, cost justification, and a schedule for the Contract revision. The Department will respond within 5 Business Days after receipt of the Contractor's submittal. The Department and the Contractor can mutually agree to extend these 5-Business-Day time limits.

1904.4 FORCE ACCOUNT

If the Engineer and Contractor are unable to negotiate a price for the Contract revision in accordance with 1904.3, "Negotiated Prices," the Engineer may direct the Contractor to perform all or part of the revised Work on a force account basis. When the Engineer directs the Contractor to perform revised Work on a force account basis, the Department will pay the Contractor as specified in 1904.4A, "Labor," through 1904.4J, "Inefficiency."

A Labor

The Department will compensate the Contractor for labor at the actual rate of wage paid and shown on the payroll for every hour that the labor and foreman are actually engaged in the revised Work. The foreman must be in direct charge of the specific operations and must be at the Project Site in order to be included in this compensation. Unless already included in the wage rates paid, the Contractor will also receive the actual labor-related costs incurred by reason of subsistence and travel allowances, health and welfare benefits, pension fund, or other fringe benefits, provided those payments are required by collective bargaining agreement or other employment contract generally applicable to the classes of labor employed on the Work.

The Department will prorate the wages of any foreman who is employed partly on the revised Work and partly on other Work. The Department will determine the prorated wage based on the number of workers employed on each class of Work as shown by the payrolls. The Department will prorate any subsistence or travel allowances paid to the foreman on the same basis as the prorated direct wages.

The Department will pay the Contractor an amount equal to 62 percent of the actual taxable rate of wage as full compensation for overhead, profit, additional bond, property damage and liability insurance premiums, workers' compensation insurance premiums, unemployment insurance contributions, employer Social Security taxes, and other indirect labor force costs. This compensation is based on a Workers' Compensation insurance premium of $21.00 per $100.00 of payroll. If the revised Work involves labor in a classification with a higher premium rate, the Contractor may submit a written request in accordance with 1403, “Notification for Contract Revisions,” for the additional premium amount. The request shall include the following:

(1) A certified copy of the Contractor's latest Workers' Compensation Final Insurance Audit
(2) A certification from the insurance carrier, listing the Workers' Compensation classification code numbers and the premium rates that are being paid in the current year

B Materials

The Department will pay the Contractor the actual cost of acceptable Materials delivered and used in the revised Work, including transportation charges paid by the Contractor (exclusive of Equipment rentals), plus an additional 15 percent for field and home office overhead costs and profit.

C Equipment

The Department will pay the Contractor for Equipment at the rental rates established by the Commissioner’s *Equipment Rental Schedule* available on the Department’s website and effective on the date the two parties execute the force account agreement (Change Order). This compensation is for Equipment, fuel, and lubricants that the Engineer authorizes and the Contractor uses on the Project. The Department will not pay for small tools. The Department will pay for the actual time the Equipment is in operation on the revised Work, plus travel time or transportation allowances. The Department will not pay for any additional Equipment costs except as provided under 1904.4D “Miscellaneous Compensation.”

If the Equipment is moved to and from the location of the revised Work under its own power, the Department will pay for the travel time at the above rental rates. If the Equipment is moved to and from the location of the revised Work by means other than its own power, the Department will pay for the actual operating time during periods of loading and unloading at the above rental rates and will pay for the actual transportation costs.

D Miscellaneous Compensation

If the Engineer directs the Contractor to perform the revised Work on the Right-of-way of a railroad, in addition to the compensation for labor, Materials, and Equipment, the Department will pay the Contractor for actual costs related to satisfying the requirements of 1708, “Railroad-Highway Provisions.” The Department will only pay for these costs to the extent that there is no duplication or overlapping of charges provided under 1904.4A “Labor,” 1904.4B “Materials,” and 1904.4C “Equipment,” or by any existing Contract Items.

The Department will pay the Contractor for the actual cost of miscellaneous fees incurred in performing the revised Work, including but not limited to dump fees, permits, and licenses. Any negotiated mark-up for miscellaneous fees may not exceed 5 percent of the miscellaneous fees.

The Department will not pay the Contractor for other miscellaneous costs that the Contract does not provide for specifically.

E Daily Records

The Engineer and Contractor will document the labor, Materials, and Equipment used in performing the revised Work on a *Daily Equipment Labor Rental Record* (Form 2137). At the end of each workday, the Engineer and Contractor will compare and sign the *Daily Equipment Labor Rental Record*.

Daily Equipment Labor Rental Records signed by both the Department and Contractor will govern over other Department and Contractor records.

In the event the Contractor declines to sign the Daily Equipment Labor Rental Record, the Department's records shall govern.

F Payments

The Department will not pay for the revised Work until the Engineer has accepted the revised Work and the Contractor has submitted to the Engineer itemized statements of the cost, including the following:

(1) Name, classification, date, daily hours, total hours, rate, and extension for each laborer and foreman
(2) Designation, dates, daily hours, total hours, rental rate, and extension for each unit of Equipment
(3) Quantities of acceptable Materials, prices, and extensions
(4) Transportation costs of Materials and Equipment
(5) Invoices for Materials used and for transportation charges; if the Contractor uses Materials on the revised Work that the Contractor did not specifically purchase for the Work but were taken from the Contractor's stock, the Contractor shall submit an affidavit certifying that such Materials were taken from the Contractor's stock, that the quantity was actually used, and that the price and transportation costs represent the actual costs to the Contractor

G Specialty Contract Work

If the Contractor uses specialty contracting firms to perform the revised Work, the Department will pay the Contractor by reasonable invoice at the discretion of the Engineer. "Specialty work" is unique Work that cannot be performed by the Contractor, its Subcontractors, or other contracting firms that generally perform work on Highway construction projects.

The provisions of 1904.4A, "Labor," through 1904.4F, "Payments," shall not apply to payments made by reasonable invoice. All firms or Contractors paid under these provisions and working on the Project are subject to all labor provisions required by the Contract.

The Contractor shall provide the Engineer with a cost estimate of the specialty Work or service and obtain the Engineer's approval before performing the specialty Work. As a minimum, the cost estimate shall include a complete description of types of Equipment to be used, the number and job classifications of employees who will perform the specialty Work, and all Material costs.

H Contractor Mark-Up

For any force account Work performed by a Subcontractor (including Work performed by a specialty Contractor), the Department will pay the Contractor one additional mark-up on revised Work performed by a Subcontractor to cover administration, general superintendence, overhead, profit, and expenses not otherwise recoverable. The additional mark-up will be a percentage of the total force account invoice for the Subcontractor's portion of the revised Work equal to 10 percent of the first $50,000.00 plus 2 percent of the balance in excess of $50,000.00.

I Acceleration

The Engineer may order the Contractor to accelerate the Work to avoid delay costs or to complete the Project early. The Department will pay for accelerations in accordance with this section.

J Inefficiency

The Department will compensate the Contractor for inefficiency or loss of productivity resulting from 1402, "Contract Revisions." Use the measured mile analysis, or other reliable methods, comparing

the productivity of Work impacted by a change to the productivity of similar Work performed under unimpacted (unchanged) conditions to quantify the inefficiency. The Department will pay for inefficiencies in accordance with this section.

1904.5 NON-ALLOWABLE CHARGES

A General

The Department will not pay the Contractor for any of the following, regardless of the method of payment for the revised Work:

(1) Loss of anticipated profits
(2) Consequential damages, including loss of bonding capacity, loss of bidding opportunities, and insolvency
(3) Indirect costs
(4) Attorney's fees, claims preparation expenses, or costs of litigation

B Profit Adjustment

Per 1402.4, "Suspensions of Work Ordered by the Engineer," the Department will not pay the Contractor for profit on suspensions or delays ordered by the Engineer. The Department will remove profit from the mark-ups in 1904.4A, "Labor," 1904.4B, "Materials," and 1904.4H, "Contractor Mark-Up," by reducing the mark-up percentages as follows:

(1) Labor: from 62 percent to 57 percent
(2) Materials: from 15 percent to 10 percent
(3) Contractor mark-up: from 10 percent for the first $50,000.00 to 5 percent for the first $50,000.00

1904.6 COMPENSATION FOR DELAY

A General

For compensable delays as identified in 1806, "Determination and Extension of Contract Time," the Department will pay for the costs specified in 1904.6B, "Allowable Delay Costs." The Department will not pay for non-allowable charges specified in 1904.5, "Non-Allowable Charges," or duplicate payment made under 1904.2, "Contract Unit Prices," through 1904.4, "Force Account."

The Department will not pay for delay costs before the Contractor submits an itemized statement of those costs. The Contractor shall include the following content for the applicable items in the statement.

B Allowable Delay Costs

B.1 Extended Field Overhead

The Department will pay the Contractor for extended field overhead costs that include costs for general field supervision, field office facilities and supplies, and for maintenance of field operations.

General field supervision labor costs include, but are not limited to, field supervisors, assistants, watchman, clerical, and other field support staff. The Contractor shall calculate these labor costs as specified in 1904.4A, "Labor." For salaried personnel, the Contractor shall calculate the daily wage rate actually paid by dividing the weekly salary by 5 Calendar Days per week.

Field office facility and supply costs include, but are not limited to, field office trailers, tool trailers, office Equipment rental, temporary toilets, and other Incidental facilities and supplies. The Contractor shall calculate these costs to provide these services on a Calendar-Day basis using actual costs incurred due to the delay.

Maintenance of field operations costs include, but are not limited to, telephone, electric, water, and other similar expenses. The Contractor shall calculate these costs to maintain these services on a Calendar-Day basis using actual costs incurred due to the delay.

B.2 Idle Labor

The Contractor shall calculate labor costs during delays as specified in 1904.4A, "Labor," for all non-salaried personnel remaining on the Project as required under collective bargaining agreements or for other Engineer approved reasons.

B.3 Escalated Labor

To receive payment for escalated labor, the Contractor shall demonstrate that the Department-caused delay forced the Work to be performed during a period when labor costs were higher than planned at the time of bid. The Contractor shall provide adequate support documentation for labor costs, allowances, and benefits.

B.4 Idle Equipment or Equipment Mobilization and Demobilization

The Department will pay the Contractor for Equipment, other than small tools, that must remain on the Project during Department-caused delays at the idle Equipment rate calculated in 1904.4C, "Equipment." The Department will pay the Contractor's transportation costs to remove and return Equipment not required on the Project during Department-caused delays.

B.5 Materials Escalation or Material Storage

The Department will pay the Contractor for increased Material costs or Material storage costs due to the Department-caused delay. The Contractor shall obtain the Engineer's approval before storing Material due to a delay.

B.6 Extended or Unabsorbed Home Office Overhead

The Department will pay the Contractor for unabsorbed or extended home office overhead costs in accordance with the Federal Acquisition Regulations, specifically 48 C.F.R. § 31. The Department will audit all extended or unabsorbed home office overhead claims in accordance with 1721, "Audits." The Department will compensate the Contractor using the standard Eichleay formula.

B.6.a Contractor Claim Requirements

To recover home office overhead, the Contractor's claim shall prove the following:

(1) The delay was caused by the Owner suspending the entire Project, in accordance with 1402.4, "Suspensions of the Work Ordered by the Engineer"
(2) The Owner required the Contractor to standby during the suspension period
(3) It was impractical for the Contractor to obtain replacement Work during the suspension period
(4) The suspension caused the Contractor to be unable to complete the Contract within the original Contract performance period, as extended by any modifications
(5) The Contractor suffered actual damages as a result of the delay caused by the suspension

B.6.b Subcontractor Claim Requirements

The Department will consider Subcontractors eligible for separate extended or unabsorbed home office overhead using the standard Eichleay formula, if the Subcontract does not contain language disallowing such claim compensation.

To recover home office overhead, the Subcontractor's claim shall prove the following:

(1) The delay was caused by the Owner suspending the entire Project, in accordance with 1402.4, "Suspensions of the Work Ordered by the Engineer"
(2) The Subcontractor was on the Project Site directly before and directly after the suspension
(3) The Owner required the Subcontractor to standby during the suspension
(4) It was impractical for the Subcontractor to obtain replacement Work during the suspension period
(5) The Subcontractor suffered actual damages as a result of the delay or caused by the suspension
(6) The delay caused the Subcontractor to be unable to complete the subcontract within the original subcontract performance period, as extended by any modifications

B.6.c General Claim Requirements

The Department will not allow compensation for home office overhead for the Contractor or Subcontractor if any of the following conditions are met:

(1) It was not impractical to obtain replacement Work during the suspension period
(2) The inability to obtain other Work was not caused by the suspension
(3) The Contractor or Subcontractor was able to reduce fixed overhead expenses during the period of delay or suspension

1905 COMPENSATION FOR ELIMINATED ITEMS

The Department will compensate the Contractor for eliminated items in accordance with the following:

(1) For completed quantities of eliminated Contract Items, the Department will compensate the Contractor for the accepted quantities at the Contract Unit Price.
(2) For Materials that the Contractor has ordered but not incorporated in the Work, the Department will compensate the Contractor in accordance with 1907, "Payment for Surplus Material."
(3) For partially completed quantities of eliminated Contract Items, the Department will compensate the Contractor for that portion of the quantity of the Work the Contractor has performed on the eliminated Contract Item on the basis of a percentage of the Contract Unit Price equal to the percentage of Work performed toward completion of that quantity of the Contract Item. To calculate this percentage, the Engineer will consider the value of Materials incorporated in the partially completed quantity of the eliminated Contract Items to be the invoice cost of the Materials plus transportation costs. The Engineer will add a 15 percent mark-up to the sum of the invoice and transportation costs.
(4) For the cost of Equipment, mobilization, and overhead that the Engineer considers directly attributable to the eliminated Contract Items and that the Department has not compensated the Contractor for through provisions (1), (2), and (3) of this list, the Department will compensate the Contractor in accordance with 1904, "Compensation for Contract Revisions."

The Department will not compensate the Contractor for loss of anticipated profits on completely or partially eliminated Work. The Department's compensation to the Contractor for completed or partially completed quantities of Work on eliminated Contract Items in accordance with 1905, "Compensation for

Eliminated Items," constitutes final and full compensation for the Work the Contractor has performed on eliminated or partially eliminated Contract Items.

The Contractor shall allow the Department access, in accordance with 1721, "Audits," to the Contractor's cost records and other data relating to the Contract as needed by the Department to determine compensation for eliminated Work.

1906 PARTIAL PAYMENTS

1906.1 GENERAL

At least once a month at regular intervals, the Engineer will prepare an estimate of the value of the Work completed to date. Each estimate will show the documented quantity of Work completed or substantially completed under each Contract Item.

The Department will make partial payments once per month based on the amount of Work performed, unless the Engineer authorizes semi-monthly partial payments.

The Department reserves the right to withhold partial payments under this Contract if the Contractor fails to provide documents as required by any other contract with the Department that prevent the Department from making the Final Estimate or executing the Certificate of Final Acceptance for the other contract.

The Department reserves the right to deduct, from any payment due to the Contractor, such amount to protect the Department's interests in consideration of charges or assessments against the Contractor, whether arising from this Contract or any other contract with the Department. The Department may withhold payment of such amount until the Contractor pays or satisfies the charges or assessments.

The Department's payment of partial estimates does not relieve the Contractor from the sole responsibility for all Materials and Work for which payments have been made or for the restoration of any damaged Work. The payments are not a waiver by the Department of any provision of the Contract or of the Department's rights to require the Contractor to fulfill all terms of the Contract.

The Contractor's acceptance of partial payment constitutes a certification by the Contractor that the Work covered by the partial payment meets the Contract requirements.

The Contractor must promptly notify the Department if the Contractor receives an underpayment or an overpayment for the Work. The Contractor must refund the Department any overpayment in response to a request for refund of overpayment within 30 Calendar Days of the Department's request. If the Contractor fails to refund the overpayment, the Department may deduct the amount of overpayment from any moneys due or becoming due to the Contractor.

1906.2 MATERIAL ON HAND

The Contractor may request partial payments for the value of "Materials on hand," defined as acceptable Materials produced for or provided to the Project, but not yet incorporated into the Work.

A Requirements

The Department will pay for Materials on hand when the Contractor meets the following requirements:

(1) Requests payment for at least $5,000
(2) Provides Materials specifically manufactured, produced, or supplied for permanent incorporation into the Project
(3) When the Contractor provided storage is accepted by the Engineer for Materials delivered to, or adjacent to, the Project Site

(4) When the Contractor irrevocably assigns the Materials to the Project, stores the Materials separately from other similar Materials, ensures the Materials are not available for use on other projects, and makes the Materials available for inspection by the Department at the Material storage location for Materials not yet delivered to, or adjacent to, the Project Site

(5) Provides Materials as shown on the Plans and in accordance with the Specifications

The Department will not make partial payments for living plant or perishable Materials as Materials on hand.

B Documentation

The Contractor must provide the following actual, authentic, customary, and auditable documents, produced in the normal course of business, to receive payment for Materials on hand:

(1) Paid invoices or receipts for delivery of Materials. If the Contractor submits receipts for delivery, the Contractor must submit a paid invoice within 30 Calendar Days after issuance of the progress payment to the Contractor.

(2) An itemized list detailing the cost of Contractor-produced Material

(3) Documents containing complete Material description and identification

The Department will pay for Materials on hand in an amount not greater than the delivered cost of the Material as verified by Contractor-provided-invoices and not greater than the Contract Unit Price for the Material complete in place. The Department may recover payments made by the Department for Materials on hand if the Contractor does not provide proof of payment to the vendor within 30 Calendar Days after issuance of the progress payment to the Contractor.

1907 PAYMENT FOR SURPLUS MATERIAL

The Department will pay for Materials ordered for the Work, but not used, if the Engineer cancels a portion of the Work or the Contract, orders the termination of the Work before completion of the entire unit, or orders a quantity greater than the quantity needed for the Work, in accordance with the following:

(1) If the Contract Item only includes providing and delivering the Material, the Department will pay for purchased surplus Materials shipped or delivered in accordance with the Contract at the Contract Unit Price

(2) If the Contract Unit Price includes the cost of providing and placing of the Material, the Department will perform any of the following:

(a) Take possession of the purchased surplus Material shipped or delivered in accordance with the Contract, and pay the actual purchase price and transportation cost plus 15 percent

(b) Order the Contractor to return the Material to the supplier for credit, and pay the Contractor 1) the difference between the purchase price and the credit received for the returned Material; 2) transportation costs; and 3) 10 percent of the total of items 1) and 2) for administrative costs

(3) The Department will pay the actual purchase price and transportation cost plus 15 percent, upon delivery, for Materials that required special manufacture, fabrication, or processing, making the Materials unsuitable for general use, only if the supplier refuses to cancel or modify the order for Materials

The foregoing items (1) to (3) will not apply and the Department will not pay for Materials ordered for the Work, but not used, if the Contractor or supplier takes possession of the surplus Material at no additional cost to the Department.

The Department will pay an amount for surplus Materials not greater than the Contract Unit Price for the same quantity of Materials complete in place. The Contractor shall provide receipted invoices or an affidavit showing the purchase price and transportation charges for surplus Materials that will become the property of the Department.

The Contractor shall deliver surplus Materials that the Department purchases to the storage sites designated by the Engineer.

The Department will only pay for Materials incorporated in the Work, except as otherwise specified in this section.

The Department will only pay for surplus Materials inspected, tested, or accepted for use and for Material properly preserved, stored, and maintained in accordance with 1606, "Storage of Materials," and 1607, "Handling Materials," until delivered to the Department.

1908 FINAL ESTIMATE AND PAYMENT – CONDITIONS AND PROCESS

1908.1 GENERAL

The Department will initiate the final estimate and payment process in accordance with this section after the Contractor achieves Project acceptance as specified in 1516.2, "Project Acceptance."

The Department may make corrections to estimates for partial payments in the final estimate. No consideration will be given for any consequential damages due to any previous overpayments or underpayments made before the final estimate and discovered at the time of the final estimate.

If the final estimate shows that the total of all partial payments exceeds the total amount due the Contractor, the Contractor shall promptly refund the overpayment. If the Contractor fails to refund the overpayment, the Department may deduct the amount of overpayment from any moneys due or becoming due to the Contractor under any other contract. This right survives the completion and closeout of the Contract.

1908.2 SEMI-FINAL ESTIMATE FOLLOWING PROJECT ACCEPTANCE

After issuing Project acceptance in accordance with 1516.2, "Project Acceptance," the Engineer will prepare a semi-final estimate showing the accepted quantity and value of each Contract Item performed by the Contractor, and the amounts the Department will retain or deduct as required by the Contract. The Contractor shall review and comment on the semi-final estimate.

1908.3 FINAL ESTIMATE FOLLOWING COMPLETION OF WORK

The Department will review records and other factors indicating compliance with the requirements of 1516.3, "Completion of the Work." The Department will prepare and provide the final estimate and certificate of final acceptance to the Contractor after the Contractor completes the Work in accordance with 1516.3, "Completion of the Work." The Contractor shall execute and return the certificate of final acceptance to the Department within 90 Calendar Days of receipt. If the Contractor does not return the executed certificate of final acceptance within the time specified in this section, the Department will deem the certificate accepted by the Contractor.

The Contractor's acceptance of the final payment constitutes a certification by the Contractor that the Contractor performed the Work in accordance with all Contract requirements.

The Department will make final payment to the Contractor after the Contractor executes and returns the certificate of final acceptance or the Department deems the certificate accepted.

Creating the final estimate and making final payment shall not relieve the Contractor of financial liabilities imposed by statute or waive Department claims, under MN Statutes Chapter 15C or otherwise, with respect to any overcharges or any claims made by the Contractor under or related to the Contract. Final

payment and Contract closeout by the Department does not affect the rights of any claimants under MN Statutes §177.44.

1909 ASSIGNMENT OF PAYMENTS

The Department will not recognize assignments or orders executed by the Contractor that direct payments of money due to the Contractor under the Contract, unless the Surety's consent is attached to the assignment or order by endorsement or other means, or the assignment or order is of an account defined in MN Statutes Chapter 336, Uniform Commercial Code.

The Department may accept or reject orders or assignments, except in cases where acceptance is required by law.

1910 COST ESCALATION

The Department will not make adjustments for cost escalation, unless the Contract requires otherwise.

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DIVISION III

MATERIALS

Cementing Materials

3101 PORTLAND CEMENT

3101.1 SCOPE

Provide Portland cement Material for use in concrete applications.

3101.2 REQUIREMENTS

Supply Portland cement from the certified source listed on the *Approved/Qualified Products List*, meeting the requirements of *AASHTO M 85*, "Standard Specification for Portland Cement."

Include the following standardized cement certification statement with delivery invoices: "(insert company name) certifies that the cement produced at (insert plant and location) conforms to *AASHTO M 85* and 3101, "Portland Cement," for Type (insert type) cement."

Do not change the source or color of cement on a Project without the written approval of the Engineer.

3101.3 SAMPLING AND TESTING

Provide samples for testing meeting the requirements of the *Schedule of Materials Control*. Measure fineness in accordance with the air permeability test in *AASHTO M 85*.

3102 SLAG CEMENT

3102.1 SCOPE

Provide slag cement or "slag" Material for use in concrete applications.

3102.2 REQUIREMENTS

Provide slag from the certified source listed on the *Approved/Qualified Products List*, meeting the requirements of *AASHTO M 302*, "Standard Specification for Slag Cement for Use in Concrete and Mortars."

Include the following standardized slag certification statement with delivery invoices: "(insert company name) certifies that the slag produced at (insert plant and location) conforms to *AASHTO M 302* and 3102, "Slag Cement," for grade (insert grade) slag."

Do not change the source or color of slag on a Project without the written approval of the Engineer.

3102.3 SAMPLING AND TESTING

Provide samples for testing meeting the requirements of the *Schedule of Materials Control*.

3103 BLENDED HYDRAULIC CEMENT

3103.1 SCOPE

Provide blended hydraulic cement Material for use in concrete applications.

3103.2 REQUIREMENTS

Provide blended hydraulic cement from the certified source listed on the *Approved/Qualified Products List*, meeting the requirements of *AASHTO M 240*, "Standard Specification for Blended Hydraulic Cement," Type IS, Type IP, Type IL, or Type IT and the following modifications:

(1) Fly ash constituent of the blended cement no greater than 25 percent
(2) Slag constituent of blended cement no greater than 35 percent
(3) Silica fume constituent of blended cement no greater than 7 percent
(4) Include the following standardized cement certification statement with delivery invoices: "(insert company name) certifies that the cement produced at (insert plant and location) conforms to *AASHTO M 240* and 3103, "Blended Hydraulic Cement," for type (insert type) cement"

Do not change the source or color of blended cement on a Project without the written approval of the Engineer.

3103.3 SAMPLING AND TESTING

Provide samples for testing meeting the requirements of the *Schedule of Materials Control*.

3105 BAGGED PORTLAND CEMENT CONCRETE PATCHING MIX 3U18 AND 3U58M

3105.1 SCOPE

Provide dry, bagged concrete patching mix 3U18 for repairing Portland cement concrete pavement and 3U58M for repairing Portland cement concrete Bridge decks, Bridge deck overlays, and approach panels.

3105.2 REQUIREMENTS

A Materials

Provide Materials for patching mix meeting the following requirements:

A.1 Cement 3101

A.2 Fine Aggregate 3126

A.3 Coarse Aggregate 3137

A.4 Intermediate Aggregate 3131

A.5 Admixtures 3113

Mix 3U58M utilizes air-entraining and Water-reducing Admixtures. Provide the manufacturer's Technical Data Information Sheet and the Materials Safety Data Sheet (MSDS) for the proposed dry admixtures when submitting the Quality Plan for approval.

B Blending

Blend the Aggregates to meet the requirements of Table 3105.2-1.

Table 3105.2-1
3U18 Gradation Requirements

Sieve Size	Percent Passing
3/8 inch	100
No. 4	80-100
No. 8	40-80
No. 16	25-50
No. 30	15-35
No. 50	0-18
No. 100	0-8
No. 200	≤ 2.3

Dry the Aggregates as approved by the Engineer before blending with the cement. Blend Materials completely before bagging the mix.

Provide a blending device meeting the following characteristics and requirements:

(1) Capable of producing the required mix proportions within ±2 percent
(2) Equipped with a warning device to indicate when the system is out-of-tolerance
(3) Capable of stopping the flow of cement to allow sampling of the blended coarse and fine Aggregate
(4) Designed to allow cement and Aggregate to discharge separately for checking Material weights

C Mix Proportions

Proportion the mix in accordance with Table 3105.2-2. Use of any other size bag requires approval of the Concrete Engineer.

Table 3105.2-2
Mix Proportions

Material	Gradation Requirements	Weight 50 pound bag	Weight 75 pound bag	Weight 3000 pound bag
Type I Cement		11.9	17.8	712
Blended Aggregate	Table 3105.2-1	Proportions determined each day on the 3U18 Quality Control Worksheet		

D Quality Control (QC) Program

Before producing concrete patching mix each construction season, a Department Certified Concrete Plant Technician representing the Department, shall perform a thorough on-site inspection of the plant with a Department Certified Plant Technician representing the producer.

In order to obtain certification, the producer will complete the *Contact Report – Prepackaged Dry Concrete*, prior to the on-site inspection with the Department representative.

(1) A Department Certified Concrete Plant Technician, representing the producer, signs the *Contact Report* certifying compliance with the certified ready-mix requirements and continual maintenance of the plant to assure that the plant can produce concrete meeting Department Specifications.
(2) A Department Certified Concrete Plant Technician, representing the Department, signs the *Contact Report* signifying that the plant complies with all requirements prior to concrete production.

Maintain an approved Quality Control Program, including a Quality Plan, for the production of bagged Portland cement concrete patching mix. Notify the Concrete Engineer immediately if a change is made to the Quality Control Program.

The producer will perform Quality Control (QC) as part of the production of grade 3U18 and 3U58M concrete.

The Engineer will perform Quality Assurance (QA) as part of the acceptance process.

D.1 Quality Plan Requirements

Submit a Quality Control Plan to the Concrete Engineer for review and approval prior to initial production of 3U18 and 3U58M. The Quality Plan includes the following QC Procedures:

(1) Moisture content
(2) Batch weight verification
(3) Aggregate gradation testing
(4) Blending
(5) Addition of dry admixtures to 3U58M
(6) Documentation and submittals

D.2 MnDOT Certified Personnel

Provide a Department Concrete Plant Technician to perform moisture content testing, Aggregate gradation testing, review batch tickets, review test results, and oversee Quality Control requirements of 3105, "Bagged Portland Cement Concrete Patching Mix 3U18 and 3U58M," and the QC Program.

D.3 Daily Production Requirements

Each day 3U18 or 3U58M bag mix is produced, the Department Certified Concrete Plant Technician, representing the producer will complete the following:

(1) Perform moisture content and gradation testing on Aggregates
(2) Complete Department's *Bagged Mix Quality Control Worksheet* and sign
(3) Electronically submit *Bagged Mix Quality Control Worksheets* and batch tickets to Department the day following production

E Bags and Batch Identification

Provide moisture-proof bags resistant to tearing.

Print the following on the bags:

(1) The phrase, "MnDOT 3U18 CONCRETE PATCH MIX" or "MnDOT 3U58M CONCRETE PATCH MIX"
(2) Weight of the bag in pounds
(3) Mix date
(4) Mixing instructions

3105.3 SAMPLING AND TESTING

The producer and Engineer will sample and test in accordance with the *Schedule of Materials Control*.

3106 HYDRATED LIME

3106.1 SCOPE

Provide hydrated lime for use in soil drying or stabilization and for use in mortar for non-sewer applications or Road pavement mixes.

3106.2 REQUIREMENTS

A Soil Drying/Stabilization

Provide hydrated lime for use in soil drying or stabilization meeting the requirements of *AASHTO M 216*, "Standard Specification for Quicklime and Hydrated Line for Soil Stabilization."

B Mortar for Other Applications

For use in mortar, provide Type S hydrated lime meeting the requirements of *ASTM C207-18*, *Standard Specification for Hydrated Lime for Masonry Purposes*.

3106.3 SAMPLING AND TESTING

Provide sample at rates and sizes as required by the *Schedule of Materials Control* or as required by the Contract.

3107 MASONRY MORTAR

3107.1 SCOPE

Provide masonry mortar for use in sewer and other applications.

3107.2 REQUIREMENTS

A Sewer Application

Provide bag mixed mortar meeting the following requirements:

A.1 Bag Mix

Provide a dry, pre-blended, air-entrained, Type S or Type M bagged mortar mix meeting the requirements of *ASTM C270, Standard Specification for Mortar for Unit Masonry* and *ASTM C387, Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar*. Purposely air-entrain the bagged mortar mixture to an air content of at least 8 percent.

A.2 Mixing

Do not exceed the manufacturer allowable mixing water. Mix mortar onsite for the minimum time stated by the manufacture. If the manufacture does not recommend a minimum mixing time, mix the mortar for a minimum of 5 minutes. The Engineer will not allow retempering mortar mixture and will reject mortar mixtures not placed within 60 minutes of mixing.

B Other Applications

For applications other than for sewers, provide masonry mortar in accordance with *ASTM C270, Standard Specification for Mortar for Unit Masonry*, based on the type of mortar required by the Contract. Mix in accordance with the manufacturer's recommendations.

3107.3 SAMPLING AND TESTING

For bag mixed masonry mortar, provide a statement of compliance meeting the requirements of *ASTM C270, Standard Specification for Mortar for Unit Masonry*, for air-entrained mortar. Label the type of mortar mix, either Type S or Type M, on each bag.

For site mixed masonry mortar, provide a statement of compliance meeting the requirements of *ASTM C91*, *Standard Specification for Masonry Cement*. Label the type of mortar mix, either Type S or Type M, on each bag. Provide samples for site mixed masonry mortar as required by the Contract.

For applications other than for sewer applications, provide samples as required by the Contract.

3113 ADMIXTURES FOR CONCRETE

3113.1 SCOPE

Provide admixtures for use in concrete applications.

3113.2 REQUIREMENTS

A Materials

Provide Class I accelerating, retarding, and Water-reducing Admixtures from the *Approved/Qualified Products List* meeting the requirements of *ASTM C494*, *Standard Specification for Chemical Admixtures for Concrete*.

Department identifies the following as Class I admixtures:

(1) Type A — Water-reducing
(2) Type B — Retarding
(3) Type C — Accelerating
(4) Type D — Water-reducing and retarding
(5) Type E — Water-reducing and accelerating
(6) Type F — Water-reducing, high range
(7) Type G — Water-reducing, high range and retarding
(8) Type S — Specific performance admixtures

Provide Class II air-entraining admixtures meeting the requirements of *AASHTO M 154*, "Standard Specification for Air-Entraining Admixtures for Concrete," except the tests for bleeding, bond strength, and volume change are not required.

Provide Class III calcium chloride admixtures from the *Approved/Qualified Products List* meeting the requirements of *AASHTO M 144*, "Standard Specification for Calcium Chloride."

B Acceptance

Submit Certified Test Reports including a print of the Materials Safety Data Sheet (MSDS), infrared spectrum and one-quart sample for the proposed Class I or Class II admixture from a CCRL Laboratory for each admixture. The Department will use the certified test results to determine if the admixtures meet the requirements of this section.

3113.3 SAMPLING AND TESTING

Take samples as specified in the *Schedule of Materials Control*.

The Department may perform tests on samples taken from the product proposed or on samples submitted and certified by the manufacturer as representative of the admixture to be supplied.

3115 FLY ASH FOR USE IN PORTLAND CEMENT CONCRETE

3115.1 SCOPE

Provide fly ash for use in concrete applications.

3115.2 REQUIREMENTS

Provide fly ash from the certified source listed on the *Approved/Qualified Products List*, meeting the requirements of *ASTM C618*, *Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete*, Class F or Class C, except as modified by Table 3115.2-1:

Table 3115.2-1
Department Modified Fly Ash Requirements

Requirement	Class F	Class C
Loss on ignition	≤ 3.5 percent	≤ 3.5 percent
Calcium Oxide (CaO)	≤ 18.0 percent	>18.0 percent

The use of fly ash produced at plants where lime is directly injected into the boiler for sulfur removal, is prohibited in Portland cement concrete.

Ensure the following standardized Fly Ash Certification Statement is included with delivery invoices: "(insert company name) certifies that the fly ash produced at (insert power plant and location) conforms to *ASTM C618*, *Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete* and Specification 3115, "Fly Ash for Use in Portland Cement Concrete," for Class (insert class) fly ash."

Do not change the source or color of fly ash on a Project without the written approval of the Engineer.

3115.3 SAMPLING AND TESTING

Provide samples for testing meeting the requirements of the *Schedule for Materials Control*.

Aggregates

3126 FINE AGGREGATE FOR PORTLAND CEMENT CONCRETE

3126.1 SCOPE

Provide fine Aggregate for use in Portland cement concrete.

3126.2 REQUIREMENTS

A General

Provide fine Aggregate consisting of clean, sound, durable particles, uniform in quality and free from wood, bark, roots, and other deleterious Material.

The Engineer may consider the following as the basis for acceptance of fine Aggregate for Portland cement concrete:

(1) Results of laboratory tests
(2) Behavior under natural exposure conditions
(3) Behavior of Portland cement concrete with Aggregate from the same or similar geological formations or deposits
(4) Any other tests or criteria as deemed appropriate by the Engineer in conjunction with the Concrete Engineer

Provide fine Aggregate from natural sand. If producing fine and coarse Aggregates simultaneously from natural Gravel deposits during the same operation, the Contractor may provide fine Aggregate containing particles of crushed rock with the approval of the Concrete Engineer.

B Quality

B.1 Washing

Wash the fine Aggregate.

B.2 Deleterious Material

Provide fine Aggregate containing a cumulative quantity of deleterious Materials in accordance with Table 3126.2-1.

Table 3126.2-1
Deleterious Materials

Quality Test	Maximum Percent by Weight
Shale, Alkali, Mica, and Soft and Flaky Particles, Cumulative Total	2.5
Coal and Lignite, Cumulative Total	0.3

B.3 Organic Impurities

Provide fine Aggregate free of injurious quantities of organic impurities. The Concrete Engineer will reject Aggregates that produce a color darker than the standard color when tested in accordance with *AASHTO T 21*, "Standard Method of Test for Organic Impurities in Fine Aggregates for Concrete," unless the mortar specimens pass the mortar strength requirements specified in 3126.2B.4, "Structural Strength."

B.4 Structural Strength

The Engineer will test the structural strength of fine Aggregate in mortar specimens in accordance with *AASHTO T 71,* "Standard Method of Test for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar," and Table 3126.2-2. The Engineer will prepare control mortar specimens using Ottawa sand with a Fineness Modulus (FM) from 2.30 to 2.50 for comparison with the proposed fine Aggregate.

Table 3126.2-2
Structural Strength in Fine Aggregate

Mortar Specimens Containing:	Compressive Strength
Type I/II Portland cement	≥ 90 percent of control at 7 Calendar Days
Type III Portland cement	≥ 90 percent of control at 3 Calendar Days

C Gradation Requirements

Produce fine Aggregate in accordance with the gradation requirements in Table 3126.2-3.

Table 3126.2-3
Fine Aggregate Gradation Requirements

Sieve Size	Percent Passing*
3/8 inch	100
No. 4	95 – 100
No. 8	80 – 100
No. 16	55 – 85
No. 30	30 – 60
No. 50	5 – 30
No. 100	0 – 10
No. 200	0 – 2.5
* Percent passing by weight through square opening Sieves.	

D Requirements for Uniformity of Grading

The uniformity of grading is determined by the Fineness Modulus (FM) of the fine Aggregate.

Both the Engineer and Contractor will determine the FM of fine Aggregate in accordance with the *Concrete Manual*. The established FM is available on the Department Concrete Engineering website.

Do not allow the Material to deviate from the FM by greater than 0.20. Contact the Engineer, in conjunction with the Concrete Engineer, for an adjustment if the FM approaches the tolerance limit.

3126.3 SAMPLING AND TESTING

Provide fine Aggregates in accordance with Table 3126.3-1.

Table 3126.3-1
Preliminary Fine Aggregate Testing

Aggregate	Notification and Testing Required
New source	Notify the Engineer at least 30 Calendar Days before use. Perform new source concrete Aggregate testing.
Previously tested Aggregate	Notify the Engineer at least 14 Calendar Days before use. Perform additional testing as required by the Engineer in conjunction with the Concrete Engineer.

Sample and test fine Aggregate in accordance with Table 3126.3-2.

Table 3126.3-2
Fine Aggregate Test Methods

Test	Testing Method
Sampling	*Concrete Manual*
Sieve analysis	*Concrete Manual*
Deleterious substances	*Laboratory Manual* Method 1207
Quantity of Material passing the No. 200 Sieve	*Concrete Manual*
Organic impurities (color plate)	*AASHTO T 21*
Structural strength	*AASHTO T 71*
Specific gravity and absorption	*Laboratory Manual* Method 1205
Alkali silica reactivity	*Laboratory Manual* Method 1222

3127 FINE AGGREGATE FOR BITUMINOUS SEAL COAT

3127.1 SCOPE

Provide fine Aggregate for use in bituminous seal coat.

3127.2 REQUIREMENTS

A Composition

Provide Aggregate for use in bituminous seal coat meeting the following requirements:

(1) Consisting of sound, durable particles of sand, Gravel, or crushed stone
(2) Clean
(3) Uniform in quality
(4) Free of deleterious Materials
(5) Meeting the requirements of Class A, B, or C in accordance with 3139.2A.2, "Classification"
(6) Only one source of Aggregate may be used

B Gradation and Quality

Provide fine Aggregate for bituminous seal coat meeting the following gradation requirements:

Table 3127.2-1
Fine Aggregate for Bituminous Seal Coat, Percent Passing by Weight and QA Tolerances

Sieve Size	FA-1	FA-2	FA-2 1/2	FA-3	FA-3 1/2	Job Mix Formula QA Tolerance percent
1/2 inch	—	—	—	—	100	—
3/8 inch	—	—	100	100	90 – 100	± 5
1/4 inch	100	100	0 – 80	0 – 70	0 – 70	± 7
No. 4	0 – 100	0 – 100	0 – 50	0 – 25	0 – 25	± 7
No. 8	—	0 – 40	0 – 12	0 – 5	0 – 5	± 4
No. 16	0 – 30	0 – 10	0 – 5	—	—	± 4
No. 50	0 – 15	0 – 5	—	—	—	± 4
No. 100	0 – 5	—	—	—	—	± 4
No. 200	0.0 – 1.0	0.0 – 1.0	0.0 – 1.0	0.0 – 1.0	0.0 – 1.0	—

Provide fine Aggregate for bituminous seal coat meeting the following quality test requirements:

Table 3127.2-2
Fine Aggregate Durability for Bituminous Seal Coat
Meeting the Requirements of *AASHTO T96* Modified by MnDOT

Material Tests	FA-1	FA-2	FA-2 1/2	FA-3	FA-3 1/2
Shale, percent	≤ 5	≤ 5	≤ 5	≤ 3	≤ 2
Flakiness index, percent *	—	≤ 25	≤ 25	≤ 25	≤ 25
One Face Crush, percent ‖	≥ 80	≥ 80	≥ 80	≥ 80	≥ 80
Insoluble residue for the portion of quarried Carbonate Aggregates passing the No. 200 Sieve, percent	≤ 10	≤ 10	≤ 10	≤ 10	≤ 10
Los Angeles Rattler, percent loss	—	—	—	≤ 35	≤ 35
Bulk Specific Gravity	Required for Mix Design Submittal and verification. Verification tolerances between the Contractor and Department are 0.040 percent for Bulk Specific Gravity, 8 pounds per cubic foot for Loose Weight of Aggregate and 0.5 percent for Absorption.				
Loose Weight of Aggregate					
Absorption					
* Test Aggregate retained on each Sieve, if weight of retained Aggregate comprises at least 4 percent of the total sample weight. ‖ For Class C Aggregates only.					

3127.3 SAMPLING AND TESTING

Report the No. 200 Sieve results to the nearest 0.1 percent and all other Sieve results to the nearest 1 percent.

A Sampling & Sieve Analysis .....*Laboratory Manual*

A.1 Coarse Sieve Analysis.....Method 1202

A.2 Fine Sieve Analysis.....Method 1203

B Flakiness Index .....*Laboratory Manual* Method 1223

C Lithological Count .....*Laboratory Manual* Method 1209

D Los Angeles Rattler .....*Laboratory Manual* Method 1210

E Percent Crushed Particles.....*Laboratory Manual* Method 1214

F Loose Weight of Aggregate..... *MN Seal Coat Handbook* MN/RC-2006-34

G Specific Gravity and Absorption (-4) .....*Laboratory Manual* Method 1205

H Insoluble Residue .....*Laboratory Manual* Method 1221

I Specific Gravity and Absorption (+4) .....*Laboratory Manual* Method 1204

3128 AGGREGATE FOR USE IN MASONRY MORTAR

3128.1 SCOPE

Provide fine Aggregate for use in masonry mortar.

3128.2 REQUIREMENTS

Provide Aggregate for use in masonry mortar meeting the requirements of *ASTM C144*, *Standard Specification for Aggregate for Masonry Mortar*. The gradation requirements of *ASTM C144* are shown in Table 3128.2-1.

Table 3128.2-1
Mortar Aggregate Gradation Limits

Sieve Size	Percent Passing
No. 4	100
No. 8	95 – 100
No. 16	70 – 100
No. 30	40 – 75
No. 50	10 – 35
No. 100	2 – 15
No. 200	0 – 5

The Engineer may allow Aggregate meeting the gradation requirements of 3126.2C, "Gradation Requirements," for joints thicker than 1/2 inch.

3128.3 SAMPLING AND TESTING — BLANK

3131 INTERMEDIATE AGGREGATE FOR PORTLAND CEMENT CONCRETE

3131.1 SCOPE

Provide intermediate Aggregate for use in Portland cement concrete.

3131.2 REQUIREMENTS

A General

Provide intermediate Aggregate consisting of clean, sound, durable particles, uniform in quality, and free from wood, bark, roots, and other deleterious Material.

The Engineer, in conjunction with the Concrete Engineer, may consider the following as the basis for acceptance of intermediate Aggregate for Portland cement concrete:

(1) Results of laboratory tests
(2) Behavior under natural exposure conditions
(3) Behavior of Portland cement concrete with Aggregate from the same or similar geological formations or deposits
(4) Any other tests or criteria as deemed appropriate by the Engineer, in conjunction with the Concrete Engineer

B Classification

The Concrete Engineer classifies intermediate Aggregate as 100 percent of the Material passing the 1/2 inch sieve meeting the requirements of 3137.2B, "Classification."

Table 3131.2-1 designates the intermediate Aggregate as one of the following:

(1) Coarse Intermediate Aggregate (CIA)
(2) Fine Intermediate Aggregate (FIA)
(3) Coarse Sand (CS)
(4) Fine Sand (FS)

Table 3131.2-1
Intermediate Aggregate Gradations for Concrete

Sieve Sizes	Intermediate Aggregate Designation Percent by weight passing square opening Sieves			
	Coarse Intermediate Aggregate (CIA)	Fine Intermediate Aggregate (FIA)	Coarse Sand (CS)	Fine Sand (FS)
1/2 inch	100	100	100	100
3/8 inch	-	-	100	100
No. 4	0 – 90	91 – 100	0 – 90	91 – 100
No. 8	0 – 50	0 – 50	51 – 90	51 – 100

C Washing

Wash the intermediate Aggregate.

D Quality

Provide CIA in accordance with 3137.2D, "Quality."

Provide FIA, CS and FS in accordance with 3126.2B, "Quality."

E Gradation

Proportion intermediate Aggregates with other Aggregate fractions to comply with a Specification requirement. Intermediate Aggregates do not have individual Sieve gradation requirements.

3131.3 SAMPLING AND TESTING

A Preliminary Intermediate Aggregate Testing

Sample and test intermediate Aggregate fractions separately in accordance with Table 3137.3-1.

B Intermediate Aggregate Test Methods

When proportioning CIA with a coarse Aggregate to meet the specified limits of #67 gradation, sample and test CIA in accordance with Table 3137.3-2. Using a minimum sample size equivalent to CA-70 per the *Schedule of Materials Control*. Sample and test all other CIA intermediate Aggregates in accordance with Table 3126.3-2.

Sample and test FIA, FS, and CS in accordance with Table 3126.3-2.

3136 DRAINABLE BASES

3136.1 SCOPE

This Specification lists the quality requirements for drainable bases types: Open Graded Aggregate Base (OGAB) and Drainable Stable Base (DSB) used for 2212, “Drainable Aggregate Base.”

3136.2 REQUIREMENTS

A Aggregate Composition

Use virgin Aggregates comprised of sound naturally occurring minerals that have uniform: appearance, texture, moisture content, and performance characteristics.

B Quality and Gradation Requirements

Meet the requirements of Table 3136.2-1.

Table 3136.2-1
Drainable Base Requirements

Total Percent Passing Requirement	Type	
	OGAB	**DSB**
1 1/2 inch Sieve	100	100
1 inch Sieve	95 - 100	-
3/4 inch Sieve	65 - 95	75 – 100
3/8 inch Sieve	30 - 65	45 – 75
No. 4 Sieve	10 - 35	30 – 60
No. 10 Sieve	3 - 20	10 – 35
No. 40 Sieve	0 - 8	5 – 20
No. 200 Sieve	0 - 3.5	0 - 5.0, for class B or C 0 - 6.5, for class A Class per Specification 3137, "Coarse Aggregate for Portland Cement Concrete"
Quality Requirements		
	OGAB	**DSB**
D60/D10*	≥ 4.0	≥ 8.0
(+4) Minimum Crushing (2 face) ‖	85 percent	60 percent
Maximum Los Angeles Rattler Loss (LAR)	40 percent	40 percent
Maximum Acid Insoluble Residue (IR) Minus No. 200 Sieve †	10 percent	10 percent
Maximum Spall – Total Sample	5.0 percent	5.0 percent
* D60 is the diameter of the Aggregate particle of which 60 percent is smaller, by weight. D10 is the diameter of the Aggregate particle of which 10 percent is smaller, by weight. ‖ Material crushed from quarries is considered crushed Material. † For drainable base composed of crushed Carbonate quarry rock.		

3136.3 SAMPLING AND TESTING

Test in accordance with the following procedures:

A Sampling..... ***Grading and Base Manual***

B Sieve Analysis..... ***Laboratory Manual*** **Methods 1202 & 1203**

C Crushing..... ***Laboratory Manual*** **Method 1214**

D Los Angeles Rattler Loss..... ***Laboratory Manual*** **Method 1210**

E Insoluble Residue..... ***Laboratory Manual*** **Method 1221**

F Spall..... ***Laboratory Manual*** **Method 1209**

3137 COARSE AGGREGATE FOR PORTLAND CEMENT CONCRETE

3137.1 SCOPE

Provide coarse Aggregate for use in Portland cement concrete.

3137.2 REQUIREMENTS

A General

Provide coarse Aggregate consisting of clean, sound, durable particles, uniform in quality, and free from wood, bark, roots, and other deleterious Material.

The Engineer, in conjunction with the Concrete Engineer, may consider the following as the basis for acceptance of coarse Aggregate for Portland cement concrete:

(1) Results of laboratory tests
(2) Behavior under natural exposure conditions
(3) Behavior of Portland cement concrete with Aggregate from the same or similar geological formations or deposits
(4) Any other tests or criteria as deemed appropriate by the Engineer, in conjunction with the Concrete Engineer

B Classification

Provide coarse Aggregate meeting the requirements of one of the following classifications:

(1) Class A: Crushed quarry rock including quartzite, gneiss, and granite, or mine trap rock including basalt, diabase, gabbro, and other igneous rock types. Class A Aggregate may contain no greater than 4.0 percent non-Class A Aggregate. The Department will not allow the intentional blending or adding of non-Class A Aggregate.
(2) Class B: Other crushed quarry or mine rock types including Carbonates, rhyolite, and schist.
(3) Class C: Natural or partly crushed Gravel obtained from a natural Gravel deposit.
(4) Class D: Mixture of at least 2 other classes of coarse Aggregate. The Engineer, in conjunction with the Concrete Engineer, will determine the suitability of the Class D Aggregate for the proposed use including proportioning.
(5) Class R: Aggregate obtained from recycling concrete. The Engineer, in conjunction with the Concrete Engineer, will determine the suitability of the Class R Aggregate for the proposed use, including proportioning.

C Washing

Wash Class B, Class C, Class D, and Class R coarse Aggregate. Wash Class A Aggregate as needed to comply with the requirements of Table 3137.2-1.

D Quality

Provide coarse and CIA intermediate Aggregate in accordance with 3137.2D.1,"Coarse Aggregate for General Use," 3137.2D.2, " Coarse Aggregate for Bridge Superstructure," or 3137.2D.3, "Coarse Aggregate for Concrete Pavement," and the following:

For fractions greater than or equal to 1 inch, base quality requirements on the individual result for the intended use.

For fractions that have 100 percent passing the 1 inch Sieve:

(1) When using a single Aggregate, base quality requirements on the individual result for the intended use.
(2) When proportioning Aggregates from a single source, base quality requirements on the composite result for the intended use.
(3) When proportioning Aggregates from multiple sources, base quality requirements on the composite result for the intended use except as modified by the following:

(a) For 3137.2D.1, “Coarse Aggregate for General Use,” each individual fraction must meet the requirements of 3137.2D.1, “Coarse Aggregate for General Use”

(b) For 3137.2D.2, “Coarse Aggregate for Bridge Superstructure,” each individual fraction must meet the requirements of 3137.2D.1, “Coarse Aggregate for General Use” except the percent absorption by weight of class B Aggregate is modified to a maximum of 1.75 percent and the percent carbonate by weight of the class C Aggregate is modified to a maximum of 30.0 percent.

(c) For 3137.2D.3, “Coarse Aggregate for Concrete Pavement,” each individual fraction must meet the requirements of 3137.2D.3, “Coarse Aggregate for Concrete Pavement,” except the percent carbonate by weight of the class C Aggregate is modified to a maximum of 35.0 percent.

The Concrete Engineer may reject the proposed Aggregate proportions if the composite result is of borderline quality in accordance with 1503, “Conformity with Contract Documents.”

Refer to Table 2461.2-5, Table 2461.2-6, Table 2461.2-7 and Table 2462.2-4 to determine the appropriate coarse Aggregate quality Specification for the intended use.

D.1 Coarse Aggregate for General Use

Provide coarse Aggregate in accordance with Table 3137.2-1 unless otherwise specified in the Contract.

Table 3137.2-1
Coarse Aggregate for General Use

	Quality Test	Maximum Percent by Weight
(a)	Shale:	
	Fraction retained on the 1/2 inch Sieve	0.4
	Fraction retained on the No. 4 Sieve, as a percentage of the total Material	0.7
(b)	Soft iron oxide particles (paint rock and ochre)	0.3
(c)	Total spall Materials *:	
	Fraction retained on the 1/2 inch Sieve	1.0
	Fraction retained on the No. 4 Sieve, as a percentage of the total Material	1.5
(d)	Soft particles ‖	2.5
(e)	Clay balls and lumps	0.3
(f)	Sum of (c) total spall Materials, (d) soft particles, and (e) clay balls and lumps †	3.5
(g)	Slate	3.0
(h)	Flat and elongated pieces ‡	15
(i)	Quantity of Material passing No. 200 Sieve:	
	Class A and Class B Aggregates #	1.5
	Class C and Class D Aggregates §	1.0
(j)	Los Angeles Rattler, loss on total sample	40
(k)	Soundness of magnesium sulfate **	15

* Includes the percentages retained by shale and soft iron oxide particles, plus other iron oxide particles, unsound cherts, pyrite, and other Materials with similar characteristics.
‖ Exclusive of shale, soft iron oxide particles, and total spall Materials.
† For total spall Materials, use the percent in the total sample retained on the No. 4 Sieve.
‡ Thickness less than 25 percent of the maximum width. Length greater than 3 times the maximum width.
# Each individual fraction at the point of placement consists of dust from the fracture and free of clay or shale.
§ For each individual fraction at the point of placement.
** Loss at 5 cycles for any fraction of the coarse Aggregate. Do not blend Materials from multiple sources to obtain a fraction meeting the sulfate soundness requirement.

D.2 Coarse Aggregate for Bridge Superstructure

Provide coarse Aggregate in accordance with 3137.2D.1, "Coarse Aggregate for General Use," except as modified by Table 3137.2-2.

Table 3137.2-2
Coarse Aggregate for Bridge Superstructure

Quality Test		Maximum Percent by Weight
(a)	Shale:	
	Fraction retained on the 1/2 inch Sieve	0.2
	Fraction retained on the No. 4 Sieve as a percentage of the total Material	0.3
(b)	Soft iron oxide particles (paint rock and ochre)	0.2
(c)	Total spall Materials*:	
	Fraction retained on the No. 4 Sieve as a percentage of the total Material	0.5
(d)	Soft particles ‖	2.5
(e)	Clay balls and lumps	0.3
(f)	Sum of (c) total spall Materials, (d) soft particles, and (e) clay balls and lumps, use the percent in the total sample retained on the No. 4 Sieve †	3.0
(g)	Absorption for Class B Aggregate	1.75
(h)	Absorption for Class B Aggregate for concrete Bridge decks and Bridge barrier	1.10
(i)	Carbonate in Class C and Class D Aggregates by weight	30.0

* Includes the percentages retained by shale and soft iron oxide particles, plus other iron oxide particles, unsound cherts, pyrite, and other Materials with similar characteristics.
‖ Exclusive of shale, soft iron oxide particles, and total spall Materials.
† For total spall Materials, use the percent in the total sample retained on the No. 4 Sieve.

D.3 Coarse Aggregate for Concrete Pavement

Provide coarse aggregate in accordance with 3137.2D.1, "Coarse Aggregate for General Use," except as modified by Table 3137.2-3, for use in the following:

(1) Concrete pavement
(2) Concrete pavement rehabilitation

Table 3137.2-3
Coarse Aggregate for Concrete Pavement

Quality Test		Maximum Percent by Weight
(a)	Absorption for Class B Aggregate	1.75
(b)	Carbonate in Class C Aggregate by weight	30.0

E Gradation

Provide coarse Aggregate in accordance with Table 3137.2-4 including sizes within the specified limits. For the purpose of the Work specified in 3137, "Coarse Aggregate for Portland Cement Concrete," the Department defines coarse Aggregate as the uniform product of the producing plant, unless some sizes are removed to meet the gradation requirements. Do not use broken or non-continuous gradations.

If the coarse Aggregate contains less than 100 percent passing the 1 inch Sieve, use at least 2 fractions to proportion the coarse Aggregate. Base gradation requirements on the composite value of the combined coarse Aggregates.

If producing Class R Aggregate, remove reinforcing steel from the concrete and any concrete Material passing the No. 4 Sieve.

Table 3137.2-4
Coarse Aggregate Gradation Requirements for Concrete

	Coarse Aggregate Designation percent by weight passing square opening sieves				
	2	**3**	**4**	**7**	**8**
Sieve Sizes	**#67*‖**	**#7*‖**	**#89***	**CA-70**	**CA-80**
2 inch	-	-	-	-	-
1 1/2 inch	-	-	-	-	-
1 inch	100	-	-	-	-
3/4 inch	90 – 100	100	-	-	-
5/8 inch	-	-	-	100	-
1/2 inch	-	90 – 100	100	85 – 100	-
3/8 inch	20 – 55	40 – 70	90 – 100	50 – 100	100
No.4	0 – 10	0 – 15	20 - 55	0 – 25	55 – 95
No.8	-	-	5 – 30	-	-
No.16	-	-	0 – 10	-	-
No.50	-	-	0 - 5	-	0-5

* Gradation sizes designated per *ASTM C33/C33M*, *Standard Specification for Concrete Aggregates*, Table 3.
‖ #67 and #7 Gradations are MnDOT Modified.

3137.3 SAMPLING AND TESTING

A Preliminary Coarse Aggregate Testing

Sample and test coarse Aggregate fractions separately in accordance with Table 3137.3-1.

Table 3137.3-1
Preliminary Coarse Aggregate Testing

Aggregate	Notification and Testing Requirement
New source	Notify the Engineer at least 30 Calendar Days before use. Perform new source concrete Aggregate testing.
Previously tested Aggregate	Notify the Engineer at least 14 Calendar Days before use. Perform additional testing as directed by the Engineer, in conjunction with the Concrete Engineer.

B Coarse Aggregate Test Methods

Sample and test coarse Aggregate in accordance with Table 3137.3-2.

Table 3137.3-2
Coarse Aggregate Test Methods

Test	Testing Method
Sampling	*Concrete Manual*
Sieve analysis	*Concrete Manual*
Shale test	*Laboratory Manual* Method 1207
Quantity of Material passing the No. 200 Sieve	*Concrete Manual*
Specific gravity and absorption	*Laboratory Manual* Method 1204
Density	*AASHTO T 19,* "Standard Method of Test for Bulk Density ("Unit Weight") and Voids in Aggregate," or *Laboratory Manual* Method 1211
Los Angeles Rattler loss	*AASHTO T 96,* "Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angel Machine"
Void content	*AASHTO T 19** or *Laboratory Manual* Method 1211
Deleterious Materials	*Laboratory Manual* Method 1209
Soundness; magnesium sulfate	*Laboratory Manual* Method 1219
Soft particles	*Laboratory Manual* Method 1218
Flat or elongated pieces	*ASTM D4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate*
Clay balls or lumps	*Concrete Manual*
* Base the void content on an oven-dry and compacted-by-rodding condition of the Aggregate and a value of 62.4 pounds per cubic foot for water.	

3138 AGGREGATE FOR SURFACE AND BASE COURSES

3138.1 SCOPE

This Specification lists the quality requirements for Aggregates used for 2118, "Aggregate Surfacing," 2211, "Aggregate Base," and 2221, "Shoulder Base Aggregate."

3138.2 REQUIREMENTS

A General

Provide Aggregates that have uniform: appearance, texture, moisture content, and performance characteristics.

B Virgin Materials

Provide virgin Aggregates meeting the following requirements:

(1) Comprised of naturally occurring sound mineral Materials
(2) Class 2 must be composed of 100 percent crushed quarry rock
(3) Conforms to the quality requirements of Table 3138.2-1

Table 3138.2-1
Quality Requirements for Virgin Materials

Requirement	Class			
	1 and 2	3 and 4	5	6
Maximum Shale	NA	7.0 percent	7.0 percent	7.0 percent
Minimum Crushing Requirements *	NA	NA	25 percent	30 percent
Maximum Los Angeles Rattler (LAR) loss from Carbonate quarry rock	40 percent	40 percent	40 percent	35 percent
Maximum Insoluble residue for the portion of quarried Carbonate Aggregates passing the No. 200 Sieve	10 percent	10 percent	10 percent	10 percent
Maximum amount of Brick	1.0 percent ‖			
Maximum amount of other objectionable Materials including but not limited to: wood, plant matter, plastic, plaster, and fabric	0.1 percent ‖			

* Material crushed from quarries is considered crushed Material.
‖ The Contractor/supplier may not knowingly allow brick and other objectionable Material and must employ a QC process to screen it out, before it becomes incorporated into the final product.

C Recycled Materials

The Contactor may substitute recycled Aggregates for virgin Aggregates, if they meet the following requirements:

(1) Recycled Aggregates contain only recycled asphalt pavement (RAP), recycled concrete Materials, recycled Aggregate Materials, or certified recycled glass (not allowed in 3138.2D, "Surfacing Aggregates.")

(2) Must meet the requirements of Table 3138.2-2

Table 3138.2-2
Quality Requirements for Recycled Materials

Requirement	Class 1	Classes 3, 4, 5, and 6
Maximum Bitumen Content of Composite	4.0 percent	4.0 percent
Maximum Masonry block percent	10 percent	10 percent
Maximum percentage of glass *	Not Allowed	10 percent
Maximum size of glass *	Not Allowed	3/4 inch
Maximum amount of Brick	1.0 percent ‖	1.0 percent ‖
Maximum amount of other objectionable debris including but not limited to: wood, plant matter, plastic, plaster, and fabric	0.2 percent ‖†	0.2 percent ‖†

* Glass must meet certification requirements on the Grading and Base website. Combine glass with other Aggregates during the crushing operation.
‖ The Contractor/supplier may not knowingly allow brick and other objectionable Material and must employ a QC process to screen it out, before it becomes incorporated into the final product.
† It is recognized that recycled Aggregates may occasionally contain debris, and the 0.2 percent requirement is meant to be an average requirement for each Material delivery.

D Surfacing Aggregates

Provide surfacing Aggregates in accordance with 3138.2A, "General," 3138.2B, "Virgin Materials," and 3138.2C, "Recycled Materials," and meeting the following requirements:

(1) 100 percent of the Material passes the 3/4 inch Sieve, regardless of the class specified; this modifies the requirements of Table 3138.2-3, Table 3138.2-4, and Table 3138.2-5 for surfacing Aggregates

(2) Does not contain glass

(3) Recycled concrete Materials may only be used for the Roadway Shoulders

(4) There is no restriction on the bitumen content, if used for shouldering

(5) Provide Aggregate with a minimum clay content of 3 percent and a Plasticity Index (PI) of 5 – 12. The requirements for PI and minimum clay content are fulfilled if one of the following are met:

(a) the Material composed of at least 25 percent recycled Materials

(b) the Material composed of at least 50 percent crushed quarry Aggregate

Note: Class 2 must be composed of 100 percent crushed quarry rock per 3138.2B, "Virgin Materials," Note (2).

E Gradation Requirements

(1) For products containing less than 25 percent recycled Materials, conform to Table 3138.2-3.

(2) For products containing 25 percent or more recycled Materials and less than 75 percent recycled concrete, conform to Table 3138.2-4.

(3) For products containing 75 percent or more recycled concrete, conform to Table 3138.2-5.

(4) Bituminous millings meeting a gradation of 100 percent passing the 1 1/2 inch Sieve and 95-100 percent passing the 1 inch Sieve may be used for the 1-2 feet fillet/rollover outside of a paved Shoulder for class 1 and class 2.

(5) Perform gradation tests prior to bituminous extraction.

(6) The Contractor may substitute reclamation Material (recycled bituminous and Aggregate) for classes 3, 4, 5 or 6, if used for base, subbase, or stabilizing Aggregate. Meet the gradation in Table 3138.2-6, and other requirements of 3138, "Aggregate for Surface and Base Courses," except that there is no maximum bitumen content.

Table 3138.2-3
Base and Surfacing Aggregate
(Containing less than 25 percent recycled Aggregates)
Total Percent Passing *

Sieve Size	Class 1 (Surfacing ‖)	Class 2 (Surfacing †)	Class 3 (Subbase)	Class 4 (Subbase)	Class 5 (Base)	Class 6 (Base)
2 inch	—	—	100	100	—	—
1 1/2 inch	—	—	—	—	100	100
1 inch	—	—	—	—	—	—
3/4 inch	100	100	—	—	70 - 100	70 - 100
3/8 inch	65 - 95	65 - 90	—	—	45 - 90	45 - 85
No. 4	40 - 85	35 - 70	35 - 100	35 - 100	35 - 80	35 - 70
No. 10	25 - 70	25 - 45	20 - 100	20 - 100	20 - 65	20 - 55
No. 40	10 - 45	12 - 35	5 - 50	5 - 35	10 - 35	10 - 30
No. 200	8.0 - 15.0	5.0 - 16.0	5.0 - 10.0	4.0 - 10.0	3.0 - 10.0	3.0 - 7.0

* If product contains recycled Aggregate, add letters in parentheses for each Aggregate blend designating the type of recycled products included in the mixture: (B) = Bituminous, (C) = Concrete, (G) = Glass, (BC) = Bituminous and Concrete, (BG) = Bituminous and Glass, (CG) = Concrete and Glass, (BCG) = Bituminous, Concrete, and Glass.
‖ Recycled concrete when used for surfacing is only allowed for Shoulders.
† Class 2 must be composed of 100 percent crushed quarry rock per 3138.2B, "Virgin Materials," Note (2).

Table 3138.2-4
Base and Surfacing Aggregate
(Containing 25 percent or more recycled Aggregates & 75 percent or less recycled concrete)
Total Percent Passing *

Sieve Size	Class 1 (Surfacing ‖)	Class 3 (Subbase)	Class 4 (Subbase)	Class 5 (Base)	Class 6 (Base)
2 inch	—	100	100	—	—
1 1/2 inch	—	—	—	100	100
1 inch	—	—	—		
3/4 inch	100	—	—	70 - 100	70 - 100
3/8 inch	65 - 95	—	—	45 - 90	45 - 85
No. 4	40 - 85	35 - 100	35 - 100	35 - 80	35 - 70
No. 10	25 - 70	20 - 100	20 - 100	20 - 65	20 - 55
No. 40	10 - 45 † 5 - 45	5 - 50	5 - 35	10 - 35	10 - 30
No. 200	5.0 - 15.0 † 0 - 15.0	0 - 10.0	0 - 10.0	0 - 10.0	0 - 7.0

* Add letters in parentheses for each Aggregate blend designating the type of recycled products included in the mixture: (B) = Bituminous, (C) = Concrete, (G) = Glass, (BC) = Bituminous and Concrete, (BG) = Bituminous and Glass, (CG) = Concrete and Glass, (BCG) = Bituminous, Concrete, and Glass.
‖ Recycled concrete is only allowed for Shoulders.
† Note: For Class 1, if the bitumen content is ≥ 1.5 percent, the gradation requirement is modified to 5 – 45 percent for the No. 40 Sieve and 0 – 15.0 percent for the No. 200 Sieve.

Table 3138.2-5
Base and Surfacing Aggregate
(Containing more than 75 percent recycled concrete)
Total Percent Passing *

Sieve Size	Class 1 (Surfacing ‖)	Class 3 (Subbase)	Class 4 (Subbase)	Class 5 (Base)	Class 6 (Base)
2 inch	—	100	100	100	100
1 1/2 inch	—	—	—	—	—
1 inch	—	—	—	—	—
3/4 inch	100	—	—	45 - 100	45 - 100
3/8 inch	65 - 95	—	—	25 - 90	25 - 85
No. 4	40 - 85	35 - 100	35 - 100	15 - 65	15 - 65
No. 10	25 - 70	20 - 100	20 - 100	10 - 45	10 - 45
No. 40	10 - 45	0 - 20	0 - 20	0 - 20	0 - 20
No. 200	5.0 - 15.0	0 - 6.0	0 - 6.0	0 - 6.0	0 - 6.0

* Add letters in parentheses for each Aggregate blend designating the type of recycled products included in the mixture: (B) = Bituminous, (C) = Concrete, (G) = Glass, (BC) = Bituminous and Concrete, (BG) = Bituminous and Glass, (CG) = Concrete and Glass, (BCG) = Bituminous, Concrete, and Glass.
‖ Recycled concrete is only allowed for Shoulders.

Table 3138.2-6
Reclamation Material Permitted as a Substitute for Class 3, 4, 5, or 6
Total Percent Passing

Sieve Size	Class 3	Class 4	Class 5	Class 6
3 inch*	100	100	100	100
3/4 inch	-	-	70 – 100	70 - 100
3/8 inch	-	-	45 – 90	45 - 85
No. 4	35 -100	35 -100	35 -80	35 - 70
No. 10	20 - 100	20 - 100	20 - 65	20 - 55
No. 40	5 - 50	5 - 35	10 - 35	10 - 30
No. 200	0 – 10.0	0 – 10.0	0 – 10.0	0 – 10.0

* Note for bedding within 2 feet of plastic pipe, the requirement is 100 percent passing the 1 inch Sieve.

3138.3 SAMPLING AND TESTING

Report the No. 200 Sieve results to the nearest 0.1 percent and other Sieve results to the nearest 1 percent.

A Sampling.....***Grading and Base Manual***

B Sieve Analysis.....***Laboratory Manual* Methods *1202 and 1203***

C Los Angeles Rattler Loss.....***Laboratory Manual* Method 1210**

D Shale Tests.....***Laboratory Manual* Methods 1207 and 1209**

E Bitumen Content.....***Laboratory Manual* Method 1852**

F Insoluble Residue.....***Laboratory Manual* Method 1221**

G Reclaimed Glass.....**AGI Visual Method (AGI Data sheet 15.1 and 15.2)**

3139 GRADED AGGREGATE FOR BITUMINOUS MIXTURES

3139.1 SCOPE

Provide graded Aggregate for use in bituminous mixtures.

3139.2 REQUIREMENTS

A Plant Mixed Asphalt

A.1 Composition

Provide graded Aggregate composed of any combination of the following sound durable particles as described in 3139.2A.2, "Classification."

Do not use graded Aggregate containing objectionable Materials including: metal, glass, wood, plastic, brick, or rubber.

Provide coarse Aggregate free of coatings of clay and Silt.

Do not add soil Materials such as clay, loam, or Silt to compensate for a lack of fines in the Aggregate.

Do not blend overburden soil into the Aggregate.

Feed each Material or size of Material from an individual storage unit at a uniform rate.

Do not place blended Materials from different sources, or for different classes, types, or sizes together in one stockpile unless approved by the Engineer as a Class E Aggregate.

A.2 Classification

A.2.a Class A

Provide crushed igneous bedrock consisting of basalt, gabbro, granite, gneiss, rhyolite, diorite, and andesite. Rock from the Sioux Quartzite Formation may contain no greater than 4.0 percent non-Class A Aggregate. Do not blend or add non-Class A Aggregate to Class A Aggregate.

A.2.b Class B

Provide crushed rock from other bedrock sources such as Carbonate and metamorphic rocks (Schist).

A.2.c Class C

Provide natural or partly crushed natural Gravel obtained from a natural Gravel deposit.

A.2.d Class D

Provide 100 percent crushed natural Gravel produced from Material retained on a square mesh Sieve with an opening at least twice as large as Table 3139.2-2 allows for the maximum size of the Aggregate in the composite asphalt mixture. Ensure the

amount of carryover, Material finer than the selected Sieve, no greater than 10 percent of the Class D Aggregate by weight.

A.2.e Class E

Provide a mixture consisting of at least 2 of the following classes of approved Aggregate: Class A, Class B, and Class D.

A.2.f Steel Slag

Steel slag cannot exceed 25 percent of the total mixture Aggregate and be free from metallic and other mill waste.

The Engineer will accept stockpiles if the total expansion is no greater than 0.5 percent as determined by *ASTM D4792*, *Standard Test Method for Potential Expansion of Aggregates from Hydration Reactions*.

A.2.g Taconite Tailings

Obtain taconite tailings from ore mined westerly of a north-south line located east of Biwabik, Minnesota (R15W-R16W) or from ore mined in southwestern Wisconsin.

A.2.h Recycled Asphalt Shingles (RAS)

Provide recycled asphalt shingles manufactured from waste scrap asphalt shingles (MWSS) or from tear-off scrap asphalt shingles (TOSS). Consider the percentage of RAS used as part of the maximum allowable Recycled Asphalt Pavement (RAP) percentage. See Table 3139.2-3.

A.2.h(1) RAS Gradation *Laboratory Manual* Procedure 1801

Provide RAS in accordance with the following gradation requirements:

Table 3139.2-1
RAS Gradation

Sieve size	Percent passing
1/2 inch	100
No. 4	90

A.2.h(2) Binder Content

Determine the binder content using chemical extraction meeting the requirements of *Laboratory Manual* Method 1851 or 1852.

A.2.h(3) Bulk Specific Gravity

The Contractor may use an Aggregate bulk specific gravity (Gsb) of 2.650 in lieu of determining the shingle Aggregate Gsb in accordance with *Laboratory Manual* Method 1205.

A.2.h(4) Waste Materials

Do not allow extraneous Materials including metals, glass, rubber, nails, soil, brick, tars, paper, wood, and plastics greater than 0.5 percent by weight of the graded Aggregate as determined by Material retained on the No. 4 Sieve as specified in *Laboratory Manual* Method 1801.

A.2.h(5) Stockpile

Do not blend an RAS stockpile with other salvage Material. Do not blend MWSS and TOSS. The Contractor may blend virgin sand Material with

RAS to minimize agglomeration if the Contractor accounts for the blended sand in the final mixture gradation.

A.2.h(6) Certification

Ensure the processor provides RAS certification on the following Department form *Scrap Asphalt Shingles from Manufacture Waste* or *Tear-Off Scrap Asphalt Shingles* on the Bituminous Engineering website.

A.2.i Crushed Concrete and Salvaged Aggregate

The Contractor may incorporate no greater than 50 percent of crushed concrete and salvaged Aggregate in non wear mixtures. Do not use crushed concrete in wearing courses.

A.2.j Ash

Sewage sludge ash and waste incinerator ash are allowed as an Aggregate source at a maximum of 5 percent of the total weight of the mixture. Sewage sludge ash for use as an Aggregate source in wear or non wear courses must be approved by examination with the *Hazard Evaluation Process* by Department's Office of Environmental Stewardship.

A.2.k Recycled Asphalt Pavement (RAP)

A.2.k(1) Aggregate Angularity

Provide combined RAP and virgin Aggregates that meet the composite coarse and fine Aggregate angularity for the mixture being produced.

A.2.k(2) Objectionable Material

Do not use RAP containing objectionable Materials including metal, glass, wood, plastic, brick, or rubber. Remove rubber or wire particles, if visibly present, from the stockpile. Effectiveness of rubber or wire particles removal will be made based upon their presence in the paved surface. Individual particles greater than 6 inches in any dimension or the presence of three or more smaller particles within a one square yard area is unacceptable and subject to 1512, "Unacceptable and Unauthorized Work."

A.2.k(3) Asphalt Binder Content

Determine the asphalt binder content using the *Laboratory Manual* Method 1851 and 1852.

A.2.k(4) Bulk Specific Gravity

Determine the bulk specific gravity in accordance with *Laboratory Manual* Method 1205 or 1815.

A.3 Quality

A.3.a Los Angeles Rattler Test .....*Laboratory Manual* Method 1210

Ensure a coarse Aggregate loss no greater than 40 percent.

A.3.b Soundness (Magnesium Sulfate) .....*Laboratory Manual* Method 1219

Maximum loss after 5 cycles on the coarse Aggregate fraction (Material retained on No. 4 Sieve for any individual source within the mix) as follows:

(1) Percent passing the 3/4 inch Sieve to percent retained on the 1/2 inch Sieve, ≤ 14 percent

(2) Percent passing the 1/2 inch Sieve to percent retained on the 3/8 inch Sieve, ≤18 percent

(3) Percent passing the 3/8 inch Sieve to percent retained on the No. 4 Sieve, ≤ 23percent

(4) For the composite if all 3 size fractions are tested, the composite loss ≤ 18 percent, and acceptance will be granted if:

(a) The Contractor meets the composite requirement, but fails to meet at least 1 of the individual components, the Engineer may accept the source if each individual component is no greater than 110 percent of the requirement for that component.

(b) The Contractor meets each individual component requirement, but fails to meet the composite, the Engineer may accept the source if the composite is no greater than 110 percent of the requirement for the composite.

Coarse Aggregate that exceeds the requirements in this section for Material passing the No. 4 Sieve cannot be used.

A.3.c Spall Materials and Lumps .....*Laboratory Manual* Method 1219

Spall is defined as shale, iron oxide, unsound cherts, pyrite, highly weathered and/or soft phyllite and argillite (may be scratched with a brass pencil), and other Materials having similar characteristics.

Lumps are defined as loosely bonded Aggregations and clayey masses.

If the percent of lumps measured in the stockpile or cold feed exceed the Specification limits, stop asphalt production and determine compliance by dry batching. This procedure may be repeated at any time at the discretion of the Engineer.

Maximum limits for Spall and lumps, expressed as percentages by mass, are listed in Table 3139.2-3.

A.3.d Insoluble Residue Test.....*Laboratory Manual* Method 1221

A.3.d(1) For Districts 1, 2, 3, 4, M, 7 and 8

If using Class B Carbonate Materials ensure the portion of the insoluble residue passing the No. 200 Sieve is no greater than 10 percent.

A.3.d(2) For District 6

If crushed Carbonate quarry rock (Limestone or dolostone) is used, the minus No. 200 sized portion of the rock insoluble residue shall not exceed 10 percent by weight.

Blending of sources and/or beds with an insoluble residue up to 15 percent is allowed to meet the 10 percent insoluble residue requirement. Individual beds thinner than 6 inches or up to 5 percent of the total face height, are exempt from the 15 percent maximum insoluble residue requirement.

However, the Aggregate producer shall practice good quality control at all times and exclude poor quality stone to the extent practical, regardless of the bed thickness and/or pocket size and location.

No Carbonate quarry rock from the Platteville Geological Formation is allowed.

A.3.e Gradation

Ensure the Aggregate gradation broad bands meet the following requirements in accordance with *AASHTO T-11, "*Standard Method of Test for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing," (passing the No. 200 wash) and *AASHTO T-27*, "Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates."

Table 3139.2-2
Aggregate Gradation Broad Bands (percent passing of total washed gradation)

Sieve size	A	B	C	D
1 inch	—	—	100	—
3/4 inch	—	100*	85 – 100	—
1/2 inch	100*	85 – 100	45 – 90	—
3/8 inch	85 – 100	35 – 90	—	100
No. 4	60 – 90	30 – 80	30 – 75	65 – 95
No. 8	45 – 70	25 – 65	25 – 60	45 – 80
No. 200	2.0 – 7.0	2.0 – 7.0	2.0 – 7.0	3.0 – 8.0
* The Contractor may reduce the gradation broadband for the maximum Aggregate size to 97 percent passing for mixtures containing RAP, if the oversize Material originates from the RAP source. Ensure the virgin Material meets the requirement of 100 percent passing the maximum Aggregate Sieve size.				

Table 3139.2-3
Mixture Aggregate Requirements

Aggregate Blend Property	Traffic Level 2	Traffic Level 3	Traffic Level 4	Traffic Level 5
20 year Design ESALs	<1 million	1 - 3 million	3 - 10 million	10 – 30 million
Minimum. Coarse Aggregate Angularity (*ASTM D5821, Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate*) (one face/two face), percent-Wear (one face/two face), percent-Non Wear	30/- 30/-	55 / - 55 / -	85 / 80 60/ -	95 / 90 80 / 75
Minimum Fine Aggregate Angularity (FAA) (*AASHTO T304*, *Standard Method of Test for Uncompacted Void Content of Fine Aggregate*, Method A) percent-Wear percent-Non Wear	40 40	42 40	44 40	45 40
Flat and Elongated Particles, max. percent by weight, (*ASTM D4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate*)	-	10 (5:1 ratio)	10 (5:1 ratio)	10 (5:1 ratio)
Minimum. Sand Equivalent (*AASHTO T 176*, *Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test*)	-	-	45	45
Max. Total Spall in fraction retained on the No. 4 Sieve – Wear Non Wear	5.0 5.0	2.5 5.0	1.0 2.5	1.0 2.5
Maximum Spall Content in Total Sample – Wear Non Wear	5.0 5.0	5.0 5.0	1.0 2.5	1.0 2.5
Maximum Percent Lumps in fraction retained on the No. 4 Sieve	0.5	0.5	0.5	0.5
Class B Carbonate Restrictions				
Maximum percent -No. 4: Final Lift/All other Lifts	100/100	100/100	80/80	50/80
Maximum percent + No. 4: Final Lift/All other Lifts	100/100	100/100	50/100	0/100
Shingle Restrictions				
Maximum allowable scrap shingles–MWSS* Wear/Non Wear	5/5	5/5	5/5	5/5
Maximum allowable scrap shingles –TOSS* Final Lift/All other Lifts	5/5	5/5	0/5	0/0
* MWSS is manufactured waste scrap shingle and TOSS is tear-off scrap shingle.				

B PASSRC and PASB

B.1 Restrictions

Do not use recycled Materials including glass, concrete, bituminous, shingles, ash, and steel slag.

B.2 Gradation

The gradation limits are also considered the job mix formula (JMF) limits.

B.2.a PASB

Table 3139.2-4
PASB Aggregate Gradation

Sieve Size	Percent Passing
1 1/2 inch	100
1 inch	95 - 100
3/4 inch	85 – 95
3/8 inch	30 – 60
No. 4	10 – 30
No. 8	0 – 10
No. 30	0 – 5
No. 200	0 – 3

B.2.b PASSRC

Table 3139.2-5
PASSRC Aggregate Gradation

Sieve Size	Percent Passing
5/8 inch	100
1/2 inch	85 – 100
3/8 inch	50 – 100
No. 4	0 – 25
No. 8	0 – 5

B.3 Quality

Will meet all requirements of 3139.2A.3.a, “Los Angeles Rattler Test,” through 3139.2A.3.c, “Spall Materials and Lumps.”

3139.2A.3.d, “Insoluble Residue Test,” changes to: If using Class B Carbonate Materials ensure the portion of the insoluble residue passing the No. 200 Sieve is no greater than 10 percent.

B.4 Mixture Quality Requirements

Table 3139.2-6
Mixture Aggregate Requirements for PASSRC & PASB

Aggregate Blend Property	Requirement
Coarse Aggregate Angularity (*ASTM D5821*‖) (one face/two face) percent PASSRC * PASB *	 95/- -/65
Fine Aggregate Angularity (FAA) (*AASHTO T304*, Method A) percent	Not Applicable
Flat and Elongated Particles, max. percent by weight, (*ASTM D4791*†)	Not Applicable
Clay Content (*AASHTO T 176*‡)	Not Applicable
Total Spall in fraction retained on the No. 4 Sieve	3.0
Maximum Spall Content in Total Sample	5.0
Maximum Percent Lumps in fraction retained on the No. 4 Sieve	0.5
* Carbonate Restrictions: If Class B (as defined in 3139.2A.2.b, "Class B"), crushed Carbonate quarry rock (Limestone or dolostone), is used in the mixture, or if Carbonate particles in the Material retained on the No. 4 Sieve exceeds 55 percent, by weight, the minus No. 200 Sieve size portion of the insoluble residue shall not exceed 10 percent. ‖ *ASTM D5821, Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.* † *ASTM D4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.* ‡ *AASHTO T 176*, "Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test."	

C Ultra-thin Bonded Wearing Course

C.1 Restrictions

Do not use recycled Materials including glass, concrete, bituminous, shingles, ash, and steel slag.

C.2 Quality

Will meet requirements of 3139.2A.3, "Quality."

C.3 Coarse Aggregate

Provide a Class A Aggregate, as defined in 3139.2A.2.a, "Class A," in accordance with the following requirements:

Table 3139.2-7
UTBWC Coarse Aggregate Requirements

Tests	***Laboratory Manual* Method**	**Limit, percent**
Flat and elongated ratio at 3:1	1208	≤ 25
Los Angeles Rattler Test (LAR)	1210	≤ 40
Bulk Specific Gravity	1204	-

C.4 Fine Aggregate

Provide fine Aggregate, passing the No. 4 Sieve in accordance with the following requirements:

Table 3139.2-8
UTBWC Fine Aggregate Requirements

Tests	Method	Limit, percent
Sand equivalent	*AASHTO T 176**	≥ 45
Uncompacted void content (FAA)	*Laboratory Manual* 1206	≥ 40
Bulk Specific Gravity	*Laboratory Manual* 1205	-
* *AASHTO T 176*, "Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test"		

C.5 Aggregate Gradation Broadband

Table 3139.2-9
UTBWC Aggregate Gradation Broadband*

Sieve Size	Gradation Broadband Limits percent Passing
3/4 inch	-
1/2 inch	100
3/8 inch	85 – 100
No. 4	28 – 42
No 8	21 – 33
No. 16	14 – 24
No. 30	9 – 20
No. 50	6 – 15
No. 100	5 – 11
No. 200	3.0 – 7.0
* Aggregate size: 3/8 inch, Typical application rates: 65-75 pounds/square yard	

D Micro-surfacing

D.1 Restrictions

Do not use recycled Materials including glass, concrete, bituminous, shingles, ash, and steel slag.

D.2 Gradation

Provide Aggregate in accordance with the gradation requirements of Table 3139.2-10. If no type is designated by the Contract, provide MnDOT Type 2/ISSA Type II.

Table 3139.2-10
Micro-surfacing Gradation Limits and QA Tolerances
Percent Passing (*AASHTO T 11* ‖, *AASHTO T 27* †)

Sieve Size	MnDOT Type 1	MnDOT Type 2 ISSA* Type II	MnDOT Type 3 ISSA* Type III	Job Mix Formula QA Tolerance, percent
3/8 inch	100	100	100	—
No. 4	100	90–100	70–90	±5.0
No. 8	85–100	65–90	45–70	±5.0
No. 16	72–92	45–70	28–50	±5.0
No. 30	50–75	30–50	19–34	±5.0
No. 50	35–55	18–30	12–25	±4.0
No. 100	15–35	10–21	7–18	±3.0
No. 200	5–15	5–15	5–15	±2.0

* International Slurry Surfacing Association
‖ *AASHTO T 11*, "Standard Method of Test for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing"
† *AASHTO T 27*, "Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregate"

D.3 Quality

Provide Aggregate that meets the durability requirements of Table 3139.2-11.

Table 3139.2-11
Micro-surfacing Aggregate Durability Requirements

Tests on Aggregate	Test	Requirement, percent
Sand equivalent	*AASHTO T 176*‖	≥ 60
Abrasion resistance*	*AASHTO T 96*†	≤ 30
Soundness (using MgSO4)#	*AASHTO T 104*‡	≤ 25

* Use Grading C for Type 3 Material. Use Grading D for Type 1 & 2 Material.
‖ *AASHTO T 176*, "Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test."
† *AASHTO T 96,* "Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angles Machine."
‡ *AASHTO T 104,* "Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate."
# Perform the soundness test on the Class B Aggregate of the blend, if applicable.

D.4 Aggregate Class

Unless modified by the Contract, provide Class A Aggregate as defined in 3139.2A.2, "Classification," or taconite tailings.

If modified by the Contract, provide Class D Aggregate which is defined, as 100 percent crushed natural Gravel produced from Material retained on a square mesh Sieve with an opening at least twice as large as the maximum size of Aggregate in Table 3139.2-10, for the type specified in the mix design. Ensure the amount of carryover, Material finer than the selected Sieve, is no greater than 10 percent of the Class D Aggregate by weight.

3139.3 SAMPLING AND TESTING

Perform sampling, Sieve analysis, lumps, crushing, and shale testing meeting the requirements of the *Laboratory Manual*.

3145 MINERAL FILLER

3145.1 SCOPE

Provide mineral filler as a soil or mixture component.

3145.2 REQUIREMENTS

A Composition

Provide a mineral filler of Carbonate dust, Portland cement, hydrated lime, crushed rock screenings*, fly ash, or rotary kiln dust.

* Crushed rock needs to have a stability and durability equivalent to those of the comparable mixture containing one of the other acceptable filler Materials and be free of clay and shale.

B Gradation

The mineral filler will be finer than a No. 4 Sieve and contain less than 25 percent of the Material passing a No. 200 Sieve. The portion passing the No. 200 Sieve will meet the following gradation‖.

Percent finer than 0.020 millimeters……35 – 100

Percent finer than 0.005 millimeters……10 – 40

Percent finer than 0.001 millimeters……1 – 25

‖ Does not apply to Portland cement or hydrated lime

C Condition

Mineral filler which is to be added directly to the dried Aggregate for the bituminous mixture will be thoroughly dry and free from lumps consisting of Aggregates of fine particles. Crushed rock screenings used as mineral filler will be processed and handled in such a manner to prevent segregation and dried by passing through a dryer.

3145.3 SAMPLING AND TESTING

A Sample according to the *Bituminous Manual*

B Fineness

B.1 Fine Aggregate Sieve Analysis .....*Laboratory Manual* Method 1203

B.2 Particle Size Analysis of Soil .....*Laboratory Manual* Method 1302

3146 BINDER SOIL

3146.1 SCOPE

This Specification lists the requirements for soil Material used as a binding agent for Aggregate mixtures.

3146.2 REQUIREMENTS

Provide binder soil with the following characteristics:

(1) Contains no sod, roots, plants, organics, or other deleterious Material
(2) Contains no fly ash, incinerator ash, other manufacturing by-products, or waste Material

3146.3 SAMPLING AND TESTING

A Sampling

The Engineer will sample binder soil in accordance with the *Schedule of Materials Control*.

B Sieve Analysis

The Engineer will perform the Sieve analysis in accordance with test method 1302 of the *Laboratory Manual*.

3149 GRANULAR MATERIAL

3149.1 SCOPE

This Specification lists the requirements for granular Materials used for granular subbase, structural bedding, and backfill.

3149.2 REQUIREMENTS

Provide certified granular Material meeting the specified requirements.

Certify granular Materials on *Form G&B-104*, "Certification of Aggregate and Granular Materials."

Provide Material that has similar appearance, texture, moisture content, and performance characteristics.

Report the No. 200 Sieve results to the nearest 0.1 percent and other Sieves to the nearest whole number.

A Granular Materials

A.1 Virgin Materials

Provide virgin Aggregate meeting the following requirements:

(1) Consists of naturally occurring uniformly blended mineral Materials
(2) Contains no topsoil, organics, or severely weathered rock
(3) Insoluble residue test results for the portion of quarried/bedrock Carbonate Aggregates, passing the No. 200 Sieve is no greater than 10 percent

A.2 Recycled Materials

For products not required to be 100 percent virgin Aggregates, the Contractor may substitute recycled Aggregates for virgin Aggregates, if the recycled Aggregates meet the following requirements:

(1) Are uniformly blended consisting only of recycled asphalt pavement (RAP), recycled concrete Materials, and recycled Aggregate Materials
(2) The bitumen content of the blended Material is no greater than 4.0 percent
(3) The recycled concrete Material is:

  (a) No greater than 75 percent of the Material blend
  (b) No greater than 10 percent masonry block

(4) The maximum amount of brick is 1.0 percent
(5) The maximum amount of other objectionable Materials, including but not limited to wood, plant matter, plastic, plaster, and fabric, is 0.1 percent

B Granular and Select Granular Materials

Provide granular Materials meeting the requirements of Table 3149.2-1.

Table 3149.2-1
Granular and Select Granular Material Gradation Ratio Requirements

Material Type	Percent Passing Ratio No. 200/1 inch	Percent Passing Ratio No. 40/No. 10	Percent Passing Ratio No. 200/No. 10
Granular Material	0 - 20	Not Applicable	Not Applicable
Select Granular Material	0 - 12	Not Applicable	Not Applicable
Select Granular Material (Super Sand)	Not Applicable	0 - 65	0 - 10
Select Granular Material Modified 10 percent	0 - 10	Not Applicable	Not Applicable

C Stabilizing Aggregate

Provide stabilizing Aggregate meeting the same requirements as required for the base. If base is not specified in the Contract meet the requirements of class 5 per 3138, "Aggregate for Surface and Base Courses."

D Structure Backfill Materials

Materials in this section are intended to be used as backfill adjacent to Structures.

D.1 Granular Backfill

Provide granular backfill meeting the requirements of Table 3149.2-2.

Table 3149.2-2
Granular Backfill Requirements

Percent Passing 3 inch Sieve	Percent Passing Ratio No. 200/1 inch
100	0 - 20

D.2 Structural Backfill

Provide 100 percent virgin structural backfill meeting the requirements of Table 3149.2-3, and the following.

Table 3149.2-3
Structural Backfill Requirements

Requirement	Percent
3/4 inch Sieve	100 passing
Ratio # 40/# 10	0 – 65 passing
No.200 Sieve	0 – 5.0 passing
Clay Percentage as Determined by MnDOT Test Method 1302	1.5 maximum

(1) Provide screened Material meeting the requirements of 3137.2B, "Classification," for Class C.

(2) Provide Material with a minimum angle of friction (Φ) of 34 degrees in accordance with *Laboratory Manual* Method 1309.

D.3 Select Granular Backfill

Provide select granular backfill meeting the requirements of Table 3149.2-4.

Table 3149.2-4
Select Granular Backfill Requirements

Percent Passing 3 inch Sieve	Percent Passing Ratio No. 200/1 inch
100	0 - 12

E Aggregate Backfill

Provide Aggregate backfill meeting the requirements of Table 3149.2-5.

Table 3149.2-5
Aggregate Backfill Gradation Requirements

Sieve Size	Percent Passing
2 inch	100
No. 4	35 - 100
No. 10	20 - 70
No. 40	10 - 35
No. 200	3 - 10.5

F Granular Bedding

Provide granular bedding meeting the requirements of Table 3149.2-6.

Table 3149.2-6
Granular Bedding Gradation Requirements

Sieve Size	Percent Passing
1 inch	100
No. 200	0 - 10.5

G Aggregate Bedding

Provide Aggregate bedding meeting the type specified.

G.1 Fine Aggregate Bedding

Provide fine Aggregate bedding meeting the requirements in 3138, "Aggregate for Surface and Base Courses," for Class 5.

For bedding non-aluminized and non-aluminum pipe, provide Aggregate composed of less than 75 percent recycled concrete and less that 75 percent recycled bituminous.

For bedding aluminized and aluminum pipe, do not provide Aggregate composed of recycled concrete or crushed quarried Carbonate rock.

G.2 Coarse Aggregate Bedding

Provide 100 percent virgin coarse Aggregate bedding meeting the requirements of Table 3149.2-7.

For bedding aluminized and aluminum pipe, do not provide Aggregate composed of quarried Carbonate rock.

Table 3149.2-7
Coarse Aggregate Bedding Gradation Requirements

Sieve Size	Percent Passing
1 1/2 inch	100
No. 4	0 - 10

G.3 Conduit Aggregate Bedding

Provide 100 percent virgin conduit Aggregate bedding meeting the requirements of Table 3149.2-8.

Table 3149.2-8
Conduit Aggregate Bedding Gradation Requirements

Sieve Size	Percent Passing
No. 4	100
No. 200	0 - 8.5

H Coarse Filter Aggregate

Provide 100 percent virgin coarse filter Aggregate, meeting the requirements of Table 3149.2-9. The maximum Los Angeles Rattler (LAR) loss from Carbonate quarry rock is 40 percent.

Table 3149.2-9
Coarse Filter Aggregate Gradation Requirements

Sieve Size	Percent Passing
1 inch	100
3/4 inch	85 - 100
3/8 inch	20 - 60
No. 4	0 - 10

I Filter Aggregates

Provide filter Aggregate meeting the requirements of the type specified.

I.1 Medium Filter Aggregate

Provide naturally rounded and 100 percent virgin medium filter Aggregate meeting the requirements of Table 3149.2-10 and the following.

Table 3149.2-10
Medium Filter Aggregate Gradation Requirements

Sieve Size	Percent Passing
3/4 inch	100
3/8 inch	50 - 100
No. 4	10 - 60
No. 10	0 - 15
No. 40	0 - 4
No. 200	0 - 2.5

(1) The maximum shale and soft rock content of the Material retained on the No. 4 Sieve is 5.0 percent.
(2) The maximum Carbonate content is 55 percent.
(3) The maximum crushing content is 15 percent. Material crushed from quarries is considered crushed Material.

I.2 Fine Filter Aggregate

Provide 100 percent virgin fine filter Aggregate meeting the requirements of Table 3149.2-11.

Table 3149.2-11
Fine Filter Aggregate Gradation Requirements

Sieve Size	Percent Passing
3/8 inch	100
No. 4	90 - 100
No. 10	45 - 90
No. 40	5 - 35
No. 200	0 - 3.5

J Sand Cover

Provide 100 percent virgin natural glacial Material meeting the requirements of Table 3149.2-12.

Table 3149.2-12
Sand Cover Gradation Requirements

Sieve Size	Percent Passing
No. 4	100
No. 10	95 - 100
No. 40	0 - 50
No. 200	0 - 8.5

3149.3 SAMPLING AND TESTING

Sample and test at the rates specified in the *Schedule of Materials Control*.

A Sampling.....*Grading and Base Manual*

B Sieve Analysis.....*Laboratory Manual* Methods *1202 &1203*

C Crushing.....*Laboratory Manual* Method *1214*

D Bitumen Content.....*Laboratory Manual* Method 1852

E Insoluble Residue.....*Laboratory Manual* Method 1221

F Light Weight Pieces in Aggregate.....*Laboratory Manual* Method 1207

G Lithological Count.....*Laboratory Manual* Method 1209

H Direct Shear Test of Soils under Consolidated Drained Conditions.....*Laboratory Manual* Method 1309

I Los Angeles Rattler Loss.....*Laboratory Manual* Method 1210

J Particle Size Analysis.....*Laboratory Manual* Method 1302

Bituminous Material

3151 BITUMINOUS MATERIAL

3151.1 SCOPE

Provide bituminous Materials consisting of asphalt binder, cut-back asphalt, and emulsified asphalt.

3151.2 REQUIREMENTS

Provide bituminous Material from a certified source listed on the *Approved/Qualified Products List* meeting the following requirements for the type and grade required by the Contract.

A Asphalt Binder

Only use Performance Grade (PG) Asphalt Binder meeting the requirements of *AASHTO M 332*, "Standard Specification for Performance-Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test," Table 3151.2-1 and the Combined State Binder Group *Method of Acceptance for Asphalt Binder*, available on the Asphalt Products page of the *Approved/Qualified Products List*.

Use asphalt binder supplier recommendations for mixing and compaction temperatures.

Table 3151.2-1
Multi Stress Creep Recovery (MSCR) Test Requirements

Grade*	Binder Code for 2360 Mix Design	Jnr at 3.2 kilopascal Maximum	Percent R at 3.2 kilopascal Minimum ‖	Jnr Difference † (Percent)
PG 58S-28	B	4.5	Not applicable	report (75)
PG 58H-28	E	2.0	30	report (75)
PG 58V-28	H	1.0	55	report (75)
PG 58E-28		0.5	75	report (75)
PG 58S-34		4.5	Not applicable	report (75)
PG 58H-34	C	2.0	30	report (75)
PG 58V-34	F	1.0	55	report (75)
PG 58E-34	I	0.5	75	report (75)
PG 49S-34	M	4.5	Not applicable	report (75)
PG 52S-34	A	4.5	Not applicable	report (75)
PG 64S-22	L	4.5	Not applicable	report (75)

* LTPP Bind temperature for Minnesota is 58°C for the high PG Binder Grade temperature. The bottom 3 grades are special use binders and are to be tested at the high temperature indicated by the grade (example: PG 49S-34 is tested at 49C).
‖ Use in place of *AASHTO R 92-18*, *Standard Practice for Evaluating the Elastic Behavior of Asphalt Binders Using the Multiple Stress Creep Recovery (MSCR) Test*.
† Jnr Difference is waived for all "S, H, V, and E" grade binders. The test value should be reported for information only.

B Medium Curing Liquid Asphalt

Provide medium curing liquid asphalt meeting the requirements of *AASHTO M 82,* "Standard Specification for Cutback Asphalt (Medium-Curing Type)." Only use cutback asphalt as approved by the Engineer.

C Emulsified Asphalt

Provide emulsified asphalt meeting the requirements of *AASHTO M 140,* "Standard Specification for Emulsified Asphalt," for the type and grade required by the Contract.

D Cationic Emulsified Asphalt

Provide cationic emulsified asphalt meeting the requirements of *AASHTO M 208*, "Standard Specification for Cationic Emulsified Asphalt."

D.1 Diluted CSS-1h

Provide diluted CSS-1h meeting the requirements of *AASHTO M 208* with the following modifications:

D.1.a CSS-1hD50

(1) Dilute the CSS-1h at a rate of one part emulsion to one part water (1:1) at the place of manufacture
(2) Meets a distillation residue of at least 29 percent
(3) Saybolt viscosity, storage stability, and particle charge only required on undiluted CSS-1h

D.1.b CSS-1hD30

(1) Dilute the CSS-1h at a rate of seven parts emulsion to three parts water (7:3) at the place of manufacture
(2) Meets a distillation residue of at least 40 percent
(3) Saybolt viscosity, storage stability, and particle charge only required on undiluted CSS-1h

E Polymer Modified Cationic Emulsified Asphalt

E.1 CRS-2P

Provide polymer-modified cationic emulsified asphalt meeting the requirements of *AASHTO M 316,* "Standard Specification for Polymer-Modified Emulsified Asphalt," CRS-2P with the following modifications:

(1) Distilled at 400°F for 15 minutes
(2) Produced using only polymer modified base asphalt. Do not use Latex modification

E.2 CRS-2Pd- diluted CRS-2P

Provide diluted polymer-modified cationic emulsified asphalt meeting the requirements of *AASHTO M 316,* CRS-2P with the following modifications:

(1) Distilled at 400°F for 15 minutes
(2) Diluted at a rate of three parts emulsion to one part water (3:1), by volume, at the place of manufacture
(3) Meets a distillation residue of at least 50 percent
(4) Produced using polymer modified base asphalt. Do not use Latex modification
(5) Saybolt viscosity, storage stability, and particle charge only required on undiluted CRS-2P

F Polymer Modified High Float Medium Set Emulsified Asphalt HFMS-2P

Provide emulsified asphalt meeting the requirements of *AASHTO M 316,* Table 1 with the following modification:

Perform the polymer modification step before the emulsification process.

G Ultrathin Bonded Wearing Course (UTBWC) Polymer Modified Emulsion Membrane

Provide a polymer modified emulsion membrane meeting the requirements of Table 3151.2-2 and Table 3151.2-3.

Table 3151.2-2
UTBWC Polymer Modified Emulsion Membrane Requirements – Tests on Emulsion

Test	Method	Minimum	Maximum
Viscosity, Saybolt Furol at 77°F	AASHTO T 59	20 seconds	100 seconds
Storage stability test *, 24 hours	AASHTO T 59	—	1.0 percent
Sieve test	AASHTO T 59	—	0.05 percent
Residue by distillation ‖	AASHTO T 59	63 percent	—
Oil distillate by distillation	AASHTO T 59	—	2.0 percent
Demulsibility, 12 ounce, 0.8 percent dioctyl sodium sulfosuccinate	AASHTO T 59	60 percent	—
* After standing undisturbed for 24 hours, ensure the surface has a smooth, homogenous color. ‖ *AASHTO T 59*, "Standard Method of Test for Emulsified Asphalts," except at no greater than 400°F ± 10°F for 15 minutes.			

Table 3151.2-3
UTBWC Polymer Modified Emulsion Membrane Requirements – Tests on Residue from Distillation

Test	Method	Minimum	Maximum
Penetration, at 77°F	*AASHTO T 49*, "Standard Method of Test for Penetration of Bituminous Materials"	60 dmm	150 dmm
Solubility in trichloroethylene	*AASHTO T 44*, "Standard Method of Test for Solubility of Bituminous Materials"	97.5 percent	—
Elastic recovery, at 77°F	*AASHTO T 301,* "Standard Method of Test for Elastic Recovery Test of Asphalt Materials by Means of a Ductilometer"	60 percent	—

H Micro-Surfacing Emulsified Asphalt

Provide a CQS-1hP or CQS-1P as required by the mix design and meeting the requirements of *AASHTO M 316,* Table 2 with the following modifications:

(1) Ensure the emulsion is polymer modified with a minimum of 3 percent natural latex polymers or a Department-approved man-made latex polymer or SBS (styrene-butadiene-styrene) polymer

(2) Distilled at 400°F for 15 minutes

(3) For SBS modified emulsion following Table 3151.2-4 and Table 3151.2-5

Table 3151.2-4
Micro-Surfacing Emulsified SBS Modified Asphalt Requirements – Tests on Emulsion

Test	Method	CQS-1hP Requirement	CQP-1P Requirement
Sieve Test	*AASHTO T 111*, "Standard Method of Test for Mineral Matter or Ash in Asphalt Materials"	<0.3 percent	<0.3 percent

Table 3151.2-5
Micro-Surfacing Emulsified SBS Modified Asphalt Requirements – Tests on Residue

Test	Method	CQS-1hP Requirement	CQP-1P Requirement
Softening Point	*AASHTO T 53*, "Standard Method of Test for Softening Point of Bitumen (Ring-and-Ball Apparatus)"	≥120°F	≥115°F

I Mixing Grade Engineered Emulsion for Stabilization / Reclamation

Provide a cationic emulsion according to the job mix design for cold in-place recycled bituminous, cold central plant recycled bituminous, stabilized base, or stabilized full depth reclamation; using the testing methods referenced in *AASHTO M208*, "Standard Specification for Cationic Emulsified Asphalt," to meet the following properties for the types listed:

I.1 Soft Base Engineered Emulsion

(1) Residue asphalt content minimum 64 percent
(2) Penetration range of 200-350 dmm

I.2 Hard Base Engineered Emulsion

(1) Residue asphalt content minimum 64 percent
(2) Penetration range of 100-200 dmm

3151.3 SAMPLING AND TESTING

Provide Bill of Lading with a certification statement that the bituminous Material meets the requirements in 3151.2, "Bituminous Material, Requirements." Sample at rates and sizes meeting the requirements of the *Schedule of Materials Control* or as required by the Contract.

The Materials Engineer will test samples submitted and certified by the manufacturer as representative of the bituminous Material to be provided.

3161 ANTI-STRIPPING ADDITIVE

3161.1 SCOPE

Provide anti-stripping additives to improve the moisture sensitivity and adhesion properties between the asphalt binder and Aggregate.

3161.2 REQUIREMENTS

Provide anti-stripping additives meeting the following requirements:

(1) Composition meeting the requirements of *AASHTO M 332,* "Standard Specification for Performance-Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test"
(2) Miscible with all types of bituminous Materials without showing separation or settlement

(3) Not affecting the long term stability of the asphalt binder
(4) With a concentration meeting the requirements of the Modified Lottman Test (*Laboratory Manual* Method 1813)

Ship and store anti-stripping additives in containers provided by the manufacturer and labeled with the following information:

(1) Name of the manufacturer
(2) Trade name or trade mark
(3) Manufacturer's lot number
(4) Date of manufacture
(5) Net weight of the contents

Maintain uniform consistency from drum to drum within shipments.

3161.3 SAMPLING AND TESTING — BLANK

3165 ASPHALT PRIMER FOR DAMPPROOFING AND WATERPROOFING

3165.1 SCOPE

Provide asphalt primer for damp proofing and waterproofing concrete and masonry surfaces above or below ground level.

3165.2 REQUIREMENTS

Provide asphalt primer meeting the requirements of *ASTM D41, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing*.

3165.3 SAMPLING AND TESTING

Provide samples at rates and sizes meeting the requirements of the *Schedule of Materials Control* or as required by the Contract.

3166 ASPHALT FOR DAMPPROOFING AND WATERPROOFING

3166.1 SCOPE

Provide asphalt for use as a mopping coat for dampproofing or as a plying or mopping cement in the construction of a membrane system of waterproofing.

3166.2 REQUIREMENTS

Provide Type II asphalt meeting the requirements of *ASTM D449*, *Standard Specification for Asphalt Used in Dampproofing and Waterproofing*, unless otherwise required by the Contract.

3166.3 SAMPLING AND TESTING

Provide samples at rates and sizes meeting the requirements of the *Schedule of Materials Control* or as required by the Contract

Bituminous Products

3201 SATURATED FABRIC FOR WATERPROOFING

3201.1 SCOPE

Provide asphalt saturated fabric for waterproofing.

3201.2 REQUIREMENTS

Provide fabric meeting the requirements of *AASHTO M 117*, "Bitumen-Saturated Cotton Fabrics Used in Roofing and Waterproofing," and saturated with asphalt. Use the asphalt saturated fabric in conjunction with asphalt for waterproofing in accordance with 3166, "Asphalt for Dampproofing and Waterproofing."

3201.3 SAMPLING AND TESTING — BLANK

3204 PREMOLDED ASPHALT PLANK

3204.1 SCOPE

Provide premolded asphalt plank.

3204.2 REQUIREMENTS

Provide asphalt plank meeting the requirements of *ASTM D517, Standard Specification for Asphalt Plank*, for the type required by the Contract.

3204.3 SAMPLING AND TESTING — BLANK

Culvert Pipe and Sewer Pipe

3222 CORRUGATED ALUMINIZED STEEL PIPE

3222.1 SCOPE

Provide corrugated aluminized steel (CAS) pipe and pipe arches for use in the construction of Culverts, underdrains, and sewers.

3222.2 REQUIREMENTS

Use Type 2 aluminum-coated steel sheets meeting the requirements of *AASHTO M 274,* "Standard Specification for Steel Sheet, Aluminum-Coated (Type 2), for Corrugated Steel Pipe," to fabricate pipe in accordance with *AASHTO M 36*, "Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains," and as specified in 3226, "Corrugated Steel Pipe."

Use pipe sections with identification marks meeting the requirements of *AASHTO M 274*, "Standard Specification for Steel Sheet, Aluminum-Coated (Type 2), for Corrugated Steel Pipe."

A Aprons

Provide aluminized coated steel aprons fabricated in accordance with this Specification and as shown on the Plans.

3222.3 SAMPLING AND TESTING — BLANK

3225 CORRUGATED ALUMINUM PIPE

3225.1 SCOPE

Provide corrugated aluminum alloy (CA) pipe for use as Culverts and underdrains.

The Department will designate the size of circular pipes by the Nominal inside diameter and the size of pipe-arches by the span width.

3225.2 REQUIREMENTS

Provide pipe meeting the requirements of *AASHTO M 196,* "Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains," and the following:

A Physical Properties

The Contractor may provide pipe in the least thickness of metal listed for a specified diameter, unless otherwise shown on the Plans or Special Provisions.

B Coupling Bands

Use aluminum alloy coupling bands meeting the requirements of *AASHTO M 196,* and as shown on the Plans to make field joints.

C Aprons

Provide aluminum aprons for circular pipes manufactured in accordance with this Specification for corrugated aluminum pipe and as shown on the Plans.

D Identification Marks

Mark each pipe section with identification meeting the requirements of *AASHTO M 196*.

3225.3 SAMPLING AND TESTING

The Engineer will inspect corrugated aluminum pipe in accordance with *AASHTO M 196*.

3226 CORRUGATED STEEL PIPE

3226.1 SCOPE

Provide prefabricated corrugated galvanized steel (CS) pipe to construct Culverts and underdrains. The unmodified term "pipe" refers to any or all types of pipe.

The Department will designate the size of the circular pipe by the Nominal inside diameter. The Department will designate the size of the pipe-arches by the span width measured from the inside crest of the corrugations.

3226.2 REQUIREMENTS

Provide pipe meeting the requirements of *AASHTO M 36*, "Standard Specification for Corrugated Steel Pip, Metallic-Coated, for Sewers and Drains," for the type required by the Contract and in accordance with the following:

A Dimensions

Ensure that pipe dimensions meet the requirements of *AASHTO M 36*, except as modified by the following:

(1) Provide each size of pipe with a Nominal sheet thickness as shown on the Plans and meeting the requirements for specified thickness in *AASHTO M 218,* "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized), for Corrugated Steel Pipe," Table 4

(2) Provide pipes with a corrugation size of 1 1/2 inch by 1/4 inch, 2 2/3 inch by 1/2 inch, 3 inch by 1 inch, or 5 inch by 1 inch as shown on the Plans and meeting the requirements in *AASHTO M 36*, Table 1 for the provided pipe sizes

(3) Provide spiral ribbed pipes with a corrugation size of 3/4 inch by 3/4 inch by 7 1/2 inch and meeting the requirements of *AASHTO M 36*, Table 3 for the provided pipe sizes. Provide the pipes with section properties meeting the requirements of *AASHTO LRFD Bridge Design Specifications*, Appendix A12

B Appurtenant Parts and Sections

Provide metallic zinc (galvanized) coated steel aprons fabricated in accordance with this section and 3351, "Sheet Steel Products."

Provide elbow, tee, and wye sections as shown on the Plans and fabricated from standard pipe sections, using mitered and welded joints, forming the required intersection angles for each installation. Provide special adapters as necessary to make connections between different sizes and types of pipe.

Provide an outlet screen at each free end of underdrain systems. The Contractor may provide metal end caps to close the dead ends of pipe instead of installing concrete or vitrified clay plugs.

C Identification Marks

Mark each pipe section with identification meeting the requirements of *AASHTO M 196,* "Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains."

Provide pipe with a sheet thickness, as designated in the markings on sheets and coils, meeting the requirements in *AASHTO M 218,* Table 4.

3226.3 SAMPLING AND TESTING

The Engineer will not accept units of pipe if the zinc (galvanized) coating has been burned by shop welding or otherwise damaged in shop fabrication, unless the Contractor regalvanizes the pipe units using the hot-dip process or the metalizing process specified in *AASHTO M 36*. Do not make shop repairs with zinc paint. Use the metalizing process to make zinc coating repairs on butt-welded seams of helical corrugated pipe, if the adjacent zinc coating is burned to a width greater than three times the metal thickness.

After the Contractor delivers the pipe to the Project, the Engineer will inspect each unit for compliance with the details of construction, workmanship, and finish requirements. In addition to all other defects as listed in *AASHTO M 36* constituting cause for rejection, the Engineer may reject, at the Project, any units damaged during shipment or fabrication.

The Contractor may use zinc paint to repair pipe coating damage caused by job site field welding or fabrication in lieu of regalvanizing. Use organic zinc primer paint specified on the *Approved/Qualified Products List* under "Bridge Structural Steel Coating" as Three Coat Systems - Organic. Clean the damaged area by sandblasting or as otherwise approved by the Engineer. Apply the zinc paint in accordance with instructions from the paint manufacturer.

3229 POLYMERIC COATED CORRUGATED STEEL PIPE

3229.1 SCOPE

Provide polymeric-coated galvanized corrugated steel (PC-CS) pipe for use as Culverts and underdrains.

3229.2 REQUIREMENTS

Use precoated galvanized steel sheets meeting the requirements of *AASHTO M 246*, "Standard Specification for Steel Sheet, Metallic-Coated and Polymeric-Precoated, for Corrugated Steel Pipe," to fabricate pipe meeting the requirements of *AASHTO M 245*, "Standard Specification for Corrugated Steel Pipe, Polymer-Precoated, for Sewers and Drains," and in accordance with 3226, "Corrugated Steel Pipe."

Provide steel sheets with a polymer coating thickness of 0.01 inch on both sides.

A Aprons

Polymeric coated aprons meeting *AASHTO M 246*, and *AASHTO M 245*, are not available. Use apron Material as shown in the Plans.

3229.3 SAMPLING AND TESTING — BLANK

3231 GALVANIZED STEEL STRUCTURAL PLATE FOR PIPE, PIPE-ARCHES, AND ARCHES

3231.1 SCOPE

Provide galvanized corrugated steel (CS) structural plate and fasteners for use in constructing pipe, pipe-arches, underpasses, and special shapes for field assembly.

3231.2 REQUIREMENTS

Provide structural plates and fasteners meeting the requirements of *AASHTO M 167*, "Standard Specification for Structural Plate for Pipe, Pipe-Arches, and Arches," and the following:

A Fabrication

Provide the plate thickness specified in *AASHTO M 167*, Table 8, unless otherwise specified on the Plans. Provide steel plate with the section modulus shown on the Plans. A different thickness and section modulus is acceptable if the strength is at least equal to the strength of the thickness and section modulus shown on the Plans.

Provide plates of a size and shape that yield a finished structure of the dimensions shown on the Plans. Stagger either the longitudinal or the transverse seams.

Punch bolt holes before galvanizing the sheets.

B Workmanship and Finish

The Engineer will reject individual plates or shipments of plates with any of the following defects:

(1) Plates without careful and finished workmanship
(2) Incorrect plate shape
(3) Unevenly lined or spaced bolt holes
(4) Plates with ragged edges
(5) Plates with illegible or improper markings
(6) Bruised, scaled, broken, or improperly repaired zinc (galvanized) coating
(7) Metal plates with dents or bends

3231.3 SAMPLING AND TESTING 3226.3

3233 ALUMINUM ALLOY STRUCTURAL PLATE FOR PIPE, PIPE-ARCHES, AND ARCHES

3233.1 SCOPE

Provide corrugated aluminum alloy (CA) structural plate, accessories, and fasteners for the construction of pipe, pipe-arches, arches, and special shapes, for field assembly.

3233.2 REQUIREMENTS

Provide structural plates, accessories, and fasteners meeting the requirements of *AASHTO M 219*, "Standard Specification for Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches," and the following:

A Fabrication

Provide the plate thickness, pipe shape, sheet fabrication details, and assembly bolting as shown on the Plans.

B Workmanship and Finish

The Engineer will reject individual plates or shipments of plates with any of the following defects:

(1) Plates without careful and finished workmanship
(2) Incorrect plate shape
(3) Unevenly lined or spaced bolt holes
(4) Plates with ragged edges
(5) Plates with illegible or improper markings
(6) Metal plates with dents or bends

3233.3 SAMPLING AND TESTING — BLANK

3236 REINFORCED CONCRETE PIPE

3236.1 SCOPE

Provide reinforced concrete pipe of circular, arch, elliptical, or special shape and design, with appropriate appurtenances to construct Culverts, sewers, or underpasses.

3236.2 REQUIREMENTS

Provide reinforced concrete pipe meeting the following requirements and as modified in this section:

Table 3236.2-1
Reinforced Concrete Pipe

Pipe Type	AASHTO Reference
Circular	*AASHTO M 170*, "Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe"
Pipe-Arch	*AASHTO M 206*, "Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe"
Elliptical	AASHTO M 207, "Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe"

Provide concrete aprons manufactured as shown on the Plans. Attach aprons compatible with pipe.

Provide concrete cattle pass units manufactured as shown on the Plans.

The Department will not require external load bearing tests on cattle passes and aprons.

A Materials

A.1 Aggregate Quality .....3126, 3131 and 3137

A.2 Form Release Agents 3902

A.3 Portland cement 3101
The Department will allow admixtures in accordance with 2462, "Precast Concrete."

A.4 Fly Ash for Use in Portland cement concrete 3115

A.5 Ground Granulated Blast Furnace Slag Cement..... 3102

A.6 Precast Concrete..... 2462

B Pipe Design

Provide pipe designed as shown on the Plans or meeting the *AASHTO* requirements referenced in Table 3236.2-1, if approved as an alternate by the Engineer for the different classes of pipe meeting the following design requirements:

(1) Pipe shape (circular, arch, elliptical)
(2) Diameter
(3) Wall thickness
(4) Compressive strength of concrete
(5) Area and type of circumferential reinforcement

Provide pipe with reinforcement placed in accordance with applicable AASHTO specifications referenced in Table 3236.2-1, except as otherwise shown on the Plans or as approved by the Engineer. Do not use circular pipe with elliptical reinforcement.

Lap wires in the circumferential steel welded wire reinforcement a minimum of forty wire diameters and include a transverse wire from each side of the lap.

Fully welded lap splices will not be allowed without specific approval of the Materials Engineer.

If the Plans show pipes with rubber gasket seals, ensure the joint surfaces adjacent to the gasket are smooth and free of imperfections to allow the rubber gasket seal to meet the specified performance requirement.

C Manufacture

Provide products manufactured in a precast concrete manufacturing plant pre-approved by the Materials Engineer, listed on the *Approved/Qualified Products List* and meeting the requirements of 3240, "Precast Concrete Manufacturing." Provide certified products as required by the Contract from a manufacturer with total production set-up on a pre-approved basis for that product type (pipe, end sections, or manholes). The Materials Engineer will limit acceptance of products to each precast concrete manufacturer, to each of the plants and to each product type as pre-approved by the Materials Engineer. The Materials Engineer will limit pre-approval to the identified sizes of circular pipe, arch pipe, elliptical pipe, and product type. Sizes and classes without designs shown in the Standard Plates or with a span greater than or equal to 120 inches will not be pre-approved.

Notify the Materials Engineer at least 5 Business Days before the manufacturer begins producing pipe requiring shear steel or Special Designs not listed on the *Approved/Qualified Products List*. Pin all shear steel.

Positive slump concrete shall be air-entrained. Zero-slump concrete shall be according to *AASHTO M170*.

Provide concrete units cured by the steam or water curing methods, unless using methods otherwise approved by the Materials Engineer. In all cases, use curing chambers with an atmospheric temperature no greater than 160°F. Protect concrete units from freezing or drying after casting until the completion of curing.

D Permissible Variations

Provide pipe meeting the tolerance requirements of applicable AASHTO specifications referenced in Table 3236.2-1.

3236.3 SAMPLING AND TESTING

The Materials Engineer will approve each precast concrete manufacturer and its individual plants to provide precast concrete products under the pre-approval program. The Materials Engineer will not authorize precast concrete production if the manufacturer fails to abide by the terms, conditions, and requirements contained in this program.

If the Materials Engineer finds manufacturer non-compliance with the pre-approval program or evidence of non-conformance of certified products, the Materials Engineer, in conjunction with the Engineer, may perform any of the following:

(1) Reject the individual product
(2) Reject the questioned shipment
(3) Reject the identified day's production
(4) Revoke pre-approval privileges

A Plant QC

Ensure the manufacturer establishes and implements a QC program, including the following elements for each pre-approved plant:

A.1 Internal QC Program

Ensure the manufacturer includes the following in the internal QC program:

(1) Sampling and testing of component Materials or documentation of acceptability if Materials were previously inspected and tested, or received from a certified source
(2) Inspection of product manufacturing including the following:

(a) Reinforcing steel fabrication and placement
(b) Concrete mix design and proportioning
(c) Concrete placement and consolidation
(d) Concrete curing

(3) Testing of finished products including the following:

(a) Strength of concrete cylinders
(b) Three-edge-bearing test (round pipe)
(c) Absorption and steel verification from pipe cores. For each class, size, and type of manufacture, on the first run of the year and as directed by the Materials Engineer, provide core specimens at least 4 inches in diameter for the absorption test and steel verification

(4) Final visual inspection and stamping
(5) Maintenance of plant facilities and Equipment

A.2 On-Site Quality Control Technicians

Ensure the manufacturer employs and has on-site during production QC technicians trained and certified meeting the requirements of Department Level I, "Concrete Field Tester" or ACI Grade I, "Quality Control Technician" to perform the following:

(1) Ensure the conformance of all pre-approved products to the requirements
(2) Maintain knowledge of the following:

(a) Plans and Specification requirements
(b) Product manufacturing operations
(c) Significance of the Specification requirements in producing quality products

(3) Correct, stop, or both, operations causing non-conforming attributes
(4) Reject products not meeting the Contract requirements
(5) Ensure the manufacturer meets requirements related to producing pre-approved products
(6) Contact the Department's Inspector before making repairs greater than 10 percent of the respective surface, inside or outside

A.3 Equipment Calibration 2462

A.4 System of Record Keeping

Ensure the manufacturer maintains the following records:

(1) Component Material sources and passing quality test results, authorized certification, or other evidence of inspection and satisfactory testing
(2) Test results covering product manufacture and the finished product as listed in the records section of the *ACPA Manual*
(3) Records of manufactured products in accordance with the following:

(a) Date
(b) Size
(c) Class

(4) Running inventory of pre-approved products in stock
(5) Equipment calibration reports

B Quality Assurance

The Materials Engineer will visit each plant to perform tasks in accordance with this Specification and including the following:

(1) Random sampling and testing of the Materials used in the manufacture of pre-approved products
(2) Random sampling and testing of the pre-approved pipe produced
(3) Observing the manufacturing process
(4) Reviewing the manufacturer's quality control tests, inspection, records, and stockpiling practices
(5) Reviewing the pre-approved product inventory

The Engineer will perform a final inspection upon delivery.

C Testing Rates

C.1 Concrete

Ensure the manufacturer tests the air content of concrete in each mix once a day for each positive slump mix.

Ensure the manufacturer tests the concrete strength of each mix according to the requirements of 3240.2F.3.a, "Concrete."

C.2 Load Bearing Test

Ensure the manufacturer conducts three-edge bearing tests meeting the requirements of *AASHTO M 170*, "Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe," on each size and class of pipe, and in accordance with the following schedule:

Table 3236.3-1
Minimum Three-Edge Bearing Testing Rates

Size Range, inch	Class Range	Test Rates
12 – 15	≤ 5	1 per 1000 pieces
18 – 36	≤ 4	1 per 800 pieces
18 – 36	5	1 per 400 pieces
42 – 60	≤ 3	1 per 400 pieces
42 – 60	4 & 5	1 per 200 pieces
66 – 96	≤ 5	1 per 200 pieces

NOTE: Testing rates for sizes not shown are as required by the Project Specifications. Begin a new schedule of testing after changing the mix design, after shutting down the system for major repairs and renovations, when beginning a new production run, and when beginning a new season. These rates are for testing to the 0.01 in D-load. Testing to failure is required on each combination of pipe size, wall thickness, and class manufactured once per production year.

Notify the Materials Engineer 2 full Business Days before testing. The Materials Engineer may select pipes for testing and may direct the manufacturer to perform additional testing at no additional cost to the Department.

Do not ship pipe that have not developed the specified D-load. Only pipe of equal or older age than a tested pipe section of the same size and class that has passed the three-edge bearing test may be shipped. Maintain documentation of all load tests performed.

D Pipe Marking

Provide pipe marked by the manufacturer in accordance with the following:

(1) Meeting the marking requirements of *AASHTO M 170*
(2) Stamped with the word, "Certified"
(3) Stamped with the manufacturing plant identification
(4) For units at least 24 inches in diameter, stamped on the inside
(5) For units smaller than 24 inches in diameter, stamped on the outside

Before stockpiling, mark products manufactured for Projects with special requirements not meeting the standards of the pre-approved program with an identifying Project number or the buyer's name.

The Engineer may accept pre-approved shipments if the Contractor provides pipe marked with the following by the manufacturer:

(1) The phrase, "CERTIFIED PLANT COMPANY," in letters at least 2 inches high
(2) Company identification
(3) Individual production plant

Provide the Engineer with a certified bill of Materials or invoice, signed by a designated, responsible company representative with each shipment that identifies the following information:

(1) Project number
(2) Contractor

(3) Type of Material
(4) Number of pieces of each size, class, and length
(5) The following statement:

"The Materials itemized in this shipment are certified to be in compliance with the applicable Minnesota Department of Transportation Specifications and the Project Plans, including any 'Buy America' provisions."

_____
Authorized Signature and Date

Ensure the manufacturer does not ship pre-approved products until after the completion of QC tests and inspections, and as approved by the Materials Engineer.

E Stockpiling

Ensure the manufacturer stockpiles products meeting the above requirements to allow the Materials Engineer to inspect the products for QA, and that the manufacturer stockpiles special, non-pre-approved product in areas separate from pre-approved stock.

3238 PRECAST CONCRETE BOX CULVERTS

3238.1 SCOPE

Provide products manufactured in a precast concrete manufacturing plant pre-approved by the Materials Engineer, listed on the *Approved/Qualified Products List* and meeting the requirements of 3240, "Precast Concrete Manufacturing." Provide precast concrete single and multi-cell box Culverts sections, headwalls, and aprons, including box Culvert sections used in the as-cast position as manholes or manhole-type Structures.

3238.2 REQUIREMENTS

A Fabrication Drawings, Falsework, and Forms

If full construction details are not included in the Plans, provide shop drawings according to 3240, "Precast Concrete Manufacturing," before fabricating the units.

Provide shop drawings and design calculations for mitered Culvert bends and other specialty Culvert shapes.

Provide precast concrete box Culverts with individual sections at least 4 feet long capable of being tied to the adjacent section with concrete pipe ties as specified by *Standard Plate 3145* and as shown on the Plans. Unless specifically called for in the Plans, openings in the flow line or sidewalls are not allowed.

B Materials

B.1 Concrete 2462

Provide concrete with mix designations as shown on the Plans for the specific items of Work.

B.2 Metal Reinforcement 2472

C Forms

Provide forms capable of withstanding pressure from concrete, vibration, and impact without distorting. Set and maintain forms in a mortar tight condition, free of warp, and on a rigid foundation. Provide joints in the sectional forms without offset. Set forms to create dimensions of the precast unit as shown on the Plans. Repair or replace forms not meeting the dimensions shown on the Plans before

casting additional sections. When recesses around lifting devices are required, use forming devices provided by the lifting device manufacturer. Clean forms before use. Treat the face of the forms in contact with the concrete with form coating Material in accordance with 3902, "Form Coating Material," before setting the forms.

D Lifting Devices and Other Steel Inserts

When lifting devices or other steel inserts will have less than 1.5 inches of concrete cover in the finished Structure or if the recess is to be grouted in the field, provide items that are galvanized according to 3392, "Galvanized Hardware."

E Reinforcement Steel

Place reinforcement steel as shown on the Plans. Support reinforcement steel with chairs. Splice, secure, and tie reinforcement steel in accordance with 2472, "Metal Reinforcement." Provide concrete cover of at least 1.5 inches or as shown on the Plans. Provide stainless steel, plastic, plastic tipped, hot dipped galvanized, or mechanically galvanized reinforcement supports in contact with the forms. Extend coatings on the supports at least 1 inch from the form surface. Do not tack-weld reinforcement.

Lap wire mesh as detailed in the Plans. Cut wire mesh so that the sum of the 2 end overhangs equals no more than 1 transverse wire spacing. When measuring the length of wire mesh for compliance with Plans (splice lengths, etc.) the end overhang shall not exceed 1/2 of the transverse wire spacing.

When a secondary pour will be used for adding a weir wall, an integral base for a manhole or similar Structures, use epoxy-coated steel reinforcement across the joint, with the bars being cast in the first pour or set in epoxy-filled drilled holes.

F Placement of Concrete

Do not place concrete for precast units until the Materials Engineer inspects and approves the forms and steel placement.

Place the concrete in each precast unit without interruption. Vibrate the concrete internally, externally, or both, to produce uniformly dense concrete and to avoid displacement of enclosures or steel units. Internally vibrate in accordance with 2401.3D, "Compaction of Concrete," except provide internal vibrators with a vibrating head no greater than 1 1/4 inch in diameter and capable of operating at a frequency of at least 100 Hz.

G Concrete Curing

Cure according to the requirements of 3240, "Precast Concrete Manufacturing," until the concrete reaches a compressive strength of at least 2,500 psi based on compressive strength test results from control cylinders cured with the product.

H Concrete Finishing and Repair

Provide formed surfaces of the precast units with a uniform dense surface finish in accordance with 2401.3F.2.a, "Ordinary Surface Finish." After removing the forms, examine the concrete surfaces for areas of unsound concrete and defective surfaces caused by faulty forms or form assembly, improper concrete placement, improper form removal, and other causes.

Remove and replace concrete with porosity, honeycomb, delamination, hollow sound, or segregated Materials as approved by the Materials Engineer.

The Materials Engineer will not allow the following repairs in the finished product:

(1) Individual repairs greater than 4 square feet on an inside or outside surface
(2) Repairs to the tongue or groove down to the steel and greater than 4 feet long

With the approval of the Materials Engineer and in compliance with the plant Quality Control program, the Contractor may repair minor surface cavities or irregularities before the unit completes curing.

I Tolerances

Dimensional tolerances will be based on *AASHTO M 259*, "Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers."

3238.3 SAMPLING AND TESTING

The Materials Engineer will inspect the units at the plant and will stamp approved units with the official mark of the Department. Store individual units in an upright position to facilitate inspection, unless otherwise approved by the Materials Engineer. Do not ship units without the official mark of the Department. Notify the Materials Engineer at least one full Business Day before intent to ship. Complete finishing and repair Work on units before submitting notice of intent to ship. The units are subject to final inspection of the units after delivery.

Unless otherwise directed by the Materials Engineer, mark the inside of each box section with the following information:

(1) Project number
(2) Overfill height
(3) Size
(4) Segment number as shown on the Plans
(5) Date (and which pour, if more than one pour per day) of manufacture
(6) Manufacturer's name and plant

3240 PRECAST CONCRETE MANUFACTURING

3240.1 SCOPE

Provide precast concrete items manufactured off-site at a permanent manufacturing facility listed on the Department's website, and manufacturing products such as box Culverts, reinforced concrete pipe and manholes, Bridge beams, abutments, pier caps, and other Structures.

After seasonal or other delays in production, provide a minimum of 14 Calendar Days of notice that production will begin.

When a manufacturing facility has not produced items covered by this Specification in the current or previous calendar year, provide a minimum of sixty Calendar Days' notice of intent to manufacture.

If a manufacturing facility is located outside of Department-specified coverage areas and has been given specific approval to manufacture products according to this Specification, all costs of providing that inspection will be deducted from monies paid under the Contract. A list of plants, locations, and products with regular Department inspection is on the *Approved/Qualified Products List* website.

3240.2 REQUIREMENTS

A Fabrication Drawings

If full construction details are not included in the Plans, or if modifications of the Plan drawings are necessary, provide shop drawings meeting the following requirements to the Engineer of Record for review and approval by the Office of Bridges and Structures or other Project representative as designated by the Materials Engineer, before fabricating the units:

(1) Complete and comprehensive
(2) Include the details of reinforcing steel
(3) Show mat makeup and configuration

Do not begin construction of the items until full approval of the shop drawings is attained. When shop drawings are transmitted electronically, the final, approved shop drawings should be sent from the approved Project representative directly to the Precast Inspection Engineer and/or the State's Inspector(s) for the manufacturing facility.

B Materials

B.1 Concrete 2462

Provide concrete with mix designations as shown on the Plans for the specific items of Work.

B.2 Metal Reinforcement..... 2472

C Forms

Provide forms capable of withstanding pressure from concrete, vibration, and impact without distorting. Set and maintain forms in a mortar tight condition, free of warp, and on a rigid foundation. If evidence of mortar leakage is apparent after a pour, take corrective action to prevent the leakage from recurring.

Provide joints in the sectional forms without offset. Set forms to create dimensions of the precast unit as shown on the Plans. Repair or replace forms not meeting the dimensions shown on the Plans before casting additional sections. When recesses around lifting devices are required, use forming devices provided by the lifting device manufacturer.

Clean forms before use. Treat the face of the forms in contact with the concrete with form coating Material in accordance with 3902, "Form Coating Material," before setting the forms.

D Concrete Curing

D.1 General

Begin curing operations immediately after concrete placement. Continue curing until reaching at least 45 percent of design strength or as required by the Plan or Special Provisions.

D.2 Curing Methods

Use any of the following to cure the precast items:

(1) Covering of burlap or canvas kept continuously wet
(2) Continuous water spray or mist
(3) Complete airtight seal using plastic curing blankets
(4) The moist air or steam method of curing in accordance with 3240.2D.3, "Steam Curing" which will be considered to include any methods using an external heat source

D.3 Steam Curing

For all products except Bridge beams, delay the introduction of steam into the curing enclosure for curing purposes, until the concrete has taken its initial set and at least 3 hours after placing the concrete. During the delay period, the temperature inside the curing chamber may be increased from the concrete temperature at the time of placement up to 10°F per hour, to no higher than 90°F. Only use steam to maintain the curing enclosure temperature within these limits.

For Bridge girder production, delay the introduction of steam into the curing enclosure, for curing purposes, until the concrete has taken its initial set and at least 3 hours after placing the concrete. During the delay period, maintain a temperature within the curing chamber of at

least 50°F and no greater than 10°F higher than the temperature of the concrete at the time of placement. Use steam only to maintain the curing enclosure temperature within the limits.

For all products, do not allow steam jets to impinge directly on the concrete or on the forms. Do not allow the rate of rise in temperature adjacent to the concrete to rise at rates greater than 30°F per hour (for Bridge beams and 40°F for all other products). Provide free circulation around the top, sides, and ends of the concrete units. Do not allow the temperatures adjacent to the concrete greater than 160°F. Use saturated steam within the curing enclosure. Maintain a temperature in the concrete unit of at least 50°F during the curing period. For Bridge items, do not allow a difference in temperature adjacent to the concrete within the enclosure to be greater than 10°F.

After the expiration of the steam curing period, reduce the temperature inside the chamber at a rate no greater than 40°F per hour until the temperature inside and outside of the chamber equalizes. After removing items from the chamber, protect the items to avoid cooling at a rate greater than 40°F per hour until reaching the air temperature at the storage site.

If removing forms before the completion of the steam curing cycle (including temperature taper off process), only remove and leave uncovered the minimum area of the curing enclosure at any one time needed to remove each individual form section. Close the open area in the enclosure immediately upon removing each form section or within 15 minutes of first uncovering the area.

When removing the precast items from the casting bed during the cooling-off process, take appropriate measures to keep the items warm during the moving operations, and immediately resume the cooling-off process at the storage area.

When control cylinders are cured in a chamber separate from the pieces represented, maintain the cylinder chamber at the same temperature as, or no more than 5°F higher than, the curing chamber for the precast items represented at all times during the curing period. Provide a continuous recording thermometer for each curing enclosure that has an individual temperature control (at least 50 percent of the curing chambers for box Culvert production and at least 1 per 100 feet for Bridge girders). Variances from these requirements may be allowed with approval of the Materials Engineer. Locate thermometers in each curing enclosure as approved by the Materials Engineer. Submit complete temperature recording charts for all recording devices to the Materials Engineer upon request.

Discontinue steam curing and use one of the other approved curing methods, if the records indicate noncompliance with temperature and time element specifications for steam curing.

E Certified Plant Requirement

Provide precast concrete items constructed in a precast concrete fabrication plant certified by the American Concrete Pipe Association, the National Precast Concrete Association, or another organization approved by the Materials Engineer. Provide Bridge beams constructed in a fabrication plant certified by the Precast/Prestressed Concrete Institute. For plants not previously required to have plant certification, attain certification by calendar year 2021.

If requested, provide quality control and plant certification records to the Materials Engineer. The quality control plans required by this Specification are subject to review and approval by the Materials Engineer. Failure to make any requested changes will result in removal of the plant from the *APL* website.

F Plant Quality Control

The Materials Engineer will approve each precast concrete manufacturer and its individual plants to provide precast concrete products. The Materials Engineer will withdraw authorization or will not authorize precast concrete production if the manufacturer fails to abide by the terms, conditions, and requirements contained in this Specification.

If the Materials Engineer finds manufacturer non-compliance with the Specification or evidence of non-conformance of precast products, the Engineer may perform any of the following:

(1) Reject the individual product
(2) Reject the questioned shipment
(3) Reject the identified day's production
(4) Revoke pre-approval privileges for the product or product class, if applicable

F.1 Plant Quality Control

In addition to the certified plant requirements of 3240.2E, Certified Plant Requirement," establish and implement a Quality Control (QC) program, including the following elements for each plant:

F.1.a Internal QC Program

Ensure the manufacturer includes the following in the internal QC program:

(1) Sampling and testing of component Materials according to the *Schedule of Materials Control* or documentation of acceptability if Materials were previously inspected and tested, or received from a certified source
(2) Inspection of product manufacturing including the following:
    (a) Reinforcing steel fabrication and placement
    (b) Concrete mix design and proportioning
    (c) Concrete placement and consolidation
    (d) Concrete curing
(3) Testing of finished products, including strength of concrete cylinders using an on-site cylinder strength testing machine, meeting the requirements of *AASHTO T22*, "Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens, " and capable of printing results.
(4) Maintenance and calibration of plant facilities and equipment.

F.1.b On-Site Quality Control Technicians

Ensure the manufacturer employs and has on-site during production a QC technician trained and certified meeting the requirements of Department "Concrete Plant 1," and either Department "Concrete Field 1" or ACI "Concrete Field 1" to perform the following:

(1) Ensure the conformance of all products to the requirements
(2) Maintain knowledge of the following:
    (a) Plans and Specification requirements
    (b) Product manufacturing operations
    (c) Significance of the Specification requirements in producing quality products
(3) Correct, stop, or both, operations causing non-conforming attributes

(4) Reject products not meeting the Contract requirements
(5) Ensure the manufacturer meets requirements related to producing pre-approved products
(6) Contact the Department's Inspector before making repairs

F.1.c System of Record Keeping

Ensure the manufacturer maintains the following records:

(1) Component Material sources and passing quality test results, authorized certification, or other evidence of inspection and satisfactory testing
(2) Test results covering product manufacture and the finished product
(3) Records of manufactured products in accordance with the following:

(a) Date
(b) Size
(c) Class

(4) Equipment calibration reports
(5) Concrete batch records

F.2 Quality Assurance

The Materials Engineer may visit each plant to perform tasks in accordance with this Specification and including the following:

(1) Random sampling and testing of the Materials used in the manufacture of precast products
(2) Random sampling and testing of the items produced
(3) Observing the manufacturing process
(4) Reviewing the manufacturer's quality control tests, inspection, records, and stockpiling practices
(5) Reviewing the completed product inventory

The Engineer will perform a final inspection upon delivery to the Project Site.

F.3 Testing Rates

F.3.a Concrete

Ensure the manufacturer tests the slump/spread of concrete in each mix at least once per 25 cubic yards for each positive slump mix.

Ensure the manufacturer tests the concrete according to the following:

Cure wetcast and drycast control cylinders to be used for determining shipping strength in the same manner as the pieces they represent until they are tested. The testing of cylinders may or may not be witnessed by the Department Inspector, but the testing of cylinders with a specified strength of 5,000 psi or greater should be witnessed and documented by the Department Inspector.

Ensure control cylinders represent what is happening in the actual product. They must be exposed to the same conditions, at the same time. During the initial cure cylinders should be cured with the product. If cylinders are not cured with the product, the cylinder curing chamber must have the temperature controlled by what is happening to the product. Extra care must be taken to make sure the cylinders are not given a better cure than the product. Once the product has been moved out of the

curing chamber, the cylinder should also be moved outside. If the cylinders do not stay with the product, they should go on a rack on the shady side of the building outside. They should not be in the sun all day, since the pieces represented are not entirely in the sun.

Cores from individual pieces are used to verify proper placement of the reinforcing cages and to measure absorption of the concrete, which is an indicator of proper compaction of the drycast concrete.

F.3.b Quality Control Testing

Notify the Materials Engineer 2 full Business Days before three-edge bearing testing, shipping strength testing, or other acceptance testing, or1 full Business Day if inspectors are present on a daily basis. The Materials Engineer may select items or cylinders for testing and may direct the manufacturer to perform additional testing at no additional cost to the Department.

Maintain documentation of all strength tests performed, including a signed, printed report from the cylinder testing machine that includes the following information:

(1) Unique identification of the original pour, such as pour number or date & time of the pour
(2) Unique cylinder ID
(3) Date and time of the test
(4) Breaking strength

F.4 Shipping

Do not ship items that have not developed the specified compressive strength.

3240.3 SAMPLING AND TESTING ..... BLANK

3245 THERMOPLASTIC PIPE

3245.1 SCOPE

Provide thermoplastic (TP) pipe and fittings for use as pipe sewers or subsurface drains.

3245.2 REQUIREMENTS

Provide thermoplastic pipe and fittings meeting the requirements of the Contract.

If pipe is not specified in the Contract, provide one of the following pipes listed below meeting the applicable application. For example, use perforated pipe for drainage application and unperforated pipe for outletting.

If perforated pipe is specified, provide pipe with perforations in accordance with the applicable Specification.

Unless otherwise specified, the Contractor may choose the joint type.

Create perforations at manufacture's plant; no field perforations are allowed.

(1) *AASHTO M 278*, "Standard Specification for Class PS 46, Poly(Vinyl Chloride) (PVC) Pipe" (perforated and unperforated)
(2) *ASTM D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings*, SDR 35, (unperforated only)

(3) *ASTM F758*, *Standard Specification for Type PSM Poly(Vinyl Chloride)* Type PS 46 (perforated and unperforated)
(4) *ASTM F949*, *Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings,* (perforated and unperforated)
(5) *ASTM D1785*, *Standard Specification for Poly(Vinyl Chloride (PVC) Plastic Pipe*, Schedule 40 pipe perforated & unperforated as applicable with one of the following:
  (a) Perforated: Slotted with maximum slot width of 1/16 inch and minimum slot area of 1.5 inches squared/linear foot for pipe 4 inches in diameter and greater and 1.0 inches squared/linear foot for pipe less than 4 inches in diameter
  (b) Perforated: Circular holes with 2 to 4 rows of holes. Hole diameter = 3/16 inch - 3/8 inch, and minimum area of holes 1.5 inches squared/linear foot for pipe 4 inches in diameter and greater and 1.0 inches squared/linear foot for pipe less than 4 inches in diameter
  (c) Unperforated
(6) *AASHTO M 252*, "Standard Specification for Corrugated Polyethylene Drainage Pipe," (CP) dual-wall, Type "S" (unperforated) or "SP" (perforated) pipe, PS 50

3245.3 SAMPLING AND TESTING

Submit to the Engineer a manufacturer's Certificate of Compliance with each pipe shipment.

3246 POLYPROPYLENE PIPE

3246.1 SCOPE

Provide polypropylene (PP) dual wall pipe for use as pipe Culverts or pipe sewers.

3246.2 REQUIREMENTS

Provide dual wall polypropylene (PP) pipe listed on *Approved/Qualified Products List* and pipe with couplings and fittings meeting the following requirements:

(1) *AASHTO M 330* dual wall Type "S" pipe
(2) Section 12 of the *AASHTO LRFD Bridge Design Specifications*
(3) Gasketed integral bell and spigot joint meeting the requirements of *ASTM F2881*, *Standard Specification for 12 to 60 inch Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications*, for respective diameters
(4) Watertight joints that meet a 10.8 psi laboratory test per *ASTM D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals*, with a gasket that meets the requirements of *ASTM F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe*

Provide polypropylene pipe and fittings manufactured from polypropylene virgin compounds. May use clean, reworked polypropylene Materials from the manufacturer's own production, if the pipe and fittings produced meet the requirements of this section.

Submit laboratory certification that the pipe connection for each size of pipe meets or exceeds the requirements in this section.

Submit shop drawings of each pipe coupler and any additional mechanical connections required by the Plans.

Mitered end sections are not allowed.

Store and handle polypropylene pipe as recommended by the manufacturer. Provide pipe manufactured no more than 12 months prior to installation.

Do not use damaged pipe.

3246.3 SAMPLING AND TESTING

Polypropylene pipe manufacturing facilities are required to participate and be in compliance with AASHTO's National Transportation Product Evaluation Program (NTPEP) for producers of *AASHTO M 330* pipe.

Submit a manufacturer's Certificate of Compliance with each pipe shipment including date manufactured and Nominal and actual inside pipe diameters.

3247 CORRUGATED POLYETHYLENE PIPE

3247.1 SCOPE

Provide corrugated polyethylene (CP) dual-wall pipe for use as pipe Culverts or pipe sewers.

3247.2 REQUIREMENTS

Provide corrugated polyethylene dual-wall pipe listed on *Approved/Qualified Products List* and pipe with couplings and fittings meeting the requirements of the following:

(1) *AASHTO M 294*, "Standard Specification for Corrugated Polyethylene Pipe, 300- to 15500-mm (12- to 60-in.) Diameter," Type "S" pipe
(2) Section 12 of the *AASHTO LRFD Bridge Design Specifications*
(3) Watertight joints that meet a 10.8 psi laboratory test per *ASTM D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals*, and utilize a bell and spigot design with a gasket meeting *ASTM F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe*

Provide corrugated polyethylene pipe and fittings manufactured from high-density polyethylene (HDPE) virgin compounds. May use clean, reworked polyethylene Materials from the manufacturer's own production, if the pipe and fittings produced meet the requirements of this section.

Submit a laboratory certification that the pipe connection for each size pipe meets or exceeds the requirements in this section.

Submit the shop drawings of each pipe coupler and any additional mechanical connections required by the Plans.

Mitered end sections are not allowed.

Store and handle corrugated polyethylene pipe as recommended by the manufacturer. Provide pipe manufactured no more than twelve months prior to installation.

Do not use damaged pipe.

3247.3 SAMPLING AND TESTING

Corrugated Polyethylene pipe manufacturing facilities are required to participate and be in compliance with AASHTO's National Transportation Product Evaluation Program (NTPEP) for producers of *AASHTO M 294*, plastic pipe.

Submit a manufacturer's Certificate of Compliance with each pipe shipment including date manufactured and Nominal and actual inside pipe diameters.

3248 POLYVINYL CHLORIDE PIPE

3248.1 SCOPE

Provide polyvinyl chloride (PVC) pipe for use as pipe Culverts or pipe sewers.

3248.2 REQUIREMENTS

Provide PVC pipe listed on *Approved/Qualified Products List* and pipe with couplings and fittings meeting the requirements of the following:

(1) *AASHTO M 304,* "Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter"
(2) *ASTM F949, Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings*
(3) Section 12 of the *AASHTO LRFD Bridge Design Specifications*
(4) Watertight joints with a gasket that shows no sign of leakage when tested in accordance with *ASTM D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals*. Elastomeric seals (gaskets) used for joining pipes must meet *ASTM F77, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe*.

Submit a laboratory certification that the pipe connection for each size pipe meets or exceeds the requirements in this section.

Submit the shop drawings of each pipe coupler and any additional mechanical connections required by the Plans.

Provide PVC pipe and fittings manufactured from virgin PVC compounds. May use clean, reworked PVC Materials from the manufacturer's own production if the pipe and fittings meet the requirements of this section.

Mitered sections are not allowed.

Store and handle corrugated PVC pipe as recommended by the manufacturer. Provide PVC pipe manufactured no more than six months prior to installation.

Do not use damaged pipe.

3248.3 SAMPLING AND TESTING

Polyvinyl Chloride pipe manufacturing facilities are required to participate and be in compliance with AASHTO's National Transportation Product Evaluation Program (NTPEP) for producers of *AASHTO M 304,* PVC pipe.

Submit a manufacturer's Certificate of Compliance with each pipe shipment including date manufactured and Nominal and actual inside pipe diameters.

3249 POLYETHYLENE LINER

3249.1 SCOPE

Provide polyethylene (PE) liner for use in lining pipes.

3249.2 REQUIREMENTS

Provide PE liner meeting one of the following requirements:

(1) PE pipe meeting the requirements of *ASTM F714*, *Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter*, (DR 32.5)
(2) Closed-profile PE pipe with an *ASTM D3350, Standard Specification for Polyethylene Plastic Pipe and Fitting Materials*, cell classification of 345464C
(3) PE pipe meeting the requirements of *ASTM F894, Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe*, with a minimum ring stiffness of 160 or 250 at 3 percent deflection when tested in accordance with

ASTM D2412, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

Store and handle liner as recommended by the manufacturer. Provide liner manufactured no more than twelve months prior to installation.

Do not use damaged liner.

3249.3 SAMPLING AND TESTING

Submit to the Engineer a manufacturer's Certificate of Compliance with each liner shipment.

3252 CAST IRON SOIL PIPE

3252.1 SCOPE

Provide cast iron soil pipe and fittings for use in gravity flow plumbing, drain, waste and vent sanitary, and storm water applications.

3252.2 REQUIREMENTS

Provide cast iron soil pipe and fittings meeting the requirements of *ASTM A74, Standard Specification for Cast Iron Soil and Pipe Fittings*, for the class shown on the Plans or Special Provisions.

3252.3 SAMPLING AND TESTING — BLANK

Subsurface Drainage Units

3278 CORRUGATED POLYETHYLENE DRAINAGE TUBING

3278.1 SCOPE

Provide corrugated polyethylene (PE) tubing and fittings.

3278.2 REQUIREMENTS

Create perforations at manufacture's plant; no field perforations are allowed.

For uses except the 2 inch perforated pipe shown on the Bridge approach panel Standard Plan sheets: Provide corrugated (PE) tubing and fittings meeting the requirements of *AASHTO M 252*, "Standard Specification for Corrugated Polyethylene Drainage Pipe."

For the 2 inch perforated pipe shown on the approach panel sill shown on the Bridge approach panel Standard Plan sheets, provide corrugated and slotted drain pipe meeting the requirements listed in Table 3278.2-1.

Table 3278.2-1
Requirements for 2 inch Perforated Pipe for Bridge Approach Panels

	Requirement
Minimum Water Inlet Area	0.50 inches squared/ foot
Maximum Slot Width	0.04 inches
Minimum Pipe Stiffness at 5 percent Deflection	30 psi
*ASTM D3550**, Cell Classification	323410C
Meeting the requirements of	*ASTM F667*‖
Inside Diameter	1.95 – 2.05 inches
Wall Thickness Minimum	0.023 inches
* *ASTM D3550, Standard Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling Soils*	
‖ *ASTM F667, Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings*	

3278.3 SAMPLING AND TESTING

Submit to the Engineer a manufacturer's Certificate of Compliance with each tubing shipment.

Metals and Metal Products

3301 REINFORCEMENT BARS

3301.1 SCOPE

Provide deformed and plain reinforcing steel for use as reinforcement in concrete construction.

3301.2 REQUIREMENTS

Provide reinforcement bars, other than wire, meeting the requirements of the following AASHTO specifications for the size, type, and grade as shown on the Plans or as required by the Contract:

Table 3301.2-1
AASHTO Specifications Per Bar Type

Reinforcement Bars	**AASHTO Specification Requirement**
Billet steel bars	*AASHTO M 31,* "Standard Specification for Deformed and Plan Carbon and Low-Alloy Steel Bars for Concrete Reinforcement"
Rail steel bars	*AASHTO M 322M/ M 322,* "Standard Specification for Rail-Steel and Axel-Steel Deformed Bars for Concrete Reinforcement"
Axle steel bars	AASHTO M 322 M/ M 322

If the Plans or Specifications do not specify the type or grade of reinforcement bars, provide Grade 60 of any type except as modified by the following:

(1) Provide deformed billet steel reinforcement bars for use in concrete Bridges, including precast units, box Culverts, and retaining walls.

(2) Provide deformed reinforcement bars of any type or grade for use in all other concrete Structures.

(3) If required or allowed by the Contract, weld bars meeting the requirements of *ASTM A706, Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement*, and having a yield point of at least 60,000 psi.

If required in the Plans, provide epoxy coated reinforcement bars meeting the requirements of *ASTM A775, Standard Specification for Epoxy-Coated Steel Reinforcing Bars*. Apply the coating in a fusion bonded epoxy coating plant certified by the CRSI.

Fabricate epoxy coated reinforcement bars in plants participating in the CRSI Epoxy Coated Fabrication Certification Program and listed on CRSI's website. Epoxy coated dowel bar and reinforcing to be used in concrete pavement is exempt from this fabrication requirement.

If epoxy coated reinforcing is supplied from a coater or fabricator that does not have regular inspection by Department, the cost of providing inspection at the coater or fabricator will be withheld from monies paid to the Contractor.

Ensure the plant's Quality Control office maintains documentation required by CRSI certification, including test data and measurements taken at times and locations as directed by the Materials Engineer.

Fabricate, store, and place reinforcement in accordance 2472, "Metal Reinforcement."

3301.3 SAMPLING AND TESTING

Sample and test reinforcement bars in accordance with the *Schedule of Materials Control*. If the Materials Engineer determines that the fusion bonded epoxy coating plant is not following approved coating procedures, correct the process and repair or replace the unacceptable Material as directed by the Materials Engineer.

3302 DOWEL BARS

3302.1 SCOPE

Provide dowel bars for use in Portland cement concrete pavements and other concrete applications as shown on the Plans.

3302.2 REQUIREMENTS

Provide dowel bars meeting the requirements of epoxy coated steel dowel bars or galvanized tubular dowel bars.

A Epoxy Coated Steel Dowel Bars

Provide Grade 40 or Grade 60 steel dowel bars meeting the requirements of *AASHTO M 31*, *Standard Specification for Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement*.

Epoxy coat the steel dowel bars in accordance with *AASHTO M254, Standard Specification for Corrosion-Resistant Coated Dowel Bars*, and as modified:

(1) Apply epoxy coating in a fusion bonded epoxy coating plant certified by the CRSI or another organization approved by the Materials Engineer.
(2) Apply 7-13 mils epoxy coating thickness.
(3) Do not epoxy coat the ends of the dowel bars unless required by the manufacturer.

If cutting dowel bars to length by shearing, immediately repair damaged coating and verify dowel bars have not exceeded the maximum deformation limits. Ensure that sheared dowel bars are not more than 0.04 inches out of round, and that such damage does not extend more than 0.40 inches from the end of the bar.

B Alternate Dowel Bars

Use alternate dowel bar Materials as allowed or required by the Contract.

C Bond Breaker Material

Provide bond breaker Material listed on the *Approved/Qualified Products List*.

Prior to delivery to the Project Site, coat the entire dowel bar assembly or dowel bar bundle with a bond breaker Material in accordance with the Manufacturer's recommendations.

D Certification of Dowel Bars

Ensure the manufacturer's plant Quality Control office maintains documentation containing the data required by certification, including test data and measurements taken at times and locations as required by the CRSI, the Materials Engineer, or both.

Include the following standardized statement with delivery invoices: "(insert company name) certifies that the dowel bars and dowel basket assemblies are coated with a bond breaker Material and meet the requirement of MnDOT Specification 3302."

E Storage and Protection of Dowel Bars

Do not store dowel bars in a manner that will cause, induce, or accelerate corrosion or contamination of the metal at any time. Locate timbers (dunnage) on the ground to support the bundles and keep them free of contamination.

Protect coated dowel bars before handling or shipping to prevent damage to the coating. Pad bundling bands and lift bundles using an OSHA-approved spreader bar, multiple supports, or platform Bridge to prevent bar to bar abrasion from sags in the bar bundle. Do not drag or drop bars or bundles. Support bars or bundles in transit to prevent damage to the coating.

Store Materials at the Project Site to allow the Engineer to visually inspect and check the various types of reinforcement for conformance to the dimensions as shown on the Plans. Store bars of the same type together. Identify dowel bars with tags bearing the identification symbols as shown on the Plans.

If the epoxy-coated steel is incorporated into the Project and is exposed to the weather or stored exposed to the weather for more than 60 Calendar Days, cover the steel to protect the Material from sunlight, salt-spray, and weather exposure. Provide for air circulation around the covered steel to minimize condensation under the protective covering.

3302.3 SAMPLING AND TESTING

Sample and test dowel bars and dowel basket assemblies in accordance with the *Schedule of Materials Control*. The Department will visually inspect the bond breaker Material coating on the dowel bars.

3303 WELDED WIRE REINFORCING

3303.1 SCOPE

Provide welded wire reinforcing for use as concrete reinforcement.

3303.2 REQUIREMENTS

Provide welded wire reinforcing for concrete reinforcement meeting the requirements of *ASTM A1064, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete*, for plain or deformed wire, except the Contractor may use oversized wire. If the Contractor uses oversize wire, the maximum and minimum diameter requirements will not apply. Provide flat sheets or rolls of welded wire reinforcing. Unless otherwise allowed by the Specification, allowable steel areas will be based on Grade 65 for smooth wire and Grade 70 for deformed wire.

3303.3 SAMPLING AND TESTING

Sample and test the welded wire reinforcing in accordance with the *Schedule of Materials Control*.

3305 SPIRAL REINFORCEMENT

3305.1 SCOPE

Provide steel wire for use as spiral cage reinforcement for round columns.

3305.2 REQUIREMENTS

Provide cold drawn steel wire to fabricate spiral cage reinforcement for round columns meeting the requirements of *ASTM A1064, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete*, for the size shown on the Plans. Alternatively, the Contractor may use plain or deformed Grade 60 billet steel bars in accordance with 3301, "Reinforcement Bars."

When required to splice spiral reinforcement by welding, perform welding in accordance with the requirements of *ANSI/AWS D1.4*, "Structural Welding Code - Reinforcing Steel."

3305.3 SAMPLING AND TESTING

Sample and test in accordance with the requirements of 3301, "Reinforcement Bars."

3306 LOW-CARBON STRUCTURAL STEEL

3306.1 SCOPE

Provide carbon steel shapes, plates, bars, sheets, and strips.

3306.2 REQUIREMENTS

Provide low-carbon structural steel meeting the following ASTM requirements, the tensile requirements, and the requirements of 3308, "General Requirements for Structural Steel."

Provide steel shapes, plates, and bars meeting the requirements of *ASTM A709, Standard Specification for Structural Steel for Bridges*, Grade 36.

Provide steel sheets and strips meeting the requirements of *ASTM A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength,* Grade 36 Type 2.

3306.3 SAMPLING AND TESTING

Perform tensile tests for all sizes of shapes and bars in accordance with the *Schedule for Materials Control*.

3308 GENERAL REQUIREMENTS FOR STRUCTURAL STEEL

3308.1 SCOPE

Provide steel for structural applications referenced in 2471, "Structural Metals."

3308.2 REQUIREMENTS

A General

Provide steel for structural applications meeting the requirements of *ASTM A6, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling,* and the following:

B Quality

Submit a Nonconformance Report (NCR) to the Engineer for review and approval before performing any weld repairs of the base metal.

Correct injurious defects (e.g. pipes, seams, unapproved repairs, laminations, cracks, segregations) and perform necessary testing to determine the extent of the defects or confirm the adequacy of repairs, as required by the Engineer, at no additional cost to the Department.

The Engineer will reject plates or rolled beams with defects that reduce the thickness of the Material in any given section by greater than 30 percent.

3308.3 SAMPLING AND TESTING

A Tensile Test

Take tensile specimens for rolled beams from the mid-thickness of the flange and oriented longitudinally to the rolling direction. Note the location and orientation of tensile specimens on the mill test report.

B Impact Tests

Perform impact tests for structural steel provided for use in major structural components as defined in 2471.1A, "Definitions," major structural components, or the Contract. The Department will not require impact testing for minor structural components unless otherwise required by the Contract.

Ensure that impact tested structural steel meets the requirements of *ASTM A709, Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe,* for Zone III Material.

3309 HIGH-STRENGTH LOW-ALLOY STRUCTURAL STEEL

3309.1 SCOPE

Provide high-strength, low-alloy structural steel shapes, plates, bars, sheets, and strips.

3309.2 REQUIREMENTS

Provide high-strength, low-alloy shapes, plates, and bars meeting the requirements of *ASTM A 709, Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe,* Grade 50W, and 3308, "General Requirements for Structural Steel."

Provide high-strength, low-alloy sheet and strip meeting the requirements of *ASTM A606, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance,* Type 4 hot rolled Material and 3308, "General Requirements for Structural Steel," except ensure the yield strength is at least 50,000 psi.

For unpainted Structures, provide all steel Material of the same type.

3309.3 SAMPLING AND TESTING — BLANK

3310 HIGH-STRENGTH LOW-ALLOY COLUMBIUM-VANADIUM STEEL

3310.1 SCOPE

Provide high-strength, low alloy columbium-vanadium steel shapes, plates, bars, sheets, and strips.

3310.2 REQUIREMENTS

Provide shapes, plates, and bars for high-strength, low-alloy columbium-vanadium steel meeting the requirements of *ASTM A709, Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe,* Grade 50, and 3308, "General Requirements for Structural Steel."

Provide sheet and strip for high-strength, low-alloy columbium-vanadium steel meeting the requirements of *ASTM A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural,*

High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength, Grade 50 Class 1, and 3308, "General Requirements for Structural Steel."

3310.3 SAMPLING AND TESTING — BLANK

3312 STAINLESS STEEL

3312.1 SCOPE

Provide stainless steel plates, sheet, and strip.

3312.2 REQUIREMENTS

Provide stainless steel plates, sheet, and strip meeting the requirements of *ASTM A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*, for Type 302 or Type 304.

For the finish, use a No. 4 polish, except on sheet and strip used in bearing and modular expansion joint assemblies, use a No. 8 polish.

Provide stainless steel bars meeting the requirements of *ASTM A276, Standard Specification for Stainless Steel Bars and Shapes*, for Type 302 or Type 304, Condition A (annealed). Provide pin stock in accordance with the requirements for Type IV in 3314, "Cold-Finished Bar Steel."

For free machining applications such as bolt stock, provide stainless steel meeting the requirements of *ASTM A582, Standard Specification for Free-Machining Stainless Steel Bars*, Type 303, Condition A, cold finished, unless otherwise required by the Contract. Provide bolt stock in accordance with 3391.2E, "Stainless Steel Bolts."

De-scale and clean stainless steel surfaces in accordance with *ASTM A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems*.

If welding, use stainless steel with a carbon content no greater than 0.03 percent.

3312.3 SAMPLING AND TESTING — BLANK

3313 HOT ROLLED BAR STEEL

3313.1 SCOPE

Provide rounds, squares, hexagons, or flats for hot rolled bar steel of the following types, as required by the Contract:

3313.2 REQUIREMENTS

A Type I — Carbon Bar Steel

Provide carbon bar steel with the following characteristics:

(1) A minimum yield strength of 45,000 psi
(2) A minimum ultimate strength of 60,000 psi
(3) A minimum elongation of 20 percent in 2 inches

Use *ASTM A400, Practice for Steel Bars, Selection Guide, Composition, and Mechanical Properties*, to select the Material Specifications and grade in accordance with the section and mechanical properties. Procure steel in accordance with the relevant procurement Specifications.

B Type II — Alloy Bar Steel

Provide alloy bar steel with the following characteristics:

(1) A minimum yield strength of 55,000 psi
(2) A minimum ultimate strength of 85,000 psi
(3) A minimum elongation of 15 percent in 2 inches

Use *ASTM A400, Practice for Steel Bars, Selection Guide, Composition, and Mechanical Properties*, to select the Material Specifications and grade in accordance with the section and mechanical properties. Procure steel in accordance with the relevant procurement Specifications.

C Type III — Heat-Treated Alloy Bar Steel (Round)

Provide heat-treated alloy bar (round) steel in accordance with *ASTM A434, Standard Specification for Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered*, with mechanical properties meeting the requirements for Class BC.

D Type IV — Corrosion Resisting Cold Finished Rounds

Provide cold-finished, hot-rolled stainless steel bars for Bridge pins, finished to size in a fabrication shop. Manufacture bars for Bridge pins from a base Material that is annealed and hot-finished free machining, Type 303, as specified in *ASTM A582, Standard Specification for Free-Machining Stainless Steel Bars*.

3313.3 SAMPLING AND TESTING — BLANK

3314 COLD-FINISHED BAR STEEL

3314.1 SCOPE

Provide rounds, squares, hexagons, or flats as required by the Contract.

3314.2 REQUIREMENTS

A Type I — Carbon Bar Steel

Provide cold-finished carbon bar steel meeting the requirements of *ASTM A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished*, Grade C1035, and the following strength requirements, unless the Contract requires otherwise:

(1) For rounds with a diameter no greater than 2 7/8 inches and hexagons and squares with a maximum dimension across flats no greater than 3 inches:

(a) A minimum yield strength of 60,000 psi
(b) A minimum ultimate strength of 70,000 psi
(c) A minimum elongation of 10 percent in 2 inches

(2) For rounds with a diameter greater than 2 7/8 inches and flats, hexagons, and squares with a maximum dimension across flats greater than 3 inches:

(a) A minimum yield strength of 45,000 psi
(b) A minimum ultimate strength of 60,000 psi
(c) A minimum elongation of 20 percent in 2 inches

B Type II — Alloy Bar Steel

Provide cold-finished alloy bar steel meeting the requirements of *ASTM A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished*, and the corresponding annealed and cold-finished Grade AISI 4140 or Grade AISI 4142 and the following strength requirements, unless the Contract requires otherwise:

(1) For rounds with a diameter no greater than 2 15/16 inches and hexagons and squares with a maximum dimension across the flats no greater than 3 inches:

(a) A minimum yield strength of 75,000 psi
(b) A minimum ultimate strength of 95,000 psi
(c) A minimum elongation of 10 percent in 2 inches

(2) For rounds with a diameter greater than 2 15/16 inches and hexagons, squares, and flats with a maximum dimension across the flats greater than 3 inches:

(a) A minimum yield strength of 55,000 psi
(b) A minimum ultimate strength of 85,000 psi
(c) A minimum elongation of 15 percent in 2 inches

C Type III — Heat Treated Alloy Bar Steel (Rounds)

Provide cold-finished pre-heat treated alloy bar steel with the base Material meeting the requirements of *ASTM A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished*, for corresponding Grade AISI 4140 or Grade AISI 4142.

D Type IV — Corrosion Resisting Cold Finished Rounds

Provide cold-finished stainless steel rounds for use as Bridge pins meeting the requirements of *ASTM A276, Standard Specification for Stainless Steel Bars and Shapes*, Type 316, annealed and center-less ground.

3314.3 SAMPLING AND TESTING — BLANK

3315 STEEL FORGINGS

3315.1 SCOPE

Provide Material for steel forgings.

3315.2 REQUIREMENTS

A Material Requirements

Provide Material for steel forgings meeting the requirements for one of the three types of steel specified in this section, as required by the Contract. If the Contract does not specify a steel type, provide Type I.

A.1 Type I — Carbon Steel Forgings

Provide carbon steel forgings meeting the requirements of *ASTM A668, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use*, Class D forged from blooms, billets, bars, or slabs meeting the requirements of *ASTM A711, Standard Specification for Steel Forging Stock*, Grade C 1035 or Grade C 1040.

A.2 Type II — Alloy Steel Forgings

Provide alloy steel forgings, for sizes no greater than 9 inches thick or in diameter, meeting the requirements of *ASTM A668, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use*, for Class G.

Provide alloy steel forgings, for sizes greater than 9 inches thick or in diameter, meeting the requirements of *ASTM A668, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use*, for Class H.

Provide alloy steel forgings made from alloy steel blooms, billets, bars, or slabs meeting the requirements of *ASTM A711, Standard Specification for Steel Forging Stock* for Grade 4140, Grade 4142, or Grade 4145.

A.3 Type III — Corrosion Resisting Steel Forgings

Provide corrosion resisting steel forgings made from billets or bars primarily produced for reforging in accordance with *ASTM A314*, *Standard Specification for Stainless Steel Billets and Bars for Forging*, for Type 316.

Provide steel forgings meeting the physical and chemical requirements for hot-rolled Materials as specified in *ASTM A276, Standard Specification for Stainless Steel Bars and Shapes*. Provide Type 316 Material that is fully annealed to develop maximum corrosion resisting properties. Workmanship, appearance, and finish must conform to *ASTM A484, Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings*.

B Machine Finishing

Machine steel forgings after the annealing process is complete. Finish forgings in accordance with 2471, "Structural Metals."

Unless otherwise shown on the Plans or required by the Contract, bore a 2 inch round hole longitudinally through the center of each type of forged steel pin roller measuring over 9 inches in diameter.

3315.3 SAMPLING AND TESTING

Ensure the supplier performs the following physical and chemical tests required by the ASTM Specifications for Type I, Type II, and Type III Material:

(1) Perform magnetic particle tests on Type I forgings in accordance with *ASTM E709, Standard Guide for Magnetic Particle Testing*
(2) Perform magnetic particle tests on Type II forgings in accordance with *ASTM A275, Standard Practice for Magnetic Particle Examination of Steel Forgings*
(3) Perform ultrasonic tests on Type III forgings in accordance with *ASTM A388, Standard Practice for Ultrasonic Examination of Steel Forgings*

Ensure the supplier performs magnetic particle testing after machining operations are complete. The Engineer will reject Material with serious defects such as bursts, cracks, pipes, internal cracks and flakes, or laminations.

Submit to the Engineer Certified Test Reports for physical, chemical, magnetic particle, and ultrasonic tests from the Supplier.

3316 HIGH PERFORMANCE STEEL (Y.S. 50 KSI)

3316.1 SCOPE

Provide high-strength, low-alloy structural steel shapes, plates, and bars to enhance atmospheric corrosion resistance, weldability, and mechanical properties.

3316.2 REQUIREMENTS

Provide Material for high-performance steel meeting the requirements of *ASTM A709, Standard Specification for Structural Steel for Brid*ges, Grade HPS 50W and 3308, "General Requirements for Structural Steel." Provide Grade HPS 50W high-performance steel with a minimum specified yield strength of 50 ksi.

3316.3 SAMPLING AND TESTING — BLANK

3317 HIGH PERFORMANCE STEEL (Y.S. 70 KSI)

3317.1 SCOPE

Provide high-strength, low-alloy structural steel shapes, plates, and bars, to enhance atmospheric corrosion resistance, weldability, and mechanical properties.

3317.2 REQUIREMENTS

Provide Materials for high-performance steel meeting the requirements of *ASTM A709, Standard Specification for Structural Steel for Bridges*, Grade HPS 70W and 3308, "General Requirements for Structural Steel." Provide high-performance steel Grade HPS 70W with a minimum specified yield strength of 70 ksi.

3317.3 SAMPLING AND TESTING — BLANK

3321 GRAY IRON CASTINGS

3321.1 SCOPE

Provide gray iron castings for drainage or structural use. The castings are classified according to tensile strength, but the Department will make provisions for acceptance of drainage castings and other ornamental or non-stress bearing castings on the basis of flexural tests.

3321.2 REQUIREMENTS

Provide gray iron castings meeting the requirements of *AASHTO M 105*, "Standard Specification for Gray Iron Castings," for the class required by the Contract. Obtain the castings from foundries, approved by the Materials Engineer, in accordance with these Specifications.

A Class Designation

If the Contract does not specify a strength class, provide castings in accordance with any of the following:

(1) Provide Class 40C, or better, for stress bearing castings such as Bridge rockers, bolsters, and sliding shoes
(2) Provide Class 35B, or better, for Bridge rail posts, light standard bases, drainage and manhole castings, and other castings subject to vehicle impact or vehicle loading

B Special Requirements

Provide drainage castings of metal with a Brinell hardness number from 190 to 265.

Provide round casting assemblies with lid-to-frame surfaces machine-milled to provide true bearing around the entire circumference.

C Foundry Control

Before beginning casting, the manufacturer and the Engineer will establish, in conference, a control procedure for correlating casting operations, arranging for foundry inspection, and establishing an approved identification system. Unless the Engineer otherwise agrees, the manufacturer will identify castings as follows:

(1) With a mark correlating the casting with test bars using a system of heat numbers or a Calendar Date and tap number, using numerals no greater than 1/2 inch.
(2) With a mark indicating the source of manufacture, using a symbol no greater than 1 1/2 inches in the largest dimension or a letter no greater than 3/4 inch high and 2 inches long.
(3) With the Department's type or style number shown on the Plans, in the size and location indicated.

Form these identification marks on castings of sufficient size during manufacture. If the casting size is insufficient for the marks, use stamped metal tags wired to the castings for markings not formed in the castings. Place identification marks, subject to approval by the Engineer, where they will not interfere with assembly of parts and will not be removed during machine finishing operations. Ensure the manufacturer does not place its name on castings except as specified above.

D Casting Details

Provide castings meeting the dimensions shown on the Plans. Provide draft by increasing the net dimensions. Provide castings within a tolerance of 1/8 inch for the overall general dimensions. Limit the tolerance in dimensions of grates and covers for drainage casting assemblies, and the openings into which they fit, to 1/16 inch. In no case is the metal thickness to be less than 1/16 inch less than the thickness shown on the Plans.

Provide castings with a density of at least 95 percent of the theoretical density of that type, based on 442 pounds per cubic foot, cast to the exact dimensions shown on the Plans.

Pour castings in closed molds with gating, feeders, risers, and sprues. Ensure castings completely fill the molds. Do not remove castings from the molds until properly cooled. Do not chill the castings.

Boldly fillet castings on the inside and reentrant corners. Round the outside corners and edges to a radius of at least 1/8 inch. For Bridge bearings, use a 1/2 inch fillet except where the fillet may interfere with assembly.

E Workmanship and Finish

Remove attachments of gates, risers, and sprues from the castings and grind remaining extensions flush to the casting surface. The Engineer will reject castings damaged through careless removal of attachments. Do not repair by welding.

Fabricate castings free of sponginess, cracks, blow holes, warping, sand inclusions, cold shuts, chilled iron shrinks, and other defects that affect the strength and value of the casting for the purpose intended. Ensure the contact surfaces between different castings in an assembly provide a firm, even bearing, without rattling or rocking.

Clean castings of foundry sand, rust, scale, and other deleterious Material.

3321.3 SAMPLING AND TESTING

Ensure the manufacturer casts the required number of test bars, as stated below, and machine finishes tension test specimens to the dimensions required in the *Schedule for Materials Control*. Unless otherwise approved by the Engineer, the manufacturer will deliver test specimens to the Materials Laboratory for testing.

Cast three test bars for each heat or tap. If adding alloys in the ladle, cast three test bars for each ladle. For continuous furnace pouring, cast two test bars at the beginning and two test bars at the end of cast.

For Bridge bearing castings, cast at least one test bar for each casting. Pour castings and test bars in the presence of the Engineer, unless the test bars are cast as an integral part of the bearing castings.

Identify each test bar separately and to the corresponding castings using symbols, letters, or numbers cast on the test bar and casting.

If properly identifying castings and corresponding test bars is not possible, the Engineer may require test specimens to be cut from selected castings that are representative of a lot, and perform tests on those samples.

3322 CARBON STEEL CASTINGS

3322.1 SCOPE

Provide mild to medium strength carbon steel castings for general applications requiring a tensile strength of no more than 70,000 psi.

3322.2 REQUIREMENTS

Provide carbon steel castings meeting the requirements of *ASTM A27, Standard Specification for Steel Castings, Carbon, for General Application*, for the grade required by the Contract and this section.

A Grade Designations

If the Contract does not specify a strength grade, provide castings in accordance with the requirements for *ASTM A27, Standard Specification for Steel Castings, Carbon, for General Application,* Grade 70-36.

Supply castings in a normalized or normalized and tempered condition.

B Casting Details

Provide casting patterns that will produce a finished casting with the dimensions and details shown on the Plans. Provide draft by increasing the net dimensions without reducing the metal thickness as required by the Contract.

Boldly fillet sharp angles. Provide fillets of a size that does not reduce the clearance required by the Contract. Round external corners on castings, except ornamental types, to a radius of 3/16 inch.

Make allowance for shrinkage and provide enough Material on surfaces requiring a finish to produce castings of the specified size and shape after the completion of finishing operations as shown on the Plans.

The Engineer will not allow split cores between unfinished surfaces of restricted clearance. Provide face cores of one piece, unless castings require machine finishing. Provide chaplets spaced, and in numbers to prevent the chaplets from impairing the strength of the casting. Provide chaplets that are completely fused.

Fabricate castings using methods that will ensure corners, arises, and edges are completely filled. For castings with one machine surface, cast with the machine surface down. Do not use metal from different melts in the same casting.

Do not withdraw castings from the mold until properly cooled. Do not quench castings to speed up cooling.

C Workmanship and Finish

The Engineer will reject castings with structural defects in a casting, including blow hole shrink pipes, sand hole cracks, checks, slag inclusions, cold shuts, unfilled arises, warped surfaces, or deformation from core or flask movement. Do not repair castings with minor defects until the Engineer provides permission and approves the repair method.

Grind extensions, high spots, and rough edges resulting from pouring connections, smooth and flush with the casting surface. Clean castings of foundry sand, rust, scale, and other deleterious Material before painting, galvanizing, or metalizing as required by the Contract.

Clean, paint, galvanize, and metalize castings in accordance with 2471, “Structural Metals.”

3322.3 SAMPLING AND TESTING

If the Engineer suspects the soundness of a casting, the Engineer has the right to subject castings to radiographic or magnetic particle inspection, at no additional cost to the Department.

A Test Specimens

Attach test coupons using the preferred method of a keel block, but do not make attachments that may structurally weaken the casting.

Cast 2 test coupons integrally for each casting greater than 750 pounds. Provide 2 test coupons for each casting heat less than 750 pounds, and cast the test coupons as ribs, integrally and below a special block no less than 6 inches by 6 inches by 2 inches.

B Foundry Control

Identify castings with embossed markings, indicating the heat from which the casting was poured, together with the Bridge and piece numbers. Die mark the same information on the representative test coupons.

Mark test coupons and castings for each heat. Do not remove coupons until after the castings are heat-treated. The Engineer will reject castings without proper identification unless the Inspector can identify corresponding test coupons by matching fractures.

3323 ALLOY STEEL CASTINGS

3323.1 SCOPE

Provide alloy steel castings.

3323.2 REQUIREMENTS

Provide alloy steel castings meeting the requirements of *ASTM A743, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application*, Grade CA-15 and this section.

Provide castings in a normalized or normalized and tempered condition. Ensure that the reduction of area is at least 30 percent.

3323.3 SAMPLING AND TESTING

Provide test specimens, foundry control, casting details, workmanship and finish, and inspection and testing in accordance with 3322.2B, "Casting Details," 3322.2C, "Workmanship and Finish," 3322.3A, "Test Specimens," and 3322.3B, "Foundry Control," except cast two test coupons integrally with each casting regardless of mass.

3324 MALLEABLE IRON CASTINGS

3324.1 SCOPE

Provide malleable iron castings.

3324.2 REQUIREMENTS

Provide malleable iron castings meeting the requirements of *ASTM A47*, *Standard Specification for Ferritic Malleable Iron Castings*, for the grade required by the Contract and this section.

For galvanized castings, heat treat to meet the requirements for the specified grade. Galvanize in accordance with *ASTM A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*.

3324.3 SAMPLING AND TESTING — BLANK

3325 WROUGHT BRONZE PLATES

3325.1 SCOPE

Provide wrought bronze plates.

3325.2 REQUIREMENTS

Provide wrought bronze plates that are cold-finished and meet the requirements of *ASTM B100, Standard Specification for Wrought Copper-Alloy Bearing and Expansion Plates and Sheets for Bridge and*

Other Structural Use, Alloy C51000 or Alloy C65500, or *ASTM B169, Standard Specification for Aluminum Bronze Sheet, Strip, and Rolled Bar*, Alloy C61400.

For plates fabricated in accordance with *ASTM B169*, meet the following hardness requirements:

Table 3325.2-1
Wrought Bronze Plates

Plate Thickness, inch	Hardness	
	Brinell	Rockwell by Conversion
≥5/16 – 1/2	≥ 128	≥ B73
≥1/2 – 2	≥ 121	≥ B70

3325.3 SAMPLING AND TESTING — BLANK

3327 BRONZE CASTINGS — TYPE 1

3327.1 SCOPE

Provide Type 1 bronze castings for nameplates and other castings.

3327.2 REQUIREMENTS

Provide Type 1 bronze castings meeting the requirements of *ASTM B584, Standard Specification for Copper Alloy Sand Castings for General Applications*, Alloy C83600.

Use this low-strength copper alloy for nameplates and other castings with light detail allowing lightly filleted corners and a natural patina.

3327.3 SAMPLING AND TESTING — BLANK

3328 BRONZE CASTINGS — TYPE 2

3328.1 SCOPE

Provide Type 2 bronze castings for Bridge bearing plates, medium pressure bearing sleeves, and bright ornamental castings and other items having light details.

3328.2 REQUIREMENTS

Provide Type 2 bronze castings meeting the requirements of *ASTM B148, Standard Specification for Aluminum-Bronze Sand Castings*, Alloy C95300 or *ASTM B584, Standard Specification for Copper Alloy Sand Castings for General Applications*, Alloy C86500, subject to the following:

(1) Modify the chemical composition of Alloy C86500 to allow a maximum manganese content of 3.5 percent
(2) Unless the Plans specify 1 alloy, the Contractor may use either of the 2 alloys designated in this section

Use Type 2 bronze castings for Bridge bearing plates, medium pressure bearing sleeves, bright ornamental castings, and other items with light detail allowing medium filleted corners and slightly rounded arises and a medium bright finish.

3328.3 SAMPLING AND TESTING — BLANK

3329 LUBRICATED BRONZE BEARING PLATES AND BUSHINGS

3329.1 SCOPE

Provide aluminum bronze bearing plates and manganese bronze bushings.

3329.2 REQUIREMENTS

Provide aluminum bronze bearing plates meeting the requirements of *ASTM B505, Standard Specification for Copper Alloy Continuous Castings*, Alloy C95400 or Alloy C95500; *ASTM B148, Standard Specification for Aluminum-Bronze Sand Castings*, Alloy C95400 or Alloy C95500; or *ASTM B169, Standard Specification for Aluminum Bronze Sheet, Strip, and Rolled Bar*, Alloy C61400, Temper M20. Provide manganese bronze bushings meeting the requirements of *ASTM B584, Standard Specification for Copper Alloy Sand Castings for General Applications*, Alloy C86200 or Alloy C86300. Provide bearing plates and bushings from standard production.

Provide bronze bearing plates and bushings with recesses completely filled with lubricating compound. Form recesses by trepanning, drilling, or the shell molding process, as shown on the Plans, but at least 3/16 inch deep. Ensure recesses have straight sides without grooves, and do not intersect the edges of the parent plate or bushing. Provide plates with recesses that are uniformly spaced in a geometric pattern over the area of the bearing, with adjacent rows overlapping in the direction of motion.

Provide lubricating compound consisting of graphite, metallic substances, and a lubricant binder to form a dense, non-plastic, lubricating insert, capable of withstanding spalling and atmospheric elements. Do not use shellac or other gummy Materials as the lubricant binder. Ensure the top surface of the bearing insert is flush with or slightly above the surface of the bearing plate or bushing.

For both bearing plates and bushings, provide a lubricated area that comprises 25 percent to 30 percent of the total area. If the plate or bushing manufacturer uses a bearing insert in the shape of a hollow cylinder, ensure the net lubricated area is at least 20 percent of the total area of the plate or bushing.

If the Plans do not indicate which surfaces to lubricate, provide inserts for surfaces that have provisions for movement other than flexural.

Provide bearing plates and bushings with contact surfaces with at least a 125 micro inch finish.

Provide bearing plates that are true to detail, flat surfaces truly flat and curved surfaces curved true to the radius with an allowable working tolerance of 0.02 inches between male and female fittings. Provide a minimum net section of 1/2 inch for the bronze.

Provide bushings with a wall thickness of at least 3/8 inch. Provide the machine allowances for the inside diameter and outside diameter operating fit of bushings recommended by the manufacturer unless otherwise shown on the Plans.

Ensure the bronze and steel portions of bearing plates and bushings are assembled in the fabricating shop and match marked or bonded together and shipped as a unit.

3329.3 SAMPLING AND TESTING — BLANK

3331 SHEET BRASS

3331.1 SCOPE

Provide sheet brass.

3331.2 REQUIREMENTS

Provide sheet brass meeting the requirements of *ASTM B36, Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar*, Alloy C26000 or Alloy C26800 in H02, H03, or H04 temper.

3331.3 SAMPLING AND TESTING — BLANK

3332 SHEET COPPER

3332.1 SCOPE

Provide sheet copper.

3332.2 REQUIREMENTS

Provide sheet copper meeting the requirements of *ASTM B152, Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar*, for any type of copper with a total copper and silver content at least 99.9 percent, and the following:

(1) Provide a light cold-rolled temper

(2) The Structural Metals Engineer will waive the requirements for resistivity and embrittlement tests

(3) Ensure the copper sheet withstands the bend test by cold-bending the sheet through an angle of 180 degrees flat upon itself without fractures on the outside of the bend portion

3332.3 SAMPLING AND TESTING — BLANK

3335 SHEET LEAD

3335.1 SCOPE

Provide sheet lead prepared from pig lead.

3335.2 REQUIREMENTS

Provide sheet lead prepared from pig lead meeting the requirements of *ASTM B29, Standard Specification for Refined Lead*. Provide sheets with a thickness within a tolerance of 5 percent of the thickness required by the Contract.

3335.3 SAMPLING AND TESTING — BLANK

3336 WROUGHT AND EXTRUDED ALUMINUM

3336.1 SCOPE

Provide aluminum alloy for specified applications.

3336.2 REQUIREMENTS

Provide aluminum alloy products meeting relevant requirements of the ASTM specifications listed in this section. Provide the alloy and temper for a specified application as required by the Contract.

Provide sheet and plate products meeting the requirements of *ASTM B209, Standard Specification for Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes*, Alloy 1100, Alclad 2024, Alclad 3003, or Alclad 6061.

Provide standard structural shapes, rolled or extruded, meeting the requirements of *ASTM B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles*, Alloy 6061-T6.

Provide pipe and tube products meeting the following requirements:

(1) Drawn, seamless tube in accordance with *ASTM B210, Standard Specification for Seamless Medium-Carbon Steel Boiler and Superheater Tubes*, Alloy 6061 or Alloy 6063

(2) Seamless pipe and seamless extruded tube in accordance with *ASTM B241, Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube*, Alloy 6061 or Alloy 6063.

(3) Extruded structural pipe in accordance with *ASTM B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube*, Alloy 6061 or Alloy 6063. Provide sand castings meeting the requirements of *ASTM B26, Standard Specification for Aluminum-Alloy Sand Castings*, Alloy SG70A or Alloy S5B. Provide permanent mold castings meeting the requirements of *ASTM B108, Standard Specification for Aluminum-Alloy Permanent Mold Castings*, Alloy SG70A, Alloy SG70B, Alloy S5B, or Alloy S7A

Provide other miscellaneous aluminum products as shown on the Plans or the Special Provisions.

3336.3 SAMPLING AND TESTING — BLANK

3340 STAINLESS STEEL CLAD PLATE

3340.1 SCOPE

Provide stainless steel clad plate.

3340.2 REQUIREMENTS

Provide stainless steel clad plate meeting the requirements of *ASTM A264, Standard Specification for Stainless Chromium-Nickel Steel-Clad Plate*, and this section.

Provide Type 316L stainless steel cladding. Unless the Contract requires otherwise, provide a plate clad on one side with a Nominal thickness of 10 percent, at least 9 percent of the total plate thickness, or no greater than 1/2 inch of cladding.

Provide cladding and base metal with a shear strength of at least 20,000 psi when tested in accordance with *ASTM A264, Standard Specification for Stainless Chromium-Nickel Steel-Clad Plate*.

Provide the clad surface of the plate with a sand blasted and pickled finish or a blast cleaned and pickled finish.

Provide the plate in a heat-treated condition. Perform heat treatment so cladding develops maximum corrosion-resistant properties.

3340.3 SAMPLING AND TESTING — BLANK

3348 SEVEN-WIRE STRAND FOR PRESTRESSED CONCRETE

3348.1 SCOPE

Provide one of two grades of seven-wire, uncoated, low-relaxation steel strand for pretensioned and posttensioned prestressed concrete construction.

3348.2 REQUIREMENTS

Provide steel strands meeting the requirements of *ASTM A416, Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete*, Grade 250 with an ultimate tensile strength of 250,000 psi, and *ASTM A416* Grade 270 with an ultimate tensile strength of 270,000 psi, based on the Nominal area of the strand.

3348.3 SAMPLING AND TESTING

Submit 2 copies of the mill certificate, 2 copies of the stress-strain curve representing the lot, and steel strand samples to the Engineer. Provide mill certifications with bond strength test results representative of the current year's production, showing that the manufacturing process produces strand with a bond strength of at least 36,000 psi at a measured free-end slip no greater than 3/32 inch. Ensure an accredited, independent testing laboratory performs or certifies bond strength tests. Perform bond strength tests on an embedment length of 18 inches in accordance with standard test procedures on file in the Department's Office of Materials.

3351 SHEET STEEL PRODUCTS

3351.1 SCOPE

Fabricate galvanized sheet steel products for erosion control or other uses, including open metal flumes or gutters, Culvert headwalls or aprons, anti-seepage diaphragms, erosion dams, and cribbing.

3351.2 REQUIREMENTS

The term, "metal unit" refers to the products specified in this section.

A Materials

Provide galvanized steel in the fabrication of metal units meeting the requirements of *ASTM A929, Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe*, except as modified for different coating classes.

If the Plans or Specifications specify a galvanized coating requirement other than 2 ounce per square foot of sheet, provide galvanized coating in accordance with *ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*.

Provide the steel thickness shown on the Plans.

Galvanize rivets consisting of the same base metal as used for the sheets. Unless the Contract requires otherwise, provide bolts, nuts, and washers of commercial grade and galvanized in accordance with *ASTM A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*. Provide other unspecified steel shapes, plates, bars, and rods made of steel meeting the requirements of 3306, "Low-Carbon Structural Steel," and galvanized in accordance with *ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products*.

B Fabrication

Provide units fabricated to the shape and dimensions shown on the Plans. Avoid cracking or breaking the spelter coating on galvanized sheets.

Ensure fabricated units of the same Nominal size and type are interchangeable. Do not drill, punch, or drift to correct defects in manufacture. Ensure the centers of rivets or bolt holes are at least twice the diameter of the holes from the edge of the metal. Locate slots, holes, and lugs for accurate field assembly as shown on the Plans.

Drive rivets cold, and ensure the plates are drawn tightly together throughout the entire lap. Provide rivets with full hemispherical heads or heads of a form acceptable to the Engineer. Drive rivets without bending and completely fill the hole with driven rivets.

3351.3 SAMPLING AND TESTING 3226.3

3352 SIGNS

3352.1 SCOPE

Provide fabricated sign panels complete with border, legend, route markers, and legend components as individual items. Retroreflective sheeting, transparent film, imaging system, and legend shall be provided by the same manufacturer and shall be a matched component system.

For the purpose of the Work specified in section 3352, Signs," the Department defines the term "Legend" as letters, numerals, arrows, and symbols that convey the message on signs.

3352.2 REQUIREMENTS

Provide sign panels as specified in the *Standard Signs and Markings Manual*, the *MN MUTCD*, as detailed in the Contract, and in accordance with this section.

A Materials

Fabricate sign panels in the colors meeting the *FHWA Color Tolerance Charts* unless otherwise specified in this section. The Department will determine color compliance by visual comparison with the appropriate chart.

A.1 Sheet Aluminum

Provide sheet aluminum for sign panels meeting the requirements of *ASTM B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)* for Alloy 5052-H38 or Alloy 6061-T6. Use sign base Material with no warps or twists so the finished sign panel will lay flat against the post or mounting Structure. Provide sheet aluminum thickness for single section sign panels, panel sections of multiple section signs, and sign panels type overlay in accordance with Table 3352.2-1.

Table 3352.2-1
Sheet Aluminum Thickness

Length of Longest Side	Thickness
≤18	0.063 ± 0.004
>18 – 30	0.080 ± 0.005
>30	0.100 ± 0.005
Installed on Extruded Panels	0.063 ± 0.004

A.2 Extruded Aluminum, Bolted Type

Provide extruded aluminum panels meeting the requirements of *ASTM B221M, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)*, for Alloy 6063-T6 and in accordance with the following sizes and weights:

(1) 12 inch wide and at least 2.53 pounds per foot of length
(2) 6 inch wide and at least 1.02 pounds per foot of length

Use aluminum alloy hardware or stainless steel hardware as recommended by the manufacturer to assemble the panel sections and to attach to the supports. Use nylon insert stainless steel locknuts meeting the requirements of *ASTM F594*, *Standard Specification for Stainless Steel Nuts*, Type 304 for the nuts for post clip bolts.

A.3 Retroreflective Sheeting

Provide retroreflective sheeting on the *Approved/Qualified Products List* for "Traffic control devices" as specified in this section. Materials on this list meet the requirements of *ASTM D4956, Standard Specification for Retroreflective Sheeting for Traffic Control*, and 23 CFR 655 Appendix to Subpart F. Some standard sheeting types have been modified to reflect Department requirements.

A.3.a Sign Sheeting Type III

Provide Sign Sheeting Type III for traffic cones, tubular delineators, and yellow cylinder style delineators. Additionally, sheeting Material shall be tested to ensure that it meets the impact resistance of the Material at 32°F.

A.3.b Sign Sheeting Type IV

Provide Sign Sheeting Type IV for permanent signs, delineators, markers, tubular delineators, and traffic cones. Provide white and fluorescent orange Sign Sheeting Type IV for reboundable plastic drums and weighted channelizers. Additionally, sheeting Material shall be tested to ensure that it meets the impact resistance of the material at 32°F.

A.3.c Sign Sheeting Type V

Provide Sign Sheeting Type V for cylinder style delineators and tubular delineators. Additionally, sheeting Material shall be tested to ensure that it meets the impact resistance of the Material at 32°F.

A.3.d Sign Sheeting Type VI

Provide Sign Sheeting Type VI for temporary roll-up signs and traffic cones.

A.3.e Sign Sheeting Type VIII

Provide white and fluorescent orange Sign Sheeting Type VIII for reboundable plastic drums, weighted channelizers, tubular delineators, and white cylinder style delineators. Additionally, sheeting Material shall be tested to ensure that it meets the impact resistance of the material at 32°F.

A.3.f Sign Sheeting Type IX

Provide fluorescent orange Sign Sheeting Type IX for rigid substrate construction signs.

A.3.g Sign Sheeting Type XI

Provide Sign Sheeting Type XI for permanent signs, delineators, markers, barricade sheeting.

Provide fluorescent orange Sign Sheeting Type XI for rigid substrate construction signs.

A.4 Sheeting Warranty Requirements

Ensure the sign sheeting Materials are included on the *Approved/Qualified Products List* at the time of letting. Ensure the warranty provided by the sign sheeting Materials manufacturer meets or exceeds the requirements in Table 3352.2-2, and flows down to and is enforceable by the Department. All warranties commence upon Project acceptance unless otherwise noted.

Table 3352.2-2
Reflective Sheeting Warranties

Material	Warranty
Prismatic sign sheeting for permanent signs and white cylinder style delineators (non-fluorescent)	Twelve years total. The first 7 years covers 100 percent full replacement of Material and labor costs associated with fabricating and installing the sign or device. The final 5 years covers 100 percent of sheeting replacement.
Fluorescent prismatic sign sheeting for permanent signs	Ten years total. The first 7 years covers 100 percent full replacement of Material and labor costs associated with fabricating and installing the sign or device. The final 3 years covers 100 percent of sheeting replacement.
Encapsulated lens sign sheeting for permanent signs and yellow cylinder style delineators	Ten years total. The first 7 years covers 100 percent full replacement of Material and labor costs associated with fabricating and installing the sign or device. The final 3 years covers 100 percent of sheeting replacement.
Prismatic sign sheeting for rigid signs (work zone use)	Three years covers 100 percent sheeting replacement.
Prismatic sign sheeting for reboundable plastic drums and weighted channelizers	Replacement of defective products.
Prismatic sign sheeting for work zone barricades	Prorated warranty for 3 years covers sheeting replacement.
Rollup sign sheeting (work zone use)	Prorated warranty for 3 years covers sheeting replacement.

Use inks and overlays that are part of the sign sheeting Materials manufacturer's integrated components system. Fabricate sign in accordance with Material manufacturer's requirements so that the sign sheeting Materials manufacturer honors the required warranty covering the loss of retroreflectivity, loss of color, cracking, and other conditions that cause ineffectiveness in meeting the intended use.

Sign sheeting must maintain retroreflectivity values during the warranty in accordance with Table 3352.2-3.

Table 3352.2-3
Minimum Retroreflectivity Values

Sign Sheeting Type	Warranty Period	Minimum Allowable Retroreflection	Total Daytime Luminance Factor Minimum
Type III	From Project acceptance until 7 years after Project acceptance	80 percent	—
Type III	7 years after Project acceptance until 10 years after Project acceptance	70 percent	—
Type III Traffic Cones	None	—	—
Type III Tubular Delineators	None	—	—
Type IV Drums and Channelizers	From installation until Project acceptance or removal, whichever is longer	—	—
Type VI	From Project acceptance until 3 years after Project acceptance	50 percent	20 percent
Type VIII Cylinder Style Delineators	From Project acceptance until 7 years after Project acceptance	80 percent	—
Type VIII Cylinder Style Delineators	From 7 years after Project acceptance until 12 years after Project acceptance	70 percent	—
Type VIII Fluorescent Orange	None	—	—
Type IX	From Project acceptance until 7 years after Project acceptance	80 percent	—
Type IX	From 7 years after Project acceptance until 12 years after Project acceptance	70 percent	—
Type IX Fluorescent Yellow-Green	From Project acceptance until 10 years after Project acceptance	70 percent	60 percent
Type IX Fluorescent Yellow	From Project acceptance until 10 years after Project acceptance	70 percent	40 percent
Type IX Fluorescent Orange	From Project acceptance until 3 years after Project acceptance	70 percent	20 percent
Type XI	From Project acceptance until 7 years after Project acceptance	80 percent	—
Type XI	From 7 years after Project acceptance until 12 years after Project acceptance	70 percent	—
Type XI Fluorescent Yellow Green	From Project acceptance until 10 years after Project acceptance	70 percent	60 percent
Type XI Fluorescent Yellow	From Project acceptance until 10 years after Project acceptance	70 percent	40 percent
Type XI Fluorescent Orange	From Project acceptance until 3 years after Project acceptance	70 percent	20 percent
Type XI Barricades	From Project acceptance until 3 years after Project acceptance	50 percent	—

Note: Percentages are based on minimum original values meeting the requirements of *ASTM D4956, Standard Specification for Retroreflective Sheeting for Traffic Control* and 23 CFR 655 Appendix to Subpart F.

A.5 Transparent Overlay Film

Ensure the transparent overlay film sign sheeting Materials are included on the *Approved/Qualified Products List* at the time of letting. Ensure the warranty provided by the sign sheeting manufacturer meets the requirements of the retroreflective sign sheeting Material to which it is applied.

Use sign faces made of pigmented, flexible, weather-resistant plastic film free from blemishes. Use a transparent acrylic film that is part of the sign sheeting manufacture's system of matched, compatible components. The transparent acrylic film shall have a pressure sensitive, transparent adhesive. Once the border, legend, route markers, and other legend components have been placed on the sheet aluminum, apply the transparent overlay film. Apply the film in accordance with the sign sheeting Materials manufacturer's recommendations. Cure the film for 48 hours between 70°F and 90°F. Ensure the film meets the following characteristics:

(1) Film does not shrink more than 1/32 inches from the edge of a panel at 150°F for 48 hours
(2) Film and adhesive do not separate at −10°F for 24 hours
(3) Adhesion, color, and general appearance show no visible effects from immersion in distilled water for 24 hours
(4) Film and adhesive do not delaminate at 150°F after 24 hours

A.6 Legend

Apply sign sheeting Material to demountable shapes before they are applied to sign panel.

A.6.a Direct Applied Legend

Provide a legend consisting of shapes cut from sign sheeting.

A.6.b Screen Processed Painted Legend

Use a direct or reverse screening process to apply the painted legend to the sheeting. Use screen process paints approved by the sign sheeting Materials manufacturer that will adhere to the retroreflective sheeting surface in accordance with sign sheeting Materials manufacturer's recommendations. Digitally printed legend and border will not be accepted.

For the sign face Material on the State route markers, obtain the gold color with a screen-processed color using a transparent gold paint. Obtain the blue color with a screen-processed color using transparent blue paint. Ensure the overlap of the blue and gold screen-processed colors does not exceed 3/32 inches.

A.6.c Transparent Overlay Film Legend

Provide a legend consisting of shapes cut from transparent overlay film.

A.7 Fasteners

A.7.a 3/16 inch Rivet

Use dome head stainless steel open end blind rivet with a stainless steel mandrel. Head diameter shall be 3/8 inch. Drilled hole shall be between 0.192 and 0.196 inch diameter. The body shall be 3/16 inch diameter.

A.7.b 1/4 inch Rivet

Use dome head aluminum structural with locking stem blind rivet and aluminum mandrel. Head diameter shall be 0.525 inch. Drilled hole shall be between 0.261 and 0.272 inch diameter. The body shall be 1/4 inch diameter.

B Fabrication

B.1 General

Fabricate sign panels as shown on the Plans and with details and alphabets contained in the *Standard Signs and Markings Manual* and *Federal Standard Highway Signs and Markings* book. Fabricate sign panels free of cracks, wrinkles, blisters, and other blemishes while adhering

to sign sheeting Material manufacturer's recommendations. Ensure that sign Materials are handled in accordance with directions and recommendations of the sign sheeting Materials manufacturer(s). Sign fabricators shall be certified by sign sheeting Materials manufacturers.

B.2 Design and Dimensions

Fabricated finished sign panels must be in accordance with the designs, dimensions, and punching as shown in the contract and *Standard Signs and Markings Manual*.

B.3 Surface Treatment of Metal

Clean and treat the metal in accordance with sign sheeting Materials manufacturer's recommendations before applying the sign sheeting Material. Do not use chromate type chemical conversion treatment.

Apply cleaning or treatment chemicals or detergents as directed by the sign sheeting Materials manufacturer. Maintain laboratory facilities to test and control the concentration of the solutions used at the treatment plant. Maintain a log of the concentration of treating solutions.

After treatment and cleaning, use a device or clean canvas gloves to handle sign base Material until after the application of sign sheeting Material.

B.4 Applying Sign Face and Legend Sheeting

Apply retroreflective sheeting, transparent overlay film, and legend Material to the sign face as recommended by the sign sheeting Materials manufacturer.

For sign panels with brown sheeting, provide white retroreflective sheeting for sign face Material and brown transparent overlay film. If splicing is required to apply transparent overlay film on sign panels, provide vertical butt splices spaced so splices do not occur through letters or arrows.

Before applying the transparent overlay film to the sign face Material, cut and weed-out the legend and border from the transparent overlay film as shown on the sign panel details in the Contract. Then apply the weeded transparent overlay film to the white, retroreflective sheeting sign-face Material. Then apply the transparent overlay film "corner" pieces located outside the border that fill in the square corners of the sign panel.

Sign panels for signs with black, blue, green, and red backgrounds may be provided through the method described for sign panels with brown sheeting.

Do not splice retroreflective sign sheeting on panels with dimensions smaller than 48 inches in height and 48 inches in width. If the retroreflective sign sheeting Material is not available in this width, use the widest width Material available for that type.

Splice the retroreflective sign sheeting so that sheeting joints are vertical. Use the least number of seams possible. Butt-joint gaps so that gap does not exceed 1/32 inch.

Match colors of adjacent sheets of retroreflective sign sheeting on sign panels so that there is no noticeable difference in color.

Do not splice transparent overlay film sign Materials except on sign panels where the background changes color.

B.5 Fabrication Stickers

Provide and affix fabrication stickers to the backside of sign panels except delineators and markers.

Screen a fabrication sticker with the following information:

(1) Sign fabricator company name and address
(2) The twelve months of the year in numeric order
(3) The last two digits of the current year and the next four years

Indicate the month and year of fabrication of the sign panel on the sticker using one of the following methods:

(1) Punch-out the fabrication month and year of the sign panel on the completed sticker
(2) Block out the month and year of fabrication on the screen before applying the black ink so that the month and year of fabrication will not be displayed

The fabrication sticker shall measure 3 inch by 1.5 inch with a black legend on a white, reflectorized background. Provide a sample to the Engineer for approval.

Affix the fabrication sticker to the backside of each sign panel in the lower right corner when facing the back of the sign panel. For installations of sign panels less than 42 inches wide mounted on two posts, install the sticker at the bottom center of the sign panel.

C Packaging

Before packaging, allow signs to stand for at least 12 hours. Pack single panel signs in corrugated paper cartons or other containers to prevent the package from breaking and to protect the signs from damage during shipment. Separate signs with coated paper that will not stick to the sign face Material. Package single-panel signs in packages weighing no greater than 125 pounds and no thicker than 3 1/2 inches. Package multiple panels, for the same sign, together. Deliver signs without damage.

3352.3 SAMPLING AND TESTING

The Engineer may inspect sign fabrication and Materials at the fabrication site, at the sign sheeting Materials manufacturer's plant, or at the Project.

Notify the Engineer at least 14 Calendar Days before fabricating the signs. The Engineer may send an Inspector to the plant to inspect the raw Materials or the fabrication. If the sign is inspected during fabrication, the Inspector will stamp each package of signs with the Department inspection mark or with the mark of its delegated representative.

3354 PREFORMED PAVEMENT MARKING TAPE

3354.1 SCOPE

Provide white, yellow, white contrast, and yellow contrast retroreflective pavement marking tape prefabricated for recessed traffic marking on bituminous and concrete pavements.

3354.2 REQUIREMENTS

A General

Provide pavement marking tape meeting the following requirements and characteristics:

(1) Made of prefabricated retroreflective pliant polymer Material
(2) Provides a cushioned resilient substrate that reduces bead crushing and loss
(3) Weather resistant
(4) Under traffic wear, shows no appreciable fading in accordance with the color requirements in 3354.2C, "Color," lifting, or shrinkage throughout the life of the marking
(5) Shows no significant tearing, roll back, or other signs of poor adhesion
(6) Underside of the pavement marking tape precoated with pressure sensitive adhesive

(7) Protected during shipment and in storage

Apply the preformed pavement marking tape as recommended by the manufacturer to provide a neat, durable marking that will not flow or distort due to temperature if the pavement surface remains stable. Use Equipment and application methods specified by the manufacturer.

Uniformly distribute beads throughout the polymer with strongly bonded protruding surface beads.

B Retroreflectivity

Provide preformed pavement marking Material meeting the minimum initial pavement marking retroreflectivity values using 30 meter geometry and meeting the testing procedures of *ASTM E1710, Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer*.

Table 3354.2-1
Minimum Initial Pavement Marking Retroreflectivity

	White	Yellow
Tape	600 milli-candela/ square meter/lux	500 milli-candela/ square meter/lux

C Color

Provide preformed pavement marking tape meeting the following requirements:

(1) White color no darker or yellower than 17778 of AMS-STD-595A
(2) Daytime color of yellow meeting the following CIE Chromaticity limits using illuminant "D65/2"

Table 3354.2-2
Daytime Chromaticity Coordinates (Corner Points)

	1	2	3	4
x	0.465	0.485	0.520	0.480
y	0.450	0.470	0.450	0.420

(3) Luminance Factor, Cap Y meeting the requirements of *ASTM D6628*, *Standard Specification for Color of Pavement Marking Materials*, Table 3
(4) Nighttime color of yellow meeting the following chromaticity limits as specified in *ASTM D6628,* Table 2:

Table 3354.2-3
Nighttime Chromaticity Coordinates (Corner Points)

	1	2	3	4
x	0.575	0.508	0.473	0.510
y	0.425	0.415	0.453	0.490

D Tensile Stress

Provide preformed pavement marking tape with a tensile stress of at least 40 psi at maximum load when tested in accordance with *ASTM D638, Standard Test Method for Tensile Properties of Plastics*. Test a sample 6 inches by 1 inch by 0.060 inches at a temperature from 70°F to 81°F using a jaw speed of 6 inches per minute.

E Elongation

Provide preformed pavement marking tape with an elongation of at least 15 percent at maximum load, when tested in accordance with *ASTM D638, Standard Test Method for Tensile Properties of Plastics*.

F Skid Resistance

Ensure the surface of the retroreflective pliant polymer provides a skid resistance value of at least 45 British Pendulum Number (BPN) when tested in accordance with *ASTM E303, Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester*.

G Thickness

G.1 Unpatterned

Provide unpatterned retroreflective pavement marking tape at least 0.060 inches thick.

G.2 Patterned

Provide patterned retroreflective pavement marking tape at least 0.065 inches thick at the thickest portion of the patterned cross-section and at least 0.020 inches thick at the thinnest portion of the cross-section.

3354.3 SAMPLING AND TESTING

Submit samples at least 10 feet long of each color required to the Materials Laboratory. Submit to the Engineer a manufacturer's Certificate of Compliance.

Mark the samples with the following information:

(1) Name of manufacturer
(2) Place of manufacture
(3) Batch or lot number
(4) Month and year of manufacture

3355 REMOVABLE PREFORMED PAVEMENT MARKING TAPE

3355.1 SCOPE

Provide white, yellow, white contrast, and yellow contrast removable retroreflective preformed pavement marking tape for use as temporary traffic markings.

3355.2 REQUIREMENTS

A General

Provide removable retroreflective preformed pavement marking tape listed on the *Approved/Qualified Products List* and meeting the following requirements and characteristics:

(1) Precoated with a pressure sensitive adhesive
(2) Capable of adhering to asphalt concrete and Portland cement concrete surfaces as recommended by the manufacturer without the use of heat, solvents, or other additional adhesive means, and immediately ready for traffic after application
(3) Capable of performing for the duration of 6 non-winter months
(4) Capable of being removed intact or in large pieces without the use of heat, solvents, grinding, or blasting
(5) Reinforced by a non-metallic medium to facilitate removal
(6) Provided in the widths and shapes required by the Contract
(7) Available in preformed words and symbols meeting the requirements for the applicable shapes and sizes in accordance with the *MN MUTCD*
(8) Packaged in a way that the chemical composition is not altered or compromised

(9) Meets the requirements in this Specification for at least 1 year after the date of purchase, when stored in a cool dry indoor area

B Color

Provide white retroreflective preformed pavement marking tape no darker or yellower than 17778 of AMS-STD-595A.

Provide yellow retroreflective preformed pavement marking tape meeting the following requirements:

(1) Daytime color meeting the following CIE Chromaticity limits using illuminant "D65/2":

Table 3355.2-1
Daytime Chromaticity Coordinates (Corner Points)

	1	2	3	4
x	0.465	0.485	0.520	0.480
y	0.450	0.470	0.450	0.420

(2) Luminance Factor, Cap Y, meeting the requirements of *ASTM D6628, Standard Specification for Color of Pavement Marking Materials*, Table 3

(3) Nighttime color meeting the following chromaticity limits as specified in *ASTM D6628,* Table 2

Table 3355.2-2
Nighttime Chromaticity Coordinates (Corner Points)

	1	2	3	4
x	0.575	0.508	0.473	0.510
y	0.425	0.415	0.453	0.490

C Retroreflectivity

Provide retroreflective preformed pavement marking Material meeting the minimum initial pavement marking retroreflectivity values using 30 meter geometry and meeting the testing procedures of *ASTM E1710, Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer*.

Table 3355.2-3
Minimum Initial Pavement Marking Retroreflectivity

	White	Yellow
Tape	600 milli-candela/ meters squared/lux	500 milli-candela/ meters squared/lux

D Frictional Resistance

Ensure the surface of the retroreflective pavement marking film provides a frictional resistance value of at least 45 British Pendulum Number (BPN) when tested in accordance with *ASTM E303, Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester*.

E Thickness

Provide retroreflective pavement marking film, including beads, at least 50 mils thick.

3355.3 SAMPLING AND TESTING

Submit samples at least 10 feet long of each color to be used. Submit to the Engineer a manufacturer's Certificate of Compliance. Clean the surface of the tape sample of dirt, adhesive, and asphalt. Provide tape samples capable of being unrolled for the entire length on a surface for testing.

Mark the rolls of Material with the following information:

(1) Name of manufacturer
(2) Place of manufacture
(3) Batch or lot number
(4) Month and year of manufacture

3356 PREFORMED THERMOPLASTIC PAVEMENT MARKING

3356.1 SCOPE

Provide retroreflective thermoplastic pavement marking product prefabricated for recessed traffic marking on bituminous and concrete pavements.

3356.2 REQUIREMENTS

A General

Provide thermoplastic pavement marking product meeting the following requirements and characteristics:

(1) Made of prefabricated retroreflective, resilient thermoplastic Material
(2) Contains glass beads uniformly distributed through the entire cross-sectional area
(3) Does not require pre-heating, unless used for the removal of moisture
(4) Capable of being affixed to bituminous or concrete pavement by heating
(3) Resistant to deterioration due to exposure to sunlight, water, salt, and adverse weather conditions
(4) Under traffic wear, shows no appreciable fading in accordance with the color requirements in 3356.2C, "Color," lifting, or shrinkage throughout the life of the marking
(5) Capable of conforming to pavement contours, breaks, and faults through the action of traffic at normal pavement temperatures
(6) Possesses resealing characteristics, such that it is capable of fusing with itself and previous thermoplastic markings when heated
(7) Protected during shipment and in storage

B Retroreflectivity

Provide preformed thermoplastic pavement marking Material meeting the minimum initial pavement marking retroreflectivity values using 30 meter geometry and meeting the testing procedures of *ASTM E1710, Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer*.

Table 3356.2-1
Minimum Initial Pavement Marking Retroreflectivity

	White	Yellow
Thermoplastic	300 milli-candela/ meters squared/lux	200 milli-candela/ meters squared /lux
Thermoplastic, enhanced skid resistance (ESR)	250 milli-candela/ meters squared /lux	150 milli-candela/ meters squared /lux

C Color

Provide preformed thermoplastic pavement marking Material meeting the following requirements:

(1) White color no darker or yellower than 17778 of AMD-STD-595A
(2) Daytime color of yellow meeting the following CIE Chromaticity limits using illuminant "D65/2":

Table 3356.2-2
Daytime Chromaticity Coordinates (Corner Points)

	1	2	3	4
x	0.465	0.485	0.520	0.480
y	0.450	0.470	0.450	0.420

(3) Luminance Factor, Cap Y meeting the requirements of *ASTM D6628 Table 3*, of 35 percent minimum for white and 25 percent minimum for yellow

(4) Nighttime color of yellow meeting the following chromaticity limits as specified in *ASTM D6628, Standard Specification for Color of Pavement Marking Materials*

Table 3356.2-3
Nighttime Chromaticity Coordinates (Corner Points)

	1	2	3	4
x	0.575	0.508	0.473	0.510
y	0.425	0.415	0.453	0.490

D Glass Beads

Ensure intermixed glass beads provided in the preformed thermoplastic Material meet the requirements of *AASHTO M 247,* "Standard Specification for Glass Beads Used in Pavement Markings," Type 1 and/or Type 3 to meet the retroreflectivity requirements of section 3356.2B, "Retroreflectivity," above, and have a minimum of 80 percent rounds.

E Skid Resistance

Ensure the surface of the retroreflective preformed thermoplastic Material provides a skid resistance value of at least 45 British Pendulum Number (BPN) when tested in accordance with *ASTM E303, Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester*. Ensure that the surface of preformed thermoplastic Material with enhanced skid resistance (ESR) provides a skid resistance value of at least 60 BPN.

F Thickness

Provide retroreflective thermoplastic pavement marking Material at least 90 mils thick.

3356.3 SAMPLING AND TESTING

Submit a sample measuring at least 6 inch by 6 inch of precut legends or 1 sheet of precut line Material of each color used to the Materials Laboratory. Submit to the Engineer a manufacturer's Certificate of Compliance.

Mark the samples with the following information:

(1) Name of manufacturer
(2) Place of manufacture
(3) Batch or lot number
(4) Month and year of manufacture

3361 STRUCTURAL STEEL TUBING

3361.1 SCOPE

Provide steel tubing for structural use in trusses or Bridge rails.

3361.2 REQUIREMENTS

Provide steel tubing that conforms to the following requirements:

(1) The ASTM requirements below and 3308, "General Requirements for Structural Steel"

(2) The requirements for Type A or the Plans
(3) Either welded or seamless tubing for all applications
(4) Easily weldable using conventional shop practices

A Type A — Cold formed Carbon Steel Tubing

Provide Type A square or rectangular structural tubing meeting the requirements of *ASTM A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes*, Grade B.

B Type B — Hot formed Carbon Steel Tubing

Provide Type B square or rectangular structural tubing meeting the requirements of *ASTM A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing*.

C Type C — High Strength Low Alloy Weathering Steel Tubing

Provide Type C square or rectangular structural tubing meeting the requirements of *ASTM A847, Standard Specification for Cold-Formed Welded and Seamless High-Strength, Low-Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance*, or *ASTM A618, Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing*, Grade Ia, Grade Ib, or Grade II.

3361.3 SAMPLING AND TESTING — BLANK

3362 STRUCTURAL STEEL PIPE

3362.1 SCOPE

Provide steel pipe for structural use in railing.

3362.2 REQUIREMENTS

Provide steel pipe for structural use meeting the requirements of *ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*, *ASTM A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service, (seamless pipe)*, *ASTM A135, Standard Specification for Electric-Resistance-Welded Steel Pipe, (welded pipe)*, or provide structural steel tubing meeting the requirements of *ASTM A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes*, or *ASTM A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing*, with the following modifications:

(1) Unless the Contract requires a different mass or wall thickness, provide pipe with a mass of at least the standard mass for Schedule 40 in accordance with *ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*
(2) Provide pipe with a minimum yield strength of 35,000 psi
(3) Unless required by the Contract, the Engineer will not require hydrostatic testing
(4) Provide pipe free of dirt, grease, loose scale, and rust
(5) Provide pipe with plain ends unless the Contract requires threaded ends
(6) Provide pipe free of mill stamps and large or heavy knurl marks
(7) Provide screw fittings 3 inches or less in diameter made from either steel or malleable iron. Provide cast steel for screw fittings over 3 inches in diameter
(8) Provide high-strength low-alloy structural tubing meeting the requirements of *ASTM A618, Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing*, Grade 1
(9) Provide welding fittings meeting the requirements of *ASTM A234, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service*, for factory-made wrought carbon steel and ferritic alloy steel welding fittings. Use a grade equivalent to the tensile properties specified for the steel pipe

3362.3 SAMPLING AND TESTING — BLANK

3363 ALUMINUM TUBE FOR PIPE RAILING

3363.1 SCOPE

Provide aluminum alloy extruded tubes for Bridge railing.

3363.2 REQUIREMENTS

Provide aluminum alloy extruded tubes for Bridge railing meeting the requirements of *ASTM B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes*, Alloy 6061-T6510.

3363.3 SAMPLING AND TESTING — BLANK

3364 WROUGHT STEEL PIPE

3364.1 SCOPE

Provide wrought steel pipe for Bridges and Structures.

3364.2 REQUIREMENTS

Provide wrought steel pipe meeting the requirements of *ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*, with a mass or wall thickness that at least meets the requirements of *ASTM A53*, Schedule 40, unless the Contract requires otherwise.

Galvanize the pipe and fittings, unless the Contract requires otherwise.

The Contractor may provide cast steel or malleable iron screw fittings for fittings no greater than 3 inches in diameter. Provide cast steel screw fittings for fittings greater than 3 inches in diameter.

Provide welding fittings meeting the requirements of *ASTM A234, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service*, for butt welding fittings.

3364.3 SAMPLING AND TESTING — BLANK

3365 DUCTILE IRON PRESSURE PIPE

3365.1 SCOPE

Provide ductile iron pressure pipe.

3365.2 REQUIREMENTS

Provide ductile iron pressure pipe meeting the requirements of *ASTM A377, Standard Index of Specifications for Ductile Iron Pressure Pipe*, for the diameter and relevant American Standard required by the Contract. Provide ductile iron pressure pipe coated with bituminous enamel lining and exterior coating.

3365.3 SAMPLING AND TESTING — BLANK

3366 COPPER WATER TUBE AND FITTINGS

3366.1 SCOPE

Provide copper water tube and fittings.

3366.2 REQUIREMENTS

Provide copper water tube meeting the requirements *of ASTM B88, Standard Specification for Seamless Copper Water Tube*, Type A pipe, annealed. Provide red brass, flared fittings for copper water tube.

3366.3 SAMPLING AND TESTING — BLANK

3371 STEEL SHELLS FOR CONCRETE PILING

3371.1 SCOPE

Provide steel shells for cast-in-place concrete piling.

3371.2 REQUIREMENTS

Provide cylindrical steel shells for cast-in-place concrete piles meeting the physical strength and chemical requirements of *ASTM A252, Standard Specification for Welded and Seamless Steel Pipe Piles*, Grade 3.

If specified in the Plans as an alternative, the Contractor may provide cold-rolled fluted steel shells meeting the requirements of SAE 1010 or SAE 1015 with tensile yield strength of at least 50,000 psi in accordance with *ASTM A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products*. Provide tapered piles with a tip diameter of at least 8 inches and a butt diameter of at least the Nominal diameter required by the Contract.

Provide steel shells with a thickness and strength capable of withstanding the driving forces to substantial refusal in accordance with 2452.3E, "Penetration and Bearing," and with a Nominal wall thickness as specified in Table 3371.2-1.

For piling with a painted finish in accordance with 2452.3H.1, "Painted Piles," or with a galvanized finish in accordance with 2452.3H.2, "Galvanized Piles," provide piling free of irregularities or deleterious matter adversely affecting the finished coating.

The Contractor may request the Engineer's approval of the use of small quantities of piling representing less than 5 percent of the entire Structure, from the Contractor's surplus of cut-offs and overruns. Submit mill test reports and a certification stating that the Department previously approved the piling for use on another Department Project.

Table 3371.2-1
Steel Shell Requirements

	Steel Shell Options	
Nominal Pile Size, inches	**Nominal Outside Diameter, inches**	**Minimum Wall Thickness, inches***
10	10	0.219
	10 3/4	0.219
12	12	0.250
	12 3/4	0.250
	12, fluted ‖	0.179
16	16	0.312
	16, fluted ‖	0.203
18	18	0.375
	18, fluted ‖	0.250
20	20	0.375
24	24	0.500
* Unless otherwise shown on the Plans or Special Provisions. ‖ Do not use fluted or tapered shells for exposed pile-bent piles unless otherwise shown on the Plans or Special Provisions for a particular Structure.		

3371.3 SAMPLING AND TESTING

Provide one certified copy of mill test reports with heat numbers identified, including physical test reports and chemical analyses, and mill shipping papers to the Engineer before delivering the Material to the Project. Include the actual carbon, manganese, and phosphorus contents in the chemical analysis report.

3372 STEEL PILING

3372.1 SCOPE

Provide steel H-piles for Structure construction.

3372.2 REQUIREMENTS

Provide steel H-piles for bearing sections in the size and weight per unit of length as shown on the Plans and meeting the requirements of *ASTM A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel*, Grade 50 for structural quality carbon steel shapes.

Provide a steel H-pile tip listed on the *Approved/Qualified Products List* under "H-Pile Tip Protection."

3372.3 SAMPLING AND TESTING

Provide one certified copy of mill test reports with heat numbers identified, including physical test reports and chemical analyses, and mill shipping papers to the Engineer before delivering the Material to the Project. Include the actual carbon, manganese, and phosphorus contents in the chemical analysis report.

3373 STEEL SHEET PILING

3373.1 SCOPE

Provide steel sheet piling for construction of Bridges and piers.

3373.2 REQUIREMENTS

Provide a steel sheet piling of the style, dimensions, and mass required by the Contract and meeting the requirements of *ASTM A328, Standard Specification for Steel Sheet Piling*, or *ASTM A572,*

Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel, Grade 42, Grade 50, or Grade 60.

3373.3 SAMPLING AND TESTING — BLANK

3376 FENCE WIRE

3376.1 SCOPE

Provide barbed, woven, and chain link fencing wire, wire fasteners, tie wires, hardware, and tension wire.

3376.2 REQUIREMENTS

A Barbed Wire

Provide 4 point, full round barbs at least 0.375 inches long. The Contractor may provide one of the following types of barbed wire, meeting the requirements of *AASHTO M 280*, "Standard Specification for Metallic-Coated (Carbon) Steel Barbed Wire," unless the Contract requires otherwise:

(1) Zinc-coated barbed wire meeting the requirements of Class 3
(2) Standard security grade aluminum-coated barbed wire
(3) High security grade aluminum-coated barbed wire

B Woven Wire

Provide metallic-coated, Type A or Type Z Class 3 steel woven wire fence fabric meeting the requirements of *AASHTO M 279*, "Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric," for the size and construction required by the Contract.

Provide No. 9 Grade 60 design woven wire fabric meeting the requirements of *AASHTO M 279* if the contract does not specify the size and construction.

Use the hinge joint method with at least 1 1/2 tightly wrapped twists to join the vertical stay wires to each horizontal line wire.

C Chain Link

Provide chain link fabric meeting the requirements of *AASHTO M 181*, "Standard Specification for Chain-Link Fence," for the type required by the Contract. Use chain link fence with the finished wire size, mesh size, selvage type, and fabric height as shown on the Plans. Use Class A extruded and bonded or Class B bonded Type IV fabric, PVC coated steel.

D Miscellaneous Items

Provide hardware items meeting the requirements of *AASHTO M 181* unless otherwise specified in this section or required by the Contract.

Use L-shaped staples with barbed, serrated, or ring shanks or U-shaped staples made of 9 gauge diameter wire galvanized after fabrication meeting the requirements of *ASTM A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*, to attach wire to wood posts with shank length as specified in 2557.3C.2, "Barbed Wire and Woven Wire."

Use flat metal bands instead of wire fasteners if approved by the Engineer.

Provide hog rings meeting the requirements of *ASTM F626, Standard Specification for Tin Mill Products, Electrolytic Tin Plate, Double Reduced*. When polymer coating is required, provide hog rings with a Class 2A or Class 2B polymer coating thickness meeting the requirements of *ASTM F668, Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric*.

Provide wire ties meeting one of the following requirements:

(1) 9 gauge steel meeting the requirements of *AASHTO M 181*
(2) At least 0.179 inch aluminum alloy meeting the requirements of *ASTM B211, Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire*, Alloy 1100 H18

Provide polymer-coated wire ties meeting the same coating thickness requirements as polymer-coated fabric.

Provide tension wire meeting the requirements of *AASHTO M 181*.

Provide tension bars, truss rods, truss rod tighteners, barbed wire arms, tension bands, brace bands, rail and brace ends, rail sleeves, post and line caps, and cups meeting the requirements of *AASHTO M 181*.

Provide polymer-coated tension bars, truss rods, truss rod tighteners, tension bands, brace bands, post and line caps, and cups with a bonded polymer coating thickness of at least 0.010 inch.

Provide zinc coated nuts and bolts meeting the requirements of *AASHTO M 232*, "Standard Specification for Zinc Coating (Hot -Dip) on Iron and Steel Hardware." Shop-paint or field-paint nuts and bolts when polymer-coated fence is required.

3376.3 SAMPLING AND TESTING

Submit to the Engineer a manufacturer's Certificate of Compliance for each fence component in this section including Buy America compliance, if required.

Sample and test in accordance with the *Schedule of Materials Control*.

3379 FENCE GATES

3379.1 SCOPE

Provide vehicular gates and pedestrian gates with pipe frames.

3379.2 REQUIREMENTS

A General

Use the same pipe, hardware, fittings, fence wire, and appurtenance Materials to assemble all gates provided to the Project.

B Materials

Use a frame made of galvanized steel pipe or aluminum alloy pipe.

B.1 Galvanized Steel Pipe

Provide galvanized steel pipe meeting the requirements of *ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*, for galvanized Standard Schedule 40 pipe with plain ends. Hydrostatic testing of the pipe is not required.

B.2 Aluminum Alloy Pipe

Provide aluminum alloy pipe meeting the requirements of *AASHTO M 181*, "Standard Specification for Chain-Link Fence."

B.3 Fittings and Hardware

As shown on the Plans, use corner fittings, tops, stretcher bars, truss rods, and other required fittings, hardware, and appurtenances made of steel, malleable iron, wrought iron, or aluminum alloy. If using steel or iron, galvanize fittings or hardware in accordance with *AASHTO M 181* after fabrication.

B.4 Wire

Provide barbed wire, gate fabric for woven wire fence, and gate fabric for chain link fence as specified in 3376, "Fence Wire."

C Physical Properties

Use gate and members with physical properties as shown on the Plans.

Use fittings, hardware, and other required appurtenances capable of being securely fastened and fitted to meet the requirements of the approved design.

Provide hinges and catch and locking devices meeting the requirements of an approved design.

3379.3 SAMPLING AND TESTING

Submit to the Engineer a manufacturer's Certificate of Compliance for each component in this section including Buy America compliance, if required.

Sample and test in accordance with the *Schedule of Materials Control*.

A Metal Pipe and Fittings..... 3406

B Fence Wire and Fasteners..... 3376

3381 WIRE ROPE AND FITTINGS FOR CABLE GUARDRAIL

3381.1 SCOPE

Provide wire rope and accessory fittings for use in cable guardrail construction.

3381.2 REQUIREMENTS

Provide wire rope and fittings for proprietary high-tension cable guardrail systems meeting the manufacturer's specifications.

Provide wire rope and fittings for low-tension cable guardrail meeting the requirements of *AASHTO M 30*, "Standard Specification for Metallic-Coated Steel Wire Rope and Fittings for Highway Guardrail," and the following:

A Wire Rope Requirements

Provide wire rope meeting the requirements of Type 1 with Class A coating unless otherwise specified.

B Fitting Requirements

Unless the manufacturer specifies otherwise, provide bolts and nuts used to assemble the guardrail elements meeting the requirements of *ASTM A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 psi Tensile Strength*.

Provide bolt heads and nuts with dimensions meeting the requirements of ANSI No. B 18.2 for the type shown on the Plans.

Use externally threaded fittings including end tie rods, anchor rods, post loops, and splicing studs that transmit direct tensile stress having a tensile strength of at least 75,000 psi. Use internally threaded

fittings such as turnbuckles, cable sockets, and nuts capable of withstanding a proof load equal to 85 percent of the proof load requirements for nuts as specified in *ASTM A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 psi Tensile Strength,* Table III. Use expansion assemblies, cable splices, and connections capable of withstanding a proof load equal to the tensile strength required of the attached wire rope cable or as specified by the manufacturer.

Provide steel rectangular plate washers and cable clamps with a tensile strength of at least 60,000 psi. Provide ferrous metal plain circular washers meeting the requirements of ANSI/ASME B 18.22.1, Type A.

3381.3 SAMPLING AND TESTING

Provide samples for testing as directed by the Engineer.

The Engineer will test wire rope and fittings for cable guardrail meeting the requirements of *AASHTO M 30*.

3382 STEEL PLATE BEAMS AND FITTINGS FOR TRAFFIC BARRIERS (GUARDRAIL)

3382.1 SCOPE

Provide steel plate beams and fittings for use in guardrail construction.

3382.2 REQUIREMENTS

Provide steel plate beams and fittings for guardrail construction meeting the requirements of *AASHTO M 180*, "Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrail" for the type and class required by the Contract. Unless the Plans show otherwise, provide beams meeting the requirements for Class A, Type II (galvanized).

Provide w-beam and thrie-beam rail elements, posts, blocks, soil plates, reducer sections, and end treatments that meet the requirements of *A Guide to Standardized Highway Barrier Hardware*, published by AASHTO, ARTBA, and AGC.

3382.3 SAMPLING AND TESTING

Triple-spot test galvanized beams and fittings.

3385 ANCHOR RODS

3385.1 SCOPE

Provide anchor rod Material in four general strength levels. The Plans may show, or the Special Provisions may specify other types of anchor rod Material.

3385.2 REQUIREMENTS

Use the ASTM or product reference for each type of anchor rod Material. Unless the Contract requires otherwise, provide anchor rods meeting the requirements for Type A and fabricated from single rounds. Galvanize Type A, Type B, and Type C anchor rods in accordance with 3392, "Galvanized Hardware," unless otherwise shown on the Plans.

A Type A — Carbon Steel Anchor Rods

Provide Type A anchor rods meeting the requirement of *ASTM F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength*, Grade 36 Class 2A, with supplementary requirement S3 for permanent grade identification. Provide nuts and washers as recommended in *ASTM F1554* Grade 36 anchor rods.

B Type B — Intermediate Strength Anchor Rods

Provide Type B anchor rods meeting the requirements of *ASTM F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength,* Grade 55 Class 2A, with supplementary

requirement S1 for weldability and supplementary requirement S3 for permanent grade identification. Provide nuts and washers as recommended in *ASTM F1554* Grade 55 anchor rods.

C Type C — High Strength Anchor Rods

Provide Type C anchor rods meeting the requirements of *ASTM F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength,* Grade 105 Class 2A, with supplementary requirement S3 for permanent grade identification and supplementary requirement S5 for Charpy impact testing. Provide nuts and washers as recommended in *ASTM F1554* Grade 105 anchor rods. Do not make an anchorage cage by tack-welding Type C anchor rods or welding anchor rods to other Material. Hold Type C anchor rods in place mechanically using methods approved by the Engineer.

D Type D — Stainless Steel Anchor Rods

Provide Type D anchor rods, nuts, and washers meeting the requirements of *ASTM A276, Standard Specification for Stainless Steel Bars and Shapes,* Type 304 or Type 316 stainless steel, and 3391.2, "Fasteners, Requirements," for stainless steel fasteners. Do not make an anchorage cage by tack welding Type D anchor rods or welding anchor rods to other Material. Hold Type D anchor rods in place mechanically using methods approved by the Engineer.

3385.3 SAMPLING AND TESTING

Provide samples for testing meeting the requirements of the Department's *Schedule of Materials Control*.

3391 FASTENERS

3391.1 SCOPE

Provide various types and grades of fasteners for use in general and structural applications.

3391.2 REQUIREMENTS

Provide fasteners of the type shown on the Plans. Provide bolts, nuts, and washers meeting the requirements of ANSI for the type required by the Contract. Unless otherwise required by the Contract, provide threads that are ANSI Coarse Thread Series with a Class 2A tolerance for bolts and Class 2B tolerance for nuts.

A Common Structural Steel Bolts

Provide bolts and nuts meeting the requirements of *ASTM A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 psi Tensile Strength*. For bolts at least 1/2 inch in diameter, use Grade B bolts with heavy hexagon nuts.

B High Strength Structural Steel Bolts

Provide field and shop bolts for steel Bridges meeting the requirements of *ASTM F3125, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength*, Grade A325 Type 3 bolts. Provide bolts that project through the nut from 1/8 inch to 3/8 inch. Provide field and shop nuts for steel Bridges that meet *ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts, Grade C3 or DH3 nuts and shop washers for steel Bridges that meet ASTM F436, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions*, Type 3 washers.

Provide bolts, nuts, and washers installed before the application of the prime coat, in the uncoated "Black" condition. Apply the same paint coatings to the bolts as applied to the structural steel. Provide mechanically galvanized fasteners that are to be field installed after the application of the prime coat meeting the requirements of *ASTM B695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel*, Class 50 Type 1.

For all other Bridges and Structures, provide bolts meeting the requirements of *ASTM F3125, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength,* Grade A 325 Type 1 (for painted or galvanized applications) or Type 3 (for unpainted weathering steel applications). Provide bolts that project through the nut from 1/8 inch to 3/8 inch. Provide nuts meeting the requirements of *ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts,* and washers meeting the requirements of *ASTM F436*, *Standard Specification for Hardened Steel Washers Inch and Metric Dimensions*.

For bolts meeting the requirements of *ASTM F3125, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength*, include Supplementary Requirement S4 *Rotational Capacity Testing*. Ship required documentation with the fastener assemblies and provide to the Engineer.

Only retighten bolts meeting the requirements of *ASTM F3125, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength* A325 once.

Regardless of specified finish, provide nuts lubricated with a lubricant of contrasting color meeting the requirements of *ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts,* Supplementary requirements S1, S2, and S3 at the time of the installation of the fasteners.

C Bolts for Wood Construction

Unless otherwise shown on the Plans, provide bolts for wood construction in accordance with 3391.2A, "Common Structural Steel Bolts," and galvanized by a mechanical or hot-dip process. Provide the mass of coating meeting the requirements of *ASTM A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*.

D Stud Welded Fasteners

Provide studs in the size and configuration required by the Contract. Provide defect-free, weldable carbon steel studs meeting the requirements of *ASTM A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished*, for cold drawn bars Grade 1015, Grade 1018, or Grade 1020. For the purpose of welding, provide studs with fluxed tips or fluxed ferrules and equipped with a ceramic ring or ferrule arc shield.

Provide Material for the studs meeting the following characteristics:

(1) An ultimate strength of at least 60,000 psi
(2) A yield strength of at least 50,000 psi
(3) A elongation of at least 20 percent in 2 inches
(4) A reduction of area of at least 50 percent

Provide threaded studs with nuts capable of developing the minimum ultimate strength requirement of the net cross-section area of the threaded portion of the stud.

Provide shear connector studs with a head height and head diameter within a dimensional tolerance of 1/16 inch.

Identify stud containers by the heat number of the steel from which the studs were produced.

E Stainless Steel Bolts

Provide stainless steel bolts made of Material meeting the requirements of *ASTM F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs*, Condition CW1, Type 304, Type 316, or Type 316L. Provide finished bolts with the following characteristics:

(1) A yield strength of at least 60,000 psi
(2) An ultimate tensile strength of 95,000 psi
(3) A minimum elongation of 20 percent in 2 inches

Provide stainless steel nuts made of Material meeting the requirements of *ASTM F594, Standard Specification for Stainless Steel Nuts*, Condition CW1, Type 304, 316, or 316L.

After fabrication (if required), fully anneal bolts, nuts, and washers to promote maximum corrosion resistance of the stainless steel. After heat treatment, give parts a pacifying treatment in a nitric acid solution. Perform the pacifying treatment in accordance with standard commercial practice. Provide bolts of dimensions meeting the requirements of ANSI B 18.2 for Regular Hexagon-head Cap Screws. Finish surfaces in accordance with the American bolt, nut and rivet manufacturers. Provide nuts meeting the requirements for ANSI B 18.2 for Regular Finished Hexagon. Provide washers as shown on the Plans.

F Tension Indicators

Provide and test compressible-washer-type, direct tension indicators (DTI) in accordance with *ASTM F959, Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series.* Submit three samples of each lot of tension indicators with the test reports to the Materials Laboratory for testing. The Engineer will reject lots if the representative washer samples fail the tests performed.

3391.3 SAMPLING AND TESTING

If the minimum bolt strength requirements are specified in the Contract, perform testing in accordance with *ASTM A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products*, except only use a wedge for testing high-strength structural steel bolts. Do not use reduced-dimension specimens for test purposes. Determine the yield strength using relevant methods specified in *ASTM E8, Standard Test Methods for Tension Testing of Metallic Materials*. For bolts with nuts, provide nuts capable of withstanding a proof load equal to the required tensile strength of the bolt.

Provide test bolts and nuts of each type, in each size and length. Provide 2 test bolts and nuts for each increment of 1,000, or fraction of 1,000, bolts supplied.

3392 GALVANIZED HARDWARE

3392.1 SCOPE

Provide galvanized hardware as specified in the Contract.

3392.2 REQUIREMENTS

Provide galvanized hardware and miscellaneous items as shown on the Plans. Galvanize hardware items using the hot-dip process meeting the requirements of with *ASTM A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*, or mechanically galvanize the hardware meeting the requirements of *ASTM B695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel*, Class 50 Type I.

3392.3 SAMPLING AND TESTING

Sample and test in accordance with the requirements of the *Schedule of Materials Control*.

3394 GALVANIZED STRUCTURAL SHAPES

3394.1 SCOPE

Provide galvanized structural shapes, plates, bars, and castings for pipes and Structures.

3394.2 REQUIREMENTS

Blast clean all items in accordance with *SSPC-SP6/NACE No. 3*, “Commercial Blast Cleaning,” before galvanizing. Exceptions to this blast cleaning requirement are listed in 2471.3L.1, "Galvanizing."

Provide structural shapes, plates, bars, and castings galvanized meeting the requirements of *ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products*. Provide castings that have been pickled before galvanizing.

For galvanized surfaces that have handling marks or minor chips that are no greater than 1/2 inch at the narrowest dimension, repair in accordance with *ASTM A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings*, Annex 1 or Annex 2 (brush applied paint only). Ensure the dry film thickness (DFT) of the coating repair is in accordance with *ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products*. Perform repairs in accordance with the supplier’s quality procedures. Obtain an approved non-conformance report (NCR) for each repair.

Calibrate dry film thickness gauges in accordance with *SSPC-PA 2*, “Measurement of Dry Coating Thickness with Magnetic Gauges.”

The galvanizer shall provide the Engineer with all galvanizing process-related Quality Control documents which demonstrate compliance to this Specification and referenced Specifications prior to shipment of the galvanized product.

Identify in a Purchase Order(s) which specific items are to be duplex coated and which Materials to be galvanized are reactive (e.g. 3309, "High-Strength Low-Alloy Structural Steel," etc.).

Submit an NCR to the Engineer before performing any repairs.

A Additional Galvanizing Requirements for Duplex Coated Material

All products supplied using this Specification have higher aesthetic expectations than standard galvanized products. Produce the final product to comply with its intended use as "architectural" with heightened aesthetics and/or visual qualities.

Process all metal component(s) to be galvanized utilizing a "dry" kettle. Preflux the Material prior to the galvanizing bath using an aqueous tank of zinc chloride/ammonium chloride. Do not use a "top flux" blanket on the molten zinc bath.

Air cool the Materials to ambient temperature before handling for shipment and/or storage. Do not quench the Material or apply any post-galvanizing treatments.

Lumps, projections, globules, high spots, drip lines, heavy deposits, blisters, black and bare areas, flux deposits, thin spots, dross inclusions, etc., are considered unacceptable. Repair unacceptable zinc coatings in accordance with the galvanizer’s approved Quality Manual and the coating applicator’s approved method. Zinc, which will interfere with the "intended use of the product,” will not be permitted.

Store galvanized metal component(s) in a manner that will prevent the formation of "white-rust" or wet storage staining. "White rust" or staining of the galvanize coating is not acceptable.

3394.3 SAMPLING AND TESTING — BLANK

3399 FLAP GATES

3399.1 SCOPE

Provide flap-type drainage control gates for direct attachment to the outlet ends of Culvert and sewer pipe as shown on the Plans or required by the Special Provisions. If shown on the Plans or required by the Special Provisions, provide gates with attachment to the outlet Structure.

3399.2 REQUIREMENTS

A Base Metal

Provide frame, flap, flange, hinge bars, and other basic components of the gate assembly made of cast iron, cast steel, structural steel, or other metals approved by the Engineer. Provide hinge bushings and pins made of non-corrosive metal approved by the Engineer. Do not use bronze or brass fittings on gates attached to aluminum alloy drainage structures.

Provide iron castings meeting the requirements of *ASTM A48, Standard Specification for Gray Iron Castings*, Class 30B or better, *ASTM A47*, *Standard Specification for Ferritic Malleable Iron Castings*, Grade 32510. Provide steel castings meeting the requirements of 3306, "Low-Carbon Structural Steel," or better. Provide steel components in accordance with 3306, "Low-Carbon Structural Steel," or 3309, "High-Strength Low-Alloy Structural Steel."

B Dimensions and Design

Provide flap gates designed to permit direct attachment to pipe of the type and size required by the Contract, or to the outlet Structure as shown on the Plans or required by the Special Provisions. Ensure the gates provide practical water tightness against a face pressure and open automatically under a back head allowing free outflow.

Provide a double pivoted flap hinge or a flap hinge otherwise designed to provide accurate seating of the flap and frame and ensure complete closure of the flap using its own mass. Use a design that limits the hinge movement to prevent the flap from becoming lodged in the frame opening.

Provide gates designed to adequately withstand the seating head as shown on the Plans. If the plans do not show seating head requirements, provide gates designed to withstand a 10 feet seating head.

Provide gates designed or installed to hang closed at all times. Provide suitable flange or hinge fastening adjustments that provide a vertical frame seat when installed. Include provisions for attaching the gate assembly to the pipe or Structure as shown in the Plans or required by the Special Provisions, using bolts, flanges, and compression bands or other devices.

For metal pipe installations, the Contractor may shop assemble the gates on a 24 inch section of pipe with rivets or bolts. Install the stub section of pipe, with gate attached, on a zero or flat grade when feasible.

The Engineer will approve all critical dimensions and design details of the gate assembly. Provide shop drawings to the Engineer upon request.

C Fabrication and Assembly

Provide castings and fabricated steel components that are free of defects that affect its ability to function for its intended purpose.

Machine mill or grind the contact surfaces between frame and flap to provide true bearing around the entire circumference.

Galvanize cast steel and fabricated steel components of the gate assembly, including steel bolts, nuts, and washers in accordance with *ASTM A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware* for the appropriate class of Material. In lieu of galvanizing, the Contractor may paint steel specified in 3309, "High-Strength Low-Alloy Structural Steel," in accordance with 2478, "Organic Zinc-Rich Paint System," with an aluminum finish coat. Paint iron castings with an asphalt or coal-tar pitch varnish, or galvanize as required for steel castings. Paint and galvanize after fabrication and before assembly.

3399.3 SAMPLING AND TESTING

Ensure the manufacturer prepared and tested physical test specimens for the tests required in accordance with this section at no additional cost to the Department. Submit to the Engineer the Certified Test Reports provided by the manufacturer showing the results of each test before delivering the Material to the Project. The Engineer may require the manufacturer make check tests, if results of previous tests are not conclusive.

Posts

3401 FLANGED CHANNEL SIGN POSTS

3401.1 SCOPE

Provide rerolled rail steel and comparable new billet steel posts for signs, delineators, and guide posts.

3401.2 REQUIREMENTS

A Material

Use posts made of rerolled rail steel or a new billet steel meeting the mechanical requirements of *ASTM A499*, *Standard Specification for Steel Bars and Shapes, Carbon Rolled from 'T' Rails*, Grade 60. For rails weighing at least 91 pounds per yard of length, use steel meeting the chemical requirements of *ASTM A1, Standard Specification for Carbon Steel Tee Rails*.

B Length

Use posts with lengths within 1/2 inch as shown on the Plans or in the Special Provisions.

C Weight

Use posts with the following Nominal weights per length, as shown on the Plans or in the Special Provisions:

(1) 2 pounds per foot
(2) 2 1/2 pounds per foot
(3) 3 pounds per foot
(4) 4 pounds per foot

Verify the Nominal weights of the posts before punching and without galvanizing, or the addition of anchor plates or other attachments. Use posts weighing within 5 percent of the weight shown on the Plans or the Special Provisions.

D Shape and Dimensions

Use channel section design posts with flanges for the placement of the signs. Use flanges with a flat front face and positioned in the same plane to provide a smooth, uniform bearing for the sign. The back of the flanges and the posts shall be flat and parallel to the front. Connect the backs of the flanges

and the posts flat and parallel to the front. Make the cross-section of the posts symmetrical about the central axis, perpendicular to the front and back.

Use straight posts, free of bow, twist, burrs, and other unsightly defects.

Table 3401.2-1
Nominal Dimensions

Dimension	2 pounds per foot	2 1/2 pounds per foot	3 pounds per foot	4 pounds per foot
Width, overall across front (inches)	3	3	3 1/4	3 1/2
Width, back surface (inches)	1	1	1 1/4	1 1/4
Width, flanges (bearing surface) (inches)	1/2	1/2	5/8	3/4
Depth overall, front to back (inches)	1 3/8	1 3/8	1 1/2	1 1/2
Thickness of metal, flanges, and back (inches)	1/8	1/8	5/32	3/16
Note: Dimension requirements are for flat flange sections				

E Punching

If the Plans specify posts weighing 2 pounds per foot of length, punch 7/16 inch diameter holes along the centerline of the back on 3 inch centers, beginning at 1 1/2 inches from the top and extending the full length of the post. Space the holes so that the variation in distance between the centers of any 2 holes is ±1/16 inches for each 1 inch between the holes.

If using posts weighing at least 2 1/2 pound per foot of length, punch 3/8 inch diameter holes along the centerline of the back on either 1 inch or 3 inches centers, beginning 1 inch or 1 1/2 inches from the top and extending the full length of the post. Space the holes so that the variation in distance between the centers of any 2 holes is ±1/16 inches for each 1 inch between the holes.

Punch holes so that cracks do not radiate from the holes.

F Galvanizing

Provide posts galvanized in accordance with *ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products*.

3401.3 SAMPLING AND TESTING

Obtain a certified mill analysis from the supplier that states the chemical composition of each lot of posts delivered.

The Engineer may take samples for testing from any of the provided posts.

During the inspection of any lot of posts, if the Engineer rejects more than 20 percent of the posts in the lot, the Engineer may reject the entire lot.

3402 SQUARE TUBULAR SIGN POSTS

3402.1 SCOPE

Provide square steel tubular posts for signs.

3402.2 REQUIREMENTS

A Material

Use steel posts meeting standard specification for hot rolled carbon sheet steel, structural quality, *ASTM A1011*, *Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Str*ength, Grade 50. The average minimum yield strength after cold forming shall be a minimum of 50,000 psi.

B Length

Use posts with lengths within 1/4 inch of the length shown on the Plans or in the Special Provisions.

C Weight

Use posts in accordance with the following, as shown on the Plans or in the Special Provisions:

Table 3402.2-1
Properties

Size	USS Gauge	Weight
1 1/2 inches by 1 1/2 inches	12	1.7 pounds/foot
1 3/4 inches by 1 3/4 inches	14	1.71 pounds/foot
2 inches by 2 inches	12	2.42 pounds/foot
2 1/4 inches by 2 1/4 inches	12	2.77 pounds/foot
2 1/2 inches by 2 1/2 inches	12	3.14 pounds/foot
2 3⁄16 inches by 2 3⁄16 inches	10	3.43 pounds/foot
2 1/2 inches by 2 1/2 inches	10	4.01 pounds/foot

The post weight shall be within 5 percent of the weight shown for the specified post size and gauge.

D Cross-Section

Use square tube formed of the size and gauge of steel as shown in Plans or Special Provisions, carefully rolled to size and welded directly in the corner by high frequency resistance welding and externally scarfed to agree with corner radii.

E Hole Punching

Use posts with punched holes 7/16 ± 1/64 inch in diameter on 1 inch centers on 4 sides down the entire length of the post. Holes shall be on centerline of each side and in true alignment and opposite of each other directly and diagonally.

F Coating

Use posts hot dip galvanized steel in accordance with *ASTM A653*, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*, G90. The corner weld shall be zinc coated after scarfing operation. The steel shall also be coated with a chromate conversion coating and a clear organic polymer topcoat. Both the interior and the exterior of the post shall be galvanized. Modifications made to the post after the initial fabrication, such as additional welding or other alterations shall be galvanized.

G Telescoping Properties

Use straight posts, with a smooth uniform finish free of bow, twist, and other unsightly defects. holes and ends shall be free from burrs and ends shall be cut square. Telescoping systems shall meet dimensional requirements and shall permit consecutive sizes of square tubes to telescope freely without necessity of matching any particular face to any other face.

H Anchors

Use galvanized square tube anchors as shown in Plans or in the Special Provisions.

3402.3 SAMPLING AND TESTING

Obtain a certified mill analysis from the supplier that states the chemical composition of each lot of posts delivered.

The Engineer may take samples for testing from any of the provided posts.

During the inspection of any lot of posts, if the Engineer rejects more than 20 percent of the posts in the lot, the Engineer may reject the entire lot.

3403 HOT-ROLLED STEEL FENCE POSTS

3403.1 SCOPE

Provide hot-rolled steel posts and angles for fencing.

3403.2 REQUIREMENTS

Provide hot-rolled steel line posts and angle section post assemblies for end, gate, corner, or intermediate brace assemblies meeting the requirements of *ASTM A702, Standard Specification for Steel Fence Posts, Hot Wrought*, and as shown on the Plans.

3403.3 SAMPLING AND TESTING

Submit to the Engineer a manufacturer's Certificate of Compliance and a certified mill analysis showing the chemical composition of each delivered lot or heat of posts and compliance with Buy America, if required.

Sample and test in accordance with the *Schedule of Materials Control*. The Engineer may take samples for testing from any of the provided posts.

3406 STRUCTURAL METAL FENCE POSTS

3406.1 SCOPE

Provide tubular metal posts and rails, metal rolled-formed “C” posts, and fittings for fencing.

3406.2 REQUIREMENTS

A Materials

Provide posts and rails meeting the requirements of the plans and *AASHTO M181*, “Standard Specification for Chain-Link Fence,” except as noted. Use Grade 1 round posts.

For Alternate Roll Formed posts, provide posts meeting the weight and property requirements of *ASTM F1043, Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Network*, for Heavy Industrial Fence Framework Grade 50 with Type A Coating.

Use line posts weighing 2.40 pounds per foot Nominal.

Use brace bars weighing 1.35 pounds per foot Nominal.

Apply coatings on posts, rails, and fittings after welding and fabrication. Provide tie wires, clips, and bands for fastening chain link fabric to posts, rails, and braces as specified in 3376, “Fence Wire.” Use Type IV (PVC) posts, rails, and frames first coated with zinc and then coated with PVC Class B bonded to a thickness of at least 0.010 inch.

B Dimensions

Provide posts, rails, and stretcher bars required by the Contract meeting the requirements of *AASHTO M181*, except the Engineer will not accept posts greater than 1 inch shorter than the specified length.

3406.3 SAMPLING AND TESTING

Submit to the Engineer a manufacturer's Certificate of Compliance and a certified mill analysis showing the chemical composition of each delivered lot or heat of posts and compliance with Buy America, if required.

Sample and test in accordance with the *Schedule of Materials Control*. The Engineer may take samples for testing from any of the provided posts.

3412 WOOD GUARDRAIL POSTS

3412.1 SCOPE

Provide preservative treated wood posts for use in guardrail construction, including round posts and sawed timber posts with rectangular cross-sections and offset blocks.

3412.2 REQUIREMENTS

A Round Posts

A.1 Species of Wood

Provide treated round posts made from any of the following species of wood:

(1) Northern White Cedar
(2) Western Red Cedar
(3) Jack Pine
(4) Norway (Red) Pine
(5) Lodgepole Pine
(6) Ponderosa Pine
(7) Southern (Yellow) Pine

A.2 Seasoning

Air-season wood for treated posts. The wood may be conditioned as part of the treating process for penetration of preservative without damage to the posts.

A.3 Dimensions and Finish

Provide naturally round posts. Shave off inner bark and closely trim knots.

Saw the bottom end of the posts square. Provide posts in the length, Nominal diameter, and with a top finish as shown on the Plans.

Complete debarking, trimming, and sizing of posts before applying the preservative treatment.

A.4 Quality

Do not use wood with any of the following defects:

(1) Unsound and unsmooth knots that impair the post strength
(2) Short kinks, defined by a line drawn between centers of the butt and tip falling outside the center of the post by more than 2 percent of the post length
(3) Checks wider than 1/4 inch
(4) Unsightly and exaggerated winding twists
(5) Decay, except Northern White Cedar may contain one pipe rot no greater than 3/8 inch in diameter in the top of the post
(6) Butt rot and ring rot totaling greater than 5 percent of the butt area in Northern White Cedar

(7) Defects that affect the appearance or impair the strength or durability of the post as determined by the Engineer
(8) One-way sweep greater than 2 inches

B Sawed Timber Posts

B.1 Species and Grade

Provide sawed timber posts made from any of the following species of wood:

(1) Douglas Fir
(2) Southern (Yellow) Pine
(3) Jack Pine
(4) Norway (Red) Pine
(5) Ponderosa Pine

Provide sawed timber posts in the grade meeting the following requirements and characteristics:

(1) Stained sapwood
(2) Splits 3/4 of the thickness
(3) Seasoning checks, single or opposite each other, with a sum total depth equal to half of the post thickness
(4) Heavy torn grain
(5) Close grain
(6) Slope of grain over the full length of post no greater than 1 in 12
(7) Pitch streaks with medium pitch pockets
(8) Wane 1/8 of any face
(9) Shakes 1/3 of the thickness
(10) Well-spaced, sound, and tight knots no wider than the following:

(a) 13/16 inches in 5-inch posts
(b) 1 1/2 inches in 6-inch posts
(c) 2 inches in 8-inch posts

For rectangular post sizes, use the wider face to determine the maximum size of the knots permitted.

B.2 Dimensions

Saw the posts and offset blocks to the Nominal dimensions as shown on the Plans. The Engineer will not require surfacing. Do not allow the sawing dimensions for dry Material to vary from the Nominal dimensions by greater than −1/4 inch or +1/2 inch.

C Preservative Treatment

Treat posts and offset blocks in accordance with 3491, “Preservatives and Preservative Treatment of Timber Products.” Provide treated posts and offset blocks with a dry surface and free of excess preservative.

3413 WOOD FENCE POSTS (TREATED)

3413.1 SCOPE

Provide preservative treated wood posts for fence construction.

3413.2 REQUIREMENTS

A Species of Wood

Provide posts cut from live, growing trees and made from Northern White Cedar or any species of Pine, except Lodgepole Pine.

B Seasoning

Air-season or otherwise condition wood posts to allow penetration of the preservative.

C Manufacture

C.1 Peeling

Shave off inner bark and closely trim knots before treating.

C.2 End Finish

Cut the ends of posts square. If setting the post by driving, the Contractor may cut the larger end to a blunt point with a length no greater than 1 1/2 times the diameter of the pointed end.

C.3 Dimensions

Provide naturally round posts in the length and minimum diameter as required by the Contract. The Contractor may provide posts with a diameter at the small end no greater than 2 inches greater than the minimum diameter required by the Contract.

C.4 Quality

Do not use wood with any of the following defects:

(1) Knots that impair the post strength
(2) Short kinks, defined by a line drawn between centers of the butt and tip falling outside the center of the post by more than 2 percent of the post length
(3) Checks wider than 1/4 inch
(4) Unsightly and exaggerated winding twists
(5) Decay, except Northern White Cedar may contain one pipe rot no greater than 1/4 inch in diameter
(6) Butt rot and ring rot totaling greater than 5 percent of the butt area in Northern White Cedar
(7) Defects that affect the appearance or impair the strength or durability of the post as determined by the Engineer

D Preservative Treatment

Treat posts in accordance with 3491, “Preservatives and Preservative Treatment of Timber Products.”

Cut, trim, and point ends before treatment.

Provide treated posts with a dry surface and free from dripping or excess preservative.

3413.3 SAMPLING AND TESTING 3491

3426 STRUCTURAL WOOD

3426.1 SCOPE

Provide structural wood for dimensional lumber, joists and planks, beams and stringers, and posts and timbers.

A Definitions of Terms .....*ASTM D9*

B Nomenclature .....*ASTM D1165*

3426.2 REQUIREMENTS

A Species of Wood

Use West Coast Douglas Fir or Southern (Yellow) Pine unless otherwise shown on the Plans, specified in the Special Provisions, or specified in the purchase order.

B Standard Sizes

Provide structural wood meeting the dimensions specified for either rough or surfaced stock.

C Preservative Treatment

Provide wood treated in accordance with 3491, "Preservatives and Preservative Treatment of Wood Products," if specified.

D Grading

Provide commercial stress grades of lumber and timber with grade descriptions meeting the stress requirements. The numerical stress values for structural wood required by the Contract are the minimum requirements. The Contractor may provide stress graded Material meeting grading rules developed from *ASTM D45, Methods for Establishing Structural Grades of Lumber,* as tabulated by the *National Design Specification for Wood Construction* (NDS).

The *Standard Grading and Dressing Rules of the West Coast Lumber Inspection Bureau*, the *Standard Grading Rules for Western Lumber of the Western Wood Products Association*, and the *Standard Grading Rules for Southern Pine of the Southern Pine Inspection Bureau* each meet the requirements of *ASTM D245*, *Standard Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber*.

3426.3 SAMPLING AND TESTING

Sample and test for preservative treatment in accordance with 3491, "Preservatives and Preservative Treatment of Wood Products."

The Department will make final inspection and acceptance in accordance with the following:

(1) For direct purchases by the Department, at the point of delivery.
(2) For Materials provided and installed by a Contractor, at the site of the Work.

Lumber, Timber, Piling and Wood Treatment

3457 LUMBER

3457.1 SCOPE

Provide lumber for general building purposes.

Refer to *ASTM D9, Standard Terminology Relating to Wood and Wood-Based Products*, for definition of terms.

3457.2 REQUIREMENTS

Use Douglas Fir, Norway (Red) Pine, Ponderosa Pine, White Pine, or Southern (Yellow) Pine.

Provide grade marked lumber graded in accordance with grading rules, adopted by regional associations of lumber manufacturers, in accordance with the requirements of the *American Lumber Standards*.

Provide No. 1 Grade lumber, unless otherwise specified.

3462 PLANK FOR WEARING COURSE

3462.1 SCOPE

Provide lumber for use as plank for wearing course on Bridges.

3462.2 REQUIREMENTS

Refer to *ASTM D9, Standard Terminology Relating to Wood and Wood-Based Products*, for the definition of terms and provide plank made from any of the following species: Douglas Fir, Norway (Red) Pine, Ponderosa Pine, White Pine, Southern (Yellow) Pine, Northern White Poplar.

Provide plank meeting the following characteristics and requirements:

(1) Sound live-cut timber
(2) Well seasoned
(3) Free from pocket rot, dry rot, red heart, cavities, bad checks, loose slivers, loose heart, shakes, splits, any incipient decay, unsound, loose or decayed knots, and ant or worm holes
(4) Contains no checks in the ends of planks extending greater than 9 inches into the piece
(5) Free from crook
(6) Contains no corner wane greater than 1/2 inch
(7) Surfaced on one side and one edge (S1S1E) or surfaced on 2 edges
(8) Lengths from 6 feet to 16 feet
(9) Uniform width and thickness through the entire length
(10) Straight with square-sawed ends
(11) Skip on the planed surfaces permitted, not exceeding 15 percent of the surfaced area of any individual plank

Surface planks with heart center appearing on one side, on the heart side.

For any one Bridge, provide planks of the same thickness of at least 1 1/2 inch after surfacing.

For any one Bridge, the Contractor may provide planks with Nominal widths of 6 inches, 8 inches, or both. Ensure the widths after surfacing are at least 5 1/2 inches for planks with a Nominal width of 6 inches and 7 1/4 inches for planks with a Nominal width of 8 inches. Provide planks of each Nominal width for any one Bridge with the same actual width.

If the Contract requires treated plank, provide planks treated with preservative in accordance with 3491, “Preservatives and Preservative Treatment of Wood Products.”

3471 TIMBER PILING

3471.1 SCOPE

Provide timber piling for treated and untreated foundation piles below water level.

3471.2 REQUIREMENTS

Provide piling meeting the following requirements:

(1) Capable of withstanding driving without breaking or suffering excessive brooming or splitting
(2) Cut from sound, live trees, except the Contractor may use fire-killed, blight-killed, or wind-felled trees if no evidence of charred sapwood, wood decay, or insect attachment
(3) Free from defects impairing strength or durability

A Permitted Species

A.1 Untreated Piles

Provide any of the following types of timber for untreated piles:

(1) Pine
(2) Tamarack
(3) Douglas Fir (Coast Region)
(4) Oak
(5) Elm
(6) Hard Maple

A.2 Treated Piles

Provide any of the following types of timber for treated piles:

(1) Norway (Red) Pine
(2) Jack Pine
(3) Ponderosa Pine
(4) Southern Yellow Pine
(5) Douglas Fir (Coast Region)

A.3 Temporary Structures

If the Contract allows untreated timber piling for temporary Structures, the Contractor may use any species that will withstand driving to the bearing and penetration required by the Contract without damage to the piling.

B Quality of Timber

Provide Douglas Fir, Norway (Red) Pine, and Jack Pine with a sapwood thickness at the butt end of at least 3/4 inch. Provide Southern Yellow Pine and Ponderosa Pine with a sapwood thickness at the butt end of at least 2 inches.

Provide untreated trestle piles with a heartwood diameter of at least 80 percent of the diameter of the pile at the butt end.

Do not use timber with checks wider than 1/4 inch.

C Peeling

Peel piles by removing the rough bark and at least 80 percent of the inner bark. Do not leave strips of inner bark greater than 3/4 inch wide and 8 inches long on the pile. Provide at least 1 inch of cleaned wood surface between any 2 strips of inner bark. Provide piles with clean wood on at least 80 percent of the surface circumference at any location on the pile.

D Straightness

Cut piles above the ground swell and provide piles with a gradual taper from the point of butt measurement to the tip.

Ensure that a line drawn from the center of the butt to the center of the tip lies wholly within the body of the pile, and the distance from this line to the center of the pile at any point along the pile is no greater than 1 percent of the length of the pile.

The Contractor may use piles with bends within the upper 75 percent of the pile length, measured from the butt end toward the tip end, if the deviation of the centerline of the pile from a line drawn from the center of the pile above the bend to the center of the pile below the bend is no greater than 4 percent of the length of the bend and is no greater than 2 1/2 inches. Do not use piles with bend deviations greater than 1 inch if located within the lower 25 percent of the pile length or if located within 10 feet from the tip end.

Use piles free of twists greater than half the circumference in any 20 feet of length.

Saw off the ends of piles square. Trim knots close to the body of the pile.

E Knots

Do not use piles with unsound knots. The Contractor may use piles with sound knots having diameters no greater than 4 inches or 35 percent of the minimum diameter of the pile measured at the knot location. Do not use piles if the sum of the diameters of all knots occurring in a 1 foot length of pile is greater than twice the diameter of the maximum allowable knot size measured at the knot location.

Do not use timber with knot clusters. For the purpose of the Work specified in section 3471, "Timber Piling," the Department defines a knot cluster as groups of at least 2 knots deflecting the fibers of the wood around the entire unit. The Department does not consider a group of single knots, with fibers deflected around each knot separately, as a cluster, regardless of their close proximity.

F Density

Ensure the number of annual rings in any pile, measured at the butt end, averages at least 4 rings per 1 inch over the outer 3 inches of a representative radial line from the pith. Ensure the outer 1 inch within the measured section contains at least 4 rings.

G Dimensions

Provide sound piles with a minimum diameter at the tip end, measured under the bark, in accordance with the following:

Table 3471.2-1
Minimum Diameter at Tip End

Length of Pile, feet	Tip Diameter, inches
< 40	8
≥40 – ≤74	7
>74 – ≤90	6
> 90	5

Provide sound piles with a minimum diameter, measured under the bark at 3 feet from the butt end in accordance with the following:

Table 3471.2-2
Minimum Diameter, 3 feet from Butt End

Length of Pile, feet	Diameter, inches
< 25	11
≥ 25 – ≤ 54	12
> 54	13

Determine the average diameter of a pile by measuring and dividing the circumference by pi (3.14), or by averaging the maximum and minimum diameters at the locations specified in Table 3471.2-1 and Table 3471.2-2 for butt and tip diameters.

Ensure the diameter of the pile, measured at the butt end, is no greater than 20 inches.

H Preservative Treatment

Treat piling in accordance with 3491, "Preservatives and Preservative Treatment of Wood Products," unless otherwise required by the Contract.

Apply wood preservatives and preservative treatment using the pressure process for lumber, timber, piling, posts, poles, plywood, and structural glued laminated members.

3491.2 REQUIREMENTS

A Materials

A.1 Wood Products

Provide timber, lumber, piling, plywood, and posts as required by the Contract.

The Department considers Southern Pine the same as Southern Yellow Pine, and Red Pine the same as Norway Pine.

A.2 Preservatives

Provide preservatives listed on the *Approved/Qualified Products List* and then only for the specific application for which they are approved. Provide preservative meeting the requirements of *AASHTO M 133*, "Standard Specification for Preservatives and Pressure Treatment Processes for Timber," as modified herein.

B Preservative Treatment

Provide preservative treatment meeting the requirements of *AWPA Standard T1*, *Use Category System: Processing and Treatment Standard,* and the current, applicable *AWPA Use Category Standards (U1)*.

B.1 Preparation for Treatment

B.1.a General Requirements

Because difficulty may be encountered in obtaining the specified retention and penetration, ensure the supplier uses wood Materials having sufficient sapwood thickness to permit the specified penetration and retention. Ensure suitable conditioning and, for some species, incising prior to the treatment, and the use of treating conditions that do not damage the wood in accordance with *AWPA Standards T1*, *U1*, and the applicable *AWPA Use Category Standards* shown in Table 3491.2-1.

B.1.b Incising

Incise the wood to allow penetration of the preservative. Incise lumber and timbers of species difficult to penetrate, including Douglas Fir, Western Larch, Spruce, Hemlock, Redwood, and Jack Pine before treatment such that the incising will not make the Material unfit for use. Incise pines if predominantly heartwood. The Engineer may

waive the incising requirement if the Contractor can meet penetration and retention requirements without incising.

B.1.c Seasoning

For sawn Material treated with an oil-type preservative and used in buildings or other construction where high moisture content or shrinkage would be objectionable, dry to a moisture content no greater than 19 percent before treatment.

Measure the moisture content at a depth equivalent to the required preservative penetration.

Unless the Contract requires otherwise, dry lumber no greater than 4 inches in Nominal thickness and plywood treated with a waterborne preservative to a moisture content no greater than 19 percent before and after treatment.

C Method of Treatment

Unless the Contract requires otherwise, use the preservative Materials listed in Table 3491.2-1 and the *Approved/Qualified Products List*. Use the same preservative on the entire product provided for each Contract Item, unless the Contract requires otherwise.

Use the full-cell process to treat timber products if using with waterborne preservatives.

Field treat cuts, bored holes, and damaged treated areas per the requirements of *AWPA M4*, except do not use coal tar products, including roofing cement.

D Results of Treatment

Unless the Contract requires otherwise, provide preservative retention in accordance with Table 3491.2-1. Determine the preservative retention meeting the requirements of the AWPA method referenced in Table 2 of the *Approved/Qualified Products List* for the treatment of timber products.

Provide preservative penetration and other timber product treatments meeting the requirements of *AWPA Standard T1* and in accordance with Table 3491.2-1.

Table 3491.2-1
Product and AWPA Use Categories

Product Usage*		AWPA Use Category	*AWPA Commodity Specification U1*	
			Section	Special Requirements
A	**Piles:**			
A1	Round	UC4C‖	E	—
B	**Posts: Fence, guide, and sight:**			
B1	Round	UC4A‖	B	—
B2	Sawn four sides	UC4A‖	A	Subsection 4.3
C	**Posts: guardrail and spacer blocks, noise walls:**			
C1	Round	UC4B‖	B	—
C2	Sawn four sides	UC4C‖	A	Subsection 4.3
D	**Poles, lighting:**			
D1	Round	UC4B‖	D	—
E	**Lumber and timber:**			
E1	Bridges, prefab (nail laminated) panels, other structural members, Culverts, and other issues	UC4C‖	A	Subsection 4.3
E2	Noise wall facing, at or below ground level	UC4B‖	A	—
E3	Building construction/repair, at or below ground level	UC4A‖	A	—
E4	Decks, porches, handicap Ramps, boardwalks, or pedestrian Bridge decking	UC4A‖	A	Subsection 4.3
F	**Lumber and timber (not in contact with ground or water):**			
F1	Handrails, Sidewalk plank	UC3B	A	Subsection 4.3
F2	Noise wall facing, above ground level	UC3B	A	Subsection 4.3
F3	Building construction/repair, above ground level	UC3B	A	Subsection 4.3
F4	Bridges, prefab (nail laminated) panels, structural Members, and other uses	UC4C‖	A	Subsection 4.3
G	**Glued-laminated structural members: (Treated after gluing)**	UC4B‖	F	—
H	**Plywood:**			
H1	In contact with ground or water	UC4A‖	F	—
H2	For use above ground	UC3B	F	—

* Refer to the *Approved/Qualified Products List* for information regarding which products may be used on which applications, such as near water, residential, or recreational areas.
‖ For products listed by the AWPA or approved by the International Code Council-Evaluation Service (ICC-ES). Include passing results from the test method *AWPA E7*, *Standard Field Test for Evaluation of Wood Preservatives to be Used in Ground Contact (UC4A, IC4B, IC4C)*; Stake Test. Do not substitute test method *AWPA E20*, *Standard Method of Determining the Depletion of Wood Preservatives in Soil Contact*.

E Handling Treated Products

Care for and handle preservative treated wood products in accordance with the requirements of *AWPA M4*, *Standard for the Care of Preservative-Treated Wood Products*.

F Product Marking

Hammer, heat brand, dye stamp, or metal tag the treated Material marking the species, commercial grade, and type of treatment meeting the requirements of *AWPA M1*, *Standard for the*

Purchase of Treated Wood Products, and *AWPA M6*, *Brands Used on Preservative Treated Materials*, except brand piles on the butt end. Include the charge number in the markings on treated piles.

The Contractor may bundle sawn Materials no greater than 2 inches in Nominal thickness and plywood treated with oil-type preservatives with the tags attached to the bundles. For sawn Materials treated with waterborne preservatives, the Contractor may dye stamp the information on the outer pieces of the bundle instead of using bundle tags.

G Framing

Provide framing with bored holes in accordance with Table 3491.2-2:

Table 3491.2-2
Bored Hole Diameter Requirements

Hardware Types	Diameter
Round drift bolts and dowels	Equal to diameter of bolt or dowel
Square drift bolts and dowels	1/16 inch greater than least dimension of bolt or dowel
Machine bolts	1/16 inch greater than diameter of bolt
Rods	1/16 inch greater than diameter of rod
Lag screws	No greater than 1/16 inch of the body diameter of the screw at the root of the thread

3491.3 SAMPLING AND TESTING

Provide for the inspection of Materials and treatments meeting the requirements of *AWPA M2*, *Standard for the Inspection of Preservative Treated Products for Industrial Use*, by an independent commercial inspection agency. Only use agencies approved by the Materials Engineer for Materials provided to Department Projects. Engage the inspection agency directly or through the supplier of the treated wood products.

The Department will include the cost of inspection with the relevant Contract Pay Items for treated wood products.

Submit to the Engineer a manufacturer's Certificate of Compliance with each shipment of treated Materials. Submit the Certificate of Compliance, the inspection report from the commercial inspection agency, and the treating company's report of treatment to the Engineer.

The Department may inspect treated products upon delivery. Consider the Department's inspection results conclusive and binding.

Paints and Enamels

3501 BASIC REQUIREMENTS FOR PAINTS

3501.1 SCOPE

Provide paints for construction and maintenance.

3501.2 REQUIREMENTS

A Package Stability

Ensure the paint does not cake, liver, thicken, curdle, gel, or show other objectionable properties that cannot be corrected by stirring during 6 months after delivery.

B Colors

Provide paint matching the AMS-STD-595A colors or the Department's standard colors required by the Contract. The Department's standard colors are located at the Materials Laboratory. A paint color is considered to match the specified Standard if Δ E ≤ 3.0 when measured according to *ASTM D2244, Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates*, using the following conditions:

(1) Geometry – 45/0 or 0/45
(2) Illuminant – D65
(3) Observer – 2 degree
(4) Color Space – Hunter Lab
(5) CIE 1976 Color Difference Equation (Δ E) applied to Hunter Lab

C Toxic Metals and Volatile Organic Compounds (VOC)

Provide paints free of toxic metals and meeting the requirements of Federal and MPCA VOC regulations.

D Manufacturing and Packaging

Screen paint while filling containers to remove coarse particles and skins.

Package the paint in new containers marked with the following information:

(1) Name of the manufacturer
(2) Name of contents
(3) Specification number
(4) Date
(5) Manufacturer's batch number

Provide paint in quantities based on the volume or unit mass at 77°F.

E Drying Time

Ensure drying time for paint meets the requirements of the Contract.

F Approval Process

Obtain approval of the paint from the Engineer before use, unless the Contract requires the paint selection or it appears on the *Approved/Qualified Products List*.

3501.3 SAMPLING AND TESTING

Provide samples at rates and sizes meeting the requirements of the *Schedule of Materials Control* or as required by the Contract.

Provide a color draw down sample on a Leneta chart per *ASTM D2805, Standard Test Method for Hiding Power of Paints by Reflectometry*, (Sections 6.1.2 for paper chart description and 7.7.1 for film application) to the Materials Laboratory for verification of the finish coat color.

3520 ZINC-RICH PAINT SYSTEMS

3520.1 SCOPE

Provide zinc-rich paint systems.

A Zinc-Rich Primer

A.1 General

Provide multi-component zinc-rich primer capable of being spray-applied in accordance with the manufacturer's instructions and applications guide. After mixing according to the manufacturer's recommendation, strain the primer through a 30-60 mesh screen or a double layer of cheesecloth to remove un-dispersed zinc agglomerates. Formulate the primer to produce a distinct contrast with blast cleaned steel and with the subsequent intermediate coat.

A.2 Pigment

Provide a metallic zinc pigment meeting the requirements of *ASTM D520, Standard Specification for Zinc Dust Pigment*. Only add inert Materials to the pigment for tinting. Ensure the inert Materials do not reduce the effectiveness of the galvanic protection.

A.3 Finished Primer

Provide finished primer meeting the requirements in Table 3520.2-1:

Table 3520.2-1
Finished Primer Requirements

Characteristic	Requirement
Zinc portion, total solids by weight	≥ 75.0 percent
Pot life at 77°F	≥ 4 hour
Density of VOC	≤ 3.5 pounds/gal
Slip coefficient of cured primer	≥0.33
Cure time for recoating*	per Manufacturer's Product Data Sheet
* When applied at 3 mil dry-film thickness at 77°F and 50 percent R.H.	

B Approved Epoxy Zinc-Rich Systems

Provide a zinc-rich paint system listed on the *Approved/Qualified Products List* for "Bridge Structural Steel Coatings."

B.1 Epoxy Zinc-Rich System

Provide an epoxy zinc-rich system consisting of an epoxy zinc-rich primer, an epoxy intermediate coat, and an aliphatic urethane finish coat.

B.2 Inorganic Zinc-Rich System

Provide an inorganic zinc-rich system consisting of solvent-based inorganic zinc-rich primer, an epoxy intermediate coat, and an aliphatic urethane finish coat.

B.3 Moisture-Cure Zinc-Rich System

Provide a moisture-cure zinc-rich system consisting of moisture-cure zinc-rich primer, a urethane intermediate coat, and an aliphatic urethane finish coat.

B.4 Two Coat Zinc-Rich System

Provide a zinc-rich system consisting of either a moisture-cure zinc-rich primer or an organic zinc-rich primer and a fast-dry polyaspartic urethane finish coat.

C Color

Provide a semi-gloss finish coat as required by the Contract.

D Packaging and Labeling

Provide multi-component paints packaged in separate containers or kits that ensure paint manufacturer's mixing proportions are achieved when using the entire container.

3520.3 SAMPLING AND TESTING

Provide to the Engineer a manufacturer's Certificate of Compliance with each batch, lot, or both for each component of the zinc-rich paint system.

Provide a color draw down sample on a Leneta chart per *ASTM D2805, Standard Test Method for Hiding Power of Paints by Reflectometry*, to the Materials Laboratory for verification of the finish coat color using the requirements and measurement conditions found in 3501.2B, "Colors."

3532 EXTERIOR POLYURETHANE PAINT

3532.1 SCOPE

Provide exterior polyurethane finish paint for use on steel lighting cabinets, signs, handrails, traffic signal poles, and transformer bases.

3532.2 REQUIREMENTS..... 3501

Provide paint free of toxic metals and meeting the requirements of Federal and MPCA VOC regulations.

Provide an aliphatic polyurethane finish coat listed on the *Approved/Qualified Products List* for "Traffic Signal Paint Systems."

Use the finish coat with an intermediate coat or primer and intermediate coat from the same manufacturer.

A Color

Provide the following semi-gloss finish coat in colors chosen from AMS-STD-595A colors unless otherwise required by the Contract:

(1) Dark green: AMS-STD-595A Color Number 14062
(2) Yellow: AMS-STD-595A Color Number 13538

3532.3 SAMPLING AND TESTING

Sample at rates and sizes meeting the requirements of the *Schedule of Materials Control* or as required by the Contract.

Provide a color draw down sample on a Leneta chart per *ASTM D2805, Standard Test Method for Hiding Power of Paints by Reflectometry,* to the Materials Laboratory for verification of the finish coat color using the requirements and measurement conditions found in 3501.2B, "Colors."

3533 ALUMINUM POLYURETHANE PAINT

3533.1 SCOPE

Provide aluminum-filled polyurethane paint for use as a finish coat on Bridges, sign posts, traffic signal poles, and luminaire extensions.

3533.2 REQUIREMENTS..... 3501

Provide paints free of toxic metals and meeting the requirements of Federal and MPCA VOC regulations.

Provide an aluminum polyurethane paint listed on the Approved Products List for Traffic Signal Paint Systems.

Use the finish coat with an intermediate coat or primer and intermediate coat from the same manufacturer.

3533.3 SAMPLING AND TESTING

Sample at the rates and sizes meeting the requirements of the *Schedule of Materials Control* or as required by the Contract.

Provide a color Draw Down sample on a Leneta chart per *ASTM D2805, Standard Test Method for Hiding Power of Paints by Reflectometry*, to the Materials Laboratory for verification of the finish coat color using the requirements and measurement conditions found in 3501.2B, "Colors."

3584 EXTERIOR MASONRY ACRYLIC EMULSION PAINT

3584.1 SCOPE

Provide acrylic latex paint for coating exterior masonry.

3584.2 REQUIREMENTS..... 3501

Provide paints free of toxic metals and meeting the requirements of Federal and MPCA VOC regulations.

Provide acrylic latex paint listed on the *Approved/Qualified Products List*, meeting the requirements of *Federal Specification TT-P-19*, "Paint, Latex (Acrylic Emulsion, Exterior Wood and Masonry)"and having a vehicle consisting of 100 percent straight acrylic polymer.

Provide paint in the color required by the Contract. Only use light fast colorants.

3584.3 SAMPLING AND TESTING

Sample at the rates and sizes meeting the requirements of the *Schedule of Materials Control* or as required by the Contract.

Provide a color Draw Down sample on a Leneta chart per *ASTM D2805, Standard Test Method for Hiding Power of Paints by Reflectometry* to the Materials Laboratory for verification of the finish coat color using the requirements and measurement conditions found in 3501.2B, "Colors."

3590 MULTI-COMPONENT LIQUID PAVEMENT MARKINGS

3590.1 SCOPE

Provide reflectorized white and yellow multi-component, 100 percent solids multi-component liquid pavement markings that are free of toxic heavy metals for installation on bituminous and concrete pavement surfaces.

3590.2 REQUIREMENTS

A General

Apply multi-component liquid pavement markings including lines, legends, symbols, crosswalks, and stop lines, in accordance with 2582, "Pavement Markings." Use Materials capable of producing pavement markings of specified thickness in accordance with 2582.3B.4, "Thickness Requirements," and retroreflectivity in accordance with 2582.3C.3, "Retroreflectivity," unless otherwise required by the Contract. Provide yellow markings distinguishable from white markings in the dark.

Provide slow dry Material from the multi-component liquid pavement markings *Approved/Qualified Products List*, unless otherwise required by the Contract.

The Department will not require the mixing of individual components before use if stored for no greater than 12 months.

B Multi-Component Liquid Material

Provide multi-component liquid Material meeting the following requirements and characteristics:

(1) Composed only of multi-component liquids and pigments
(2) Does not emit or leach solvents into the environment upon application to a pavement surface
(3) The infrared spectrum for each components shall match the reference sample provided by the manufacturer for the product tested and approved by the Department
(4) Free of lead, cadmium, mercury, hexavalent chromium, and other toxic heavy metals as defined by the Environmental Protection Agency
(5) White Material no darker than or no yellower than 17778 of Federal Standard Number 595C Colors
(6) Daytime color of the yellow epoxy meeting the following CIE Chromaticity limits using illuminant "D65/2":

Table 3590.2-1
Daytime Chromaticity Coordinates (Corner Points) — Yellow

	1	2	3	4
x	0.465	0.485	0.520	0.480
y	0.450	0.470	0.450	0.420

(7) White daylight directional reflectance (Y) of least 83 percent
(8) Yellow daylight directional reflectance (Y) of at least 50 percent
(9) Nighttime color of yellow meeting the following chromaticity limits in *ASTM D6628, Standard Specification for Color of Pavement Marking Materials*, Table 2.

Table 3590.2-2
Nighttime Chromaticity Coordinates (Corner Points) — Yellow

	1	2	3	4
x	0.575	0.508	0.473	0.510
y	0.425	0.415	0.453	0.490

(10) Contrast Ratio of 0.98 or greater when measured on a black/white drawdown card at 15 mils WFT application rate

B.1 Adhesion Capabilities

Provide Material meeting the adhesion requirements of the American Concrete Institute Committee 403 when tested on Portland cement concrete. Apply multi-component liquid pavement markings during the test to concrete pavements with a tensile strength of at least 300 psi and ensure the failure of the system occurs in the concrete during testing.

B.2 Abrasion Resistance

Provide Material with an abrasion resistance wear index no greater than 82 when tested in accordance with *ASTM C501, Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser*, with a CS 17 wheel under a load of 1,000 grams for 1,000 cycles. The Department defines the wear index as the weight in milligrams of Material abraded from the sample under the test conditions.

B.3 Hardness

Provide Material with a Type D durometer hardness from 75 to 90 when tested in accordance with *ASTM D2240, Standard Test Method for Rubber Property – Durometer Hardness*, after curing for 72 hours at 73°F ±4°F.

B.4 Tensile Strength

For epoxy-amine based multi-component systems, including variations of this base chemistry, provide Material with a tensile strength of at least 6,000 psi when tested in accordance with *ASTM D638, Standard Test Method for Tensile Properties of Plastics*, after curing for 72 hours at 73°F ±4°F. For polyurea based multi-component systems provide Material with a tensile strength of at least 3,000 psi when tested in accordance with *ASTM D638* after curing for 72 hours at 73°F ±4°F.

B.5 Compressive Strength

For epoxy-amine based multi-component systems, including variations of this base chemistry, provide Material with a compressive strength of at least 12,000 psi when tested in accordance with *ASTM D695, Standard Test Method for Compressive Properties of Rigid Plastics*, after curing for 72 hours at 73°F ±4°F.

3590.3 SAMPLING AND TESTING

Test the daylight directional reflectance and the color meeting the requirements of *ASTM E1349, Standard Test Method for Reflectance Factor and Color by Spectrophotometry Using Bidirectional (45°:0° or 0°:45°) Geometry*.

Provide 1 pint samples of each manufacturer's lot or batch of Material when manufactured to the Department. Provide 1 pint samples of Part A (yellow/white multi-component liquid) and Part B (catalyst) to the Materials Laboratory. Mark the samples with the following information:

(1) Manufacturer product number
(2) Lot or batch number
(3) Name of manufacturer
(4) Date of manufacture
(5) Color
(6) State Project numbers for intended Material use

Submit to the Engineer a manufacturer's Certificate of Compliance for each components of the multi-component liquid pavement marking system.

Mark containers for epoxy components with the following information:

(1) Name of manufacturer
(2) Product identification number
(3) Lot or batch number
(4) Date of manufacture
(5) Color
(6) Net weight of contents

3591 WATER-BASED TRAFFIC PAINT

3591.1 SCOPE

Provide fast-dry white and yellow acrylic latex traffic marking paints for use with drop-on glass beads for application on concrete and bituminous pavements.

3591.2 REQUIREMENTS

A General Requirements

Use paint listed on the *Approved/Qualified Products Lists* for "Latex Paint and High Build Latex Paint."

A.1 Quality

Provide paint meeting the following requirements and characteristics:

(1) Formulated from first-grade Materials
(2) Capable of being applied by conventional traffic striping Equipment at elevated spray temperatures with drop-on glass beads
(3) Smooth
(4) Homogeneous
(5) Free of coarse particles, skins, or other foreign Materials detrimental to the application or appearance of the paint

A.2 Package Stability

Within 12 months from the time of delivery, if the paint cakes, settles, livers, thickens, skins, curdles, gels, or shows other objectionable properties not correctable with stirring, return the paint to the manufacturer for credit. Ensure the manufacturer adds anti-settling agents, stabilizers, and other additives to ensure proper storage stability.

A.3 Manufacturing and Packaging

Provide paint from a manufacturer capable of producing paint in batches of at least 1,000 gallons. Provide paint screened with a 40 mesh or finer screen to remove coarse particles, skins, or foreign Material.

Provide paint packaged in lined, new totes of 55 gallon or 5 gallon containers meeting the following requirements and characteristics:

(1) Full removable-head universal drums meeting the requirements of DOT-17H
(2) Drum covers containing one 2-inch fitting and one 3/4-inch fitting
(3) Marked with the following information:

(a) Manufacturer's name
(b) Type of paint
(c) Batch number
(d) Date of manufacture
(e) Gross weight
(f) Container weight

To prevent formation of "skins," ensure the manufacturer uses one of the following:

(1) A "float" of ammonia water on the paint surface
(2) A "floating type" plastic liner on the top of the filled container

B Properties of Finished Paint

Provide finished paint with properties in accordance with either Table 3591.2-1 or Table 3591.2-2:

Table 3591.2-1
High Solids Paint Properties

Parameter	Test Method	Range
Weight per gallon at 77°F	*ASTM D1475**	≥12.0 pounds per gal
Viscosity, Krebs Stormer, at 77°F	*ASTM D562*‖	80 – 100 Krebs units
Grind, Hegman	*ASTM D1210*†	≥3
Total solids	*ASTM D2369*‡	≥ 73 percent by weight
Non-volatile vehicle		≥43 percent by weight
Pigment	*ASTM D2371*#	45 – 62 percent by weight
Dry time, 12 mil WFT at 65 percent RH	*ASTM D711*§, *Laboratory Manual*	≤ 12 minutes
Dry through, at 90 percent RH	*Laboratory Manual*	≤ 130 minutes
Daylight directional reflectance, white	*ASTM E1349***	≥ 83 percent
Daylight directional reflectance, yellow	*ASTM E1349***	≥ 50 percent
Contrast ratio, 15 mil wet	*ASTM D2805*‖‖	≥ 0.98
Flexibility and adhesion	*Laboratory Manual*	No cracking or flaking
Water resistance	*Laboratory Manual*	No blistering or loss of adhesion
Settling	*Laboratory Manual*	≥ 6 rating
Skinning at 48 hours	*Laboratory Manual*	none
Track free time	*Laboratory Manual*	≤ 3 minutes
pH	*ASTM E70*††	≥ 9.6
Lab Retro-reflectivity, white, min., milli-candela/meters squared/lux	*Laboratory Manual*	300
Lab Retro-reflectivity, yellow, min., milli-candela/meters squared/lux	*Laboratory Manual*	200

* *ASTM D1475, Standard Test Method for Density of Liquid Coatings, Inks, and Related Products*
‖ *ASTM D562, Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer*
† *ASTM D1210, Standard Test Method for Fineness of Dispersion of Pigment Vehicle Systems by Hegman-Type Gage*
‡ *ASTM D2369, Standard Test Method for Volatile*
# *ASTM D2371, Standard Test Method for Pigment Content of Solvent-Reducible Paints*
§ *ASTM D711*, *Standard Test Method for No-Pick-Up Time of Traffic Paint,* modified
***ASTM E1349, Standard Test Method for Reflectance Factor and Colo by Spectrophotometry Using Bidirectional (45°:0° or 0°:45°) Geometry*
‖‖ *ASTM D2805, Standard Test Method for Hiding Power of Paints by Reflectometry*
†† *ASTM E70, Standard Test Method for pH of Aqueous Solutions With the Glass Electrode*

Table 3591.2-2
High Build Paint Properties

Parameter	Test Method	Range
Weight per gallon at 77°F	*ASTM D1475**	≥12.0 pounds per gal
Viscosity, Krebs Stormer, at 77°F	*ASTM D562*‖	83 – 98 Krebs units
Grind, Hegman	*ASTM D1210*†	≥3
Total solids	*ASTM D2369*‡	≥ 73 percent by weight
Non-volatile vehicle		≥43 percent by weight
Pigment	*ASTM D2371*#	45 – 62 percent by weight
Dry time, 15 mil WFT at 50 percent RH	*ASTM D711*§, modified – *Laboratory Manual*	≤ 10 minutes
Dry time, 25 mil WFT at 50 percent RH	*ASTM D711*§, modified – *Laboratory Manual*	≤ 25 minutes
Dry through, at 90 percent RH	*Laboratory Manual*	≤ 150 minutes
Daylight directional reflectance, white	*ASTM E1349***	≥ 83 percent
Daylight directional reflectance, yellow	*ASTM E1349***	≥ 50 percent
Contrast ratio, 15 mil wet	*ASTM D2805*‖‖	≥ 0.98
Flexibility and adhesion	*Laboratory Manual*	No cracking or flaking
Water resistance	*Laboratory Manual*	No blistering or loss of adhesion
Settling	*Laboratory Manual*	≥ 6 rating
Skinning at 48 h	*Laboratory Manual*	none
Track free time	*Laboratory Manual*	≤ 3 minutes
pH	*ASTM E70*††	≥ 9.6
Lab Retro-reflectivity, white, min., milli-candela/meters squared/lux	*Laboratory Manual*	300
Lab Retro-reflectivity, yellow, min., milli-candela/meters squared/lux	*Laboratory Manual*	200

* *ASTM D1475, Standard Test Method for Density of Liquid Coatings, Inks, and Related Products*
‖ *ASTM D562, Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer*
† *ASTM D1210, Standard Test Method for Fineness of Dispersion of Pigment Vehicle Systems by Hegman-Type Gage*
‡ *ASTM D2369, Standard Test Method for Volatile*
# *ASTM D2371, Standard Test Method for Pigment Content of Solvent-Reducible Paints*
§ *ASTM D711, Standard Test Method for No-Pick-Up Time of Traffic Paint,* modified
***ASTM E1349, Standard Test Method for Reflectance Factor and Colo by Spectrophotometry Using Bidirectional (45°:0° or 0°:45°) Geometry*
‖‖ *ASTM D2805, Standard Test Method for Hiding Power of Paints by Reflectometry*
†† *ASTM E70, Standard Test Method for pH of Aqueous Solutions With the Glass Electrode*

C Specific Requirements

For high solids paints meeting the requirements of Table 3591.2-1 use a vehicle composed of a 100 percent acrylic polymer.

For high build paints meeting the requirements of Table 3591.2-2 use Rohm & Hass HD-21, Dow DT400, or approved equal acrylic emulsion polymer.

Use white Material no darker than or no yellower than 17778 of Federal Standard Number 595C Colors.

Use yellow paint with a daytime color meeting the following CIE Chromaticity limits using illuminant “D65/2”:

Table 3591.2-3
Daytime Chromaticity Coordinates (Corner Points)

	1	2	3	4
x	0.465	0.485	0.520	0.480
y	0.450	0.470	0.450	0.420

Use yellow paint with a nighttime color meeting the following chromaticity limits as specified by *ASTM D6628, Standard Specification for Color of Pavement Marking Materials*, Table 2.

Table 3591.2-4
Nighttime Chromaticity Coordinates (Corner Points)

	1	2	3	4
x	0.575	0.508	0.473	0.510
y	0.425	0.415	0.453	0.490

Use white and organic yellow paints free of the following heavy metals:

(1) Lead
(2) Mercury
(3) Cadmium
(4) Hexavalent chromium
(5) Other toxic heavy metals as defined by the United States Environmental Protection Agency

3591.3 SAMPLING AND TESTING

Provide 1 pint manufacturer-provided paint samples of each batch and a certification stating that the sample represents the full manufactured batch.

The Department may base acceptance on 1 pint samples taken at the point of delivery or from the Contractor’s supply.

Submit to the Materials Laboratory the manufacturer’s certified test results with each batch of paint, including tests for weight per gallon, viscosity, and drying time.

Provide the manufacturer’s certified test results, for tests performed annually at the start of paint production, meeting the following requirements:

Table 3591.3-1
Paint Property Standard

Parameter	Standard
Weight per gallon	*ASTM D1475**
Viscosity	*ASTM D562*‖
Grind fineness	*ASTM D1210*†
Total solids	*ASTM D2369*‡
Total pigment	*ASTM D2371*#
Dry time	*ASTM D711*§, modified
Daylight directional reflectance	*ASTM E1349***
Contrast ratio, 15 mil wet	*ASTM D2805*‖‖
Color	*ASTM E1349***
pH	*ASTM E70*††

** ASTM D1475, Standard Test Method for Density of Liquid Coatings, Inks, and Related Products*
‖ ASTM D562, Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer
† ASTM D1210, Standard Test Method for Fineness of Dispersion of Pigment Vehicle Systems by Hegman-Type Gage
‡ ASTM D2369, Standard Test Method for Volatile
 # ASTM D2371, Standard Test Method for Pigment Content of Solvent-Reducible Paints
§ *ASTM D711*, *Standard Test Method for No-Pick-Up Time of Traffic Paint,* modified
***ASTM E1349, Standard Test Method for Reflectance Factor and Colo by Spectrophotometry Using Bidirectional (45°:0° or 0°:45°) Geometry*
‖‖ ASTM D2805, Standard Test Method for Hiding Power of Paints by Reflectometry
†† ASTM E70, Standard Test Method for pH of Aqueous Solutions With the Glass Electrode

3592 DROP-ON GLASS BEADS

3592.1 SCOPE

Provide treated glass beads for retroreflectorizing liquid pavement markings.

3592.2 REQUIREMENTS

Provide treated glass beads meeting *AASHTO M 247,* "Standard Specification for Glass Beads Used in Pavement Markings," with the following characteristics and requirements:

A General Requirements

(1) Listed on the *Approved/Qualified Products List*
(2) Made from clean colorless transparent glass
(3) Smooth
(4) Spherically shaped
(5) Free from milkiness, pits, excessive air bubbles, chips, and foreign Material
(6) Capable of being applied by conventional striping Equipment
(7) Produce a retroreflectorized line when viewed at night with automobile headlights

B Gradation and Roundness Requirements

B.1 Standard Gradation

Meet the requirements of *AASHTO M 247*, Type 1 except with at least 80 percent true spheres.

B.2 "Utah Blend" Gradation

Meet the graduation requirements of Table 3592.2-1 and at least 80 percent true spheres for beads passing the No. 30 Sieve.

Table 3592.2-1
Utah Blend Gradation Requirements

Sieve Size	Percent Passing
No. 18	65-80
No. 30	30-50
No. 50	0-5

C Coating Requirements

C.1 Dual Coated Beads

Provide beads with dual surface treatment meeting the following requirements and characteristics for use with water-based paints:

(1) Moisture resistant silicone surface treatment meeting the requirements of *AASHTO M 247* and *AASHTO T346,* "Standard Method of Test for Glass Beads Used in Pavement Markings," as recommended by the paint manufacturer
(2) Silane adherence surface treatment as recommended by the paint manufacturer
(3) Meet the adherence treatment Dansyl Chloride Test of *AASHTO M 247* and *T346*

C.2 Moisture Resistant Coated Beads

Provide beads for use with multi-component liquid with a moisture resistant silicone surface treatment meeting the requirements of *AASHTO M 247* and *T346* as recommended by the multi-component liquid manufacturer.

D Packaging Requirements

Unless otherwise specified, provide beads packaged in moisture-proof, multi-wall shipping bags, and in containers marked with the following information:

(1) Manufacturer name
(2) Manufacturer address
(3) Type(s) of coating treatment(s)
(4) Batch number
(5) Date of manufacture

Deliver the containers and contents in a dry condition. The Engineer will reject beads not meeting the requirements of this Specification.

3592.3 SAMPLING AND TESTING

Provide samples in the rates and sizes meeting the requirements of the Schedule for Materials Control and as required by the Contract.

The Engineer will test in accordance with *AASHTO M 247*, except the Engineer will determine roundness meeting the requirements detailed in the *Laboratory Manual*.

Stone and Brick

3601 RIPRAP MATERIAL

3601.1 SCOPE

Provide stone and filter Layer Material for use in random or hand-placed riprap, gabion, and revet mattress construction.

3601.2 REQUIREMENTS

A Random Riprap

A.1 Sizing Requirements

Meet the requirements of Table 3601.2-1.

Table 3601.2-1
Random Riprap Gradation Requirements

Class	Median Particle Diameter (inch)	Minimum and Maximum Allowable Particle Size (inches)							
		D_{15}		D_{50}		D_{85}		D_{100}	
		Min	Max	Min	Max	Min	Max	Min	Max
I	**3**	1	3	2	4	3	5	4	6
II	**6**	3	6	5	8	7	11	9	12
III	**9**	6	8	8	11	11	15	15	18
IV	**12**	8	10	10	14	15	19	21	24
V	**15**	9	12	12	17	19	23	27	30

A.2 Quality Requirements

Provide stone of the quality approved by the Department and meeting the following requirements:

(1) Each individual stone has at least one fractured face. For the purpose of the Work specified in section 3601, "Riprap Material" an acceptable fractured face is defined as a broken surface constituting an area equal to at least 50 percent of the projected area of the particle, as viewed perpendicular to (looking directly at) the fractured face.

(2) Is free of soil or other debris before placement

(3) Contains less than 10 percent of the following by weight:

- (a) Stones with defects that could cause rapid or excessive deterioration or degradation during service, such as cracks or seams
- (b) Stones with a width or thickness less than 30 percent of the length

(4) For Carbonate quarry/bedrock Material used in total or in part for riprap, the portion of the insoluble residue passing the No. 200 Sieve is no greater than 10 percent

(5) Use 100 percent virgin Materials for riprap and granular filter

To determine suitable quality of stone, the Department may consider the results of laboratory tests, the performance of the stone under natural exposure conditions, the performance of the riprap from the same or similar geological formations or deposits, or other tests or criteria.

B Hand-placed Riprap

B.1 Sizing Requirements

Provide individual stones with a weight of at least 50 pounds. The Department will not require a minimum weight for smaller stones required for filling in the narrow openings between individual stones (chinking).

B.2 Quality Requirements

Meet the requirements of 3601.2A.2, "Quality Requirements."

C Gabions and Revet Mattresses

C.1 Sizing Requirements

Provide well graded stones for filling the baskets, ranging in size from 4 inches to 8 inches for gabions and 3 inches to 6 inches for revet mattresses.

C.2 Quality Requirements

Provide stone that is free of soil or other debris, and is composed of sound Aggregate.

D Granular Filter Under Class I Random Riprap

D.1 Sizing Requirements

Use Class 5 gradation requirements listed in Table 3138.2-3.

D.2 Quality Requirements

Provide virgin Aggregate meeting the requirements of 3138, "Aggregate for Surface and Base Courses."

E Granular Filter Under Other Riprap, Gabion, and Revet Mattress

E.1 Sizing Requirements

Meet the requirements of Table 3601.2-2.

Table 3601.2-2
Granular Filter Material

Sieve Size	Percent Passing by Weight
6 inch	100
3 inch	75 – 100
1 inch	35 – 75
No. 4	10 – 40
No. 10	5 – 25
No. 40	0 – 15
No. 200	0 – 8

E.2 Quality Requirements

Meet the requirements of 3149.2A.1, "Virgin Materials."

3601.3 SAMPLING AND TESTING

Sample and test at the rates specified in the *Schedule of Materials Control*.

The Department will inspect the Material for compliance to the requirements of this section. Obtain the Engineer's approval of the quality of the stone before delivering the stone to the Project. The Engineer will inspect the stone for compliance to the gradation requirements after delivery of the stone to the Project.

The Department may inspect and reject Material for compliance at any time.

If the quantity of riprap for any class is greater than 40 cubic yards, the Engineer may require construction of a control unit consisting of 4 cubic yards of riprap as a reference for size and quality compliance. Construct the control unit at the source or on the Project. When the Engineer requires and approves a control unit for reference, maintain the control unit during riprap construction and incorporate the stones from the control unit as the last stones placed in the riprap construction. Use production stone equivalent to the stone placed in the approved control unit.

A Riprap Gradation Test Method Using D_{85} .....*Grading and Base Manual* 5-692.210

B Riprap Gradation Test Method Using Wolman Count.....*Grading and Base Manual* 5-692.211

C Riprap Gradation Test Method Using FHWA Hydraulic Toolbox ..... *Grading and Base Manual* 5-692.212

D Sieve Analysis.....*Laboratory Manual* Method 1202 & 1203

E Insoluble Residue .....*Laboratory Manual* Method 1221

3602 GABIONS AND REVET MATTRESSES MATERIALS

3602.1 SCOPE

Provide Material and construct baskets for gabions and revet mattresses meeting the following characteristics:

(1) Rectangular
(2) Variable in size
(3) Manufactured from double-twisted metallic-coated wire mesh or metallic-coated welded wire fabric

A Gabion

Use rectangular basket.

B Revet Mattress

Use thin flat rectangular basket.

3602.2 REQUIREMENTS

Provide gabions and revet mattresses meeting the requirements of *ASTM A974*, *Standard Specification for Welded Wire Fabric Gabions and Gabion Mattresses (Metallic-Coated or Polyvinyl Chloride (PVC) Coated)*, for welded wire fabric, or *ASTM A975, Standard Specification for Double-Twisted Hexagonal Mesh Gabions and Revert Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire with Poly(Vinyl Chloride) (PVC) Coating)*, for double-twisted wire. Unless otherwise specified, provide welded wire fabric gabions and revet mattresses with a Style 2 coating, and provide double-twisted wire gabions and revet mattresses with a Style 1 coating as listed in the *ASTM A974* and *ASTM A975* specifications, respectively.

3602.3 SAMPLING AND TESTING

Submit to the Engineer a manufacturer's Certificate of Compliance for the wire and basket Materials and the construction of gabions and revet mattresses.

3604 PRECAST ARTICULATED CONCRETE

3604.1 SCOPE

Provide manufactured articulated concrete block and mat revetment systems to protect embankment slopes, river channels, spillways, and vehicle accesses where the soil may erode.

3604.2 REQUIREMENTS

A Revetment Systems

A.1 Articulated Block Mat

Provide closed cell or open cell articulated block mat consisting of blocks cabled together into a prefabricated mat placed on a geotextile fabric meeting *ASTM D6684, Standard Specification for Materials and Manufacture of Articulating Concrete Block (ACB) Systems*. Place the mats side-by-side, and clamp and anchor to provide one homogeneous erosion protection system. Provide blocks for the mats ranging in thickness and weight meeting the bed shear requirements in accordance with Table 3604.2-1. Determine the type in accordance with Table 3604.2-1 for Type A, Type B, Type C, Type D, and Type E.

Table 3604.2-1
Bed Shear Requirements

Type	Minimum Bed Shear, pounds/square foot
A	10
B	15
C	20
D	25
E	30

A.2 Articulated Interlocking Block Mat

Provide closed cell or open cell articulated interlocking block consisting of hand placed concrete blocks placed on a geotextile fabric and locked together to form a soil protecting paver system. Provide blocks ranging in thickness and weight meeting the bed shear requirements in accordance with Table 3604.2-1. Determine the type in accordance with Table 3604.2-1 for Type A, Type B, and Type C.

Provide open cell units with an open area of at least 20 percent when measured at the bottom of the block in the system. Provide closed cell systems with an open area no greater than 10 percent when measured at the bottom of the block in the system.

B Concrete

Provide blocks meeting Specification 2461, “Structural Concrete” and the following:

(1) Manufactured in a plant with a Department approved Quality Control Plan
(2) Design air content of 6.5 percent for wet cast blocks
(3) Less than 1.0 percent loss in 100 freeze/thaw cycles when tested in accordance with *ASTM C1262, Standard Test Method for Evaluating the Freeze-Thaw Durability of Dry-Cast Segmental Retaining Wall Units and Related Concrete Units*, using a distilled water solution or less than 1.0 percent loss in 50 freeze/thaw cycles when tested in accordance with *ASTM C67*, *Standard Test Method for Sampling and Testing Brick and Structural Clay Tile*
(4) Absorption no greater than 7.0 percent when tested in accordance with *ASTM C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units*
(5) Minimum Design Strength at 28 Calendar Days when tested in accordance with *ASTM C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units*:

    (a) 4000 psi for wet cast
    (b) 5800 psi for dry cast

C Cable

For systems using cables, provide stainless steel or coated high-strength polyester cables compatible with the system and designed to meet a 5:1 factor of safety in accordance with *ASTM D6684*, *Standard Specification for Materials and Manufacture of Articulating Concrete Block (ACB) Systems*. Use stainless steel cable at least 3/16 inches thick and use high-strength polyester cable at least 1/4 inches thick.

D Geotextile Filter

Provide geotextile appropriate for the soil conditions in accordance with the manufacture's recommendations and 3733, "Geosynthetic Materials." The Engineer will make the final approval of the geotextile type.

E Clamps

Use stainless-steel wire rope clamps and sleeves to secure loops of adjoining mats.

F Anchors

Use helical or duckbill anchors with a pull resistance of 4,000 pounds to secure the top and exposed sides of the articulating block system.

3604.3 SAMPLING AND TESTING

Submit to the Engineer a manufacture's Certificate of Compliance for the revetment system and components that meets the requirements of *ASTM D7277, Standard Test Method for Performance Testing of Articulating Concrete Block (ACB) Revetment Systems for Hydraulic Stability in Open Channel Flow*, and *ASTM D7276, Standard Guide for Analysis and Interpretation of Test Data for Articulating Concrete Block (ACB) Revetment Systems in Open Flow Channels*.

3608 CONCRETE ARMOR UNITS

3608.1 SCOPE

Provide manufactured concrete armor units for use in stream bank, riverbank, and lakeshore stabilization, and for soil bioengineering construction.

3608.2 REQUIREMENTS

Use interlocking concrete cross shaped units, each with 2 individual and symmetrical interlocking halves, to provide concrete armor units. Assemble the units with the 2 individual halves forming a 3-dimensional cross with 6 symmetrical legs. Assemble multiple, identical units into a continuous and flexible interlocking matrix with a 40 percent void space for soil filling and planting.

Use concrete meeting the following requirements to form the armor units:

(1) Type 3 concrete per 2461, "Structural Concrete"
(2) Compressive strength of at least 4,000 psi
(3) Water absorption no greater than 10 pounds per cubic foot

Ensure each concrete armor unit meets the physical requirements in accordance with the following:

Table 3608.2-1
Concrete Armor Units Size

Designation	A-24	A-36
Overall dimension (outside of leg to outside of leg)	24 inches	36 inches
Thickness of each side of leg	3.6 inches	5.5 inches
Kerf corner reinforcement	1.8 inches	2.7 inches
Overall weight of assembled unit	78 pounds	265 pounds
NOTE: Dimensions are Nominal dimensions with a 10 percent tolerance.		

3608.3 SAMPLING AND TESTING — BLANK

3612 SEWER BRICK (CLAY)

3612.1 SCOPE

Provide brick made from burned clay or shale for the following:

(1) Drainage Structures that are part of a sewage, industrial waste, or storm water system
(2) Related Structures such as manholes and catch basins.

3612.2 REQUIREMENTS

Use sewer bricks meeting the requirements of *ASTM C32, Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)*, for the grade shown on the Plans. If the plans do not specify a grade, provide Grade MS for manholes or catch basin construction and Grade SS for other sewer construction.

3612.3 SAMPLING AND TESTING

A Compressive Strength and Absorption ..... *ASTM C67*

B Freezing and Thawing ..... *ASTM C67*

C Sample Bricks

The Engineer will select bricks for testing. Provide test specimens from the manufacturer or seller, at no additional cost to the Department.

3613 BUILDING BRICK (CLAY OR SHALE)

3613.1 SCOPE

Provide clay or shale building brick for use in the construction of transportation facilities

3613.2 REQUIREMENTS

Use sewer bricks meeting the requirements of *ASTM C32, Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)*, for the grade shown on the Plans. If the Plans do not specify a grade, provide Grade MS for manholes or catch basin construction and Grade SS for other sewer construction.

3613.3 SAMPLING AND TESTING

Sample and test in accordance with the *Schedule of Materials Control*.

3614 BUILDING BRICK (SAND-LIME)

3614.1 SCOPE

Provide sand-lime building brick for use in the construction of transportation facilities.

3614.2 REQUIREMENTS

Provide sand-lime building brick meeting the requirements of *ASTM C73, Standard Specification for Calcium Silicate (Sand-Lime Brick)*. If the Contract does not require a specific brick grade, provide grade SW building brick.

3614.3 SAMPLING AND TESTING

Sample and test in accordance with the *Schedule of Materials Control*.

3615 BUILDING BRICK (CONCRETE)

3615.1 SCOPE

Provide concrete building brick for construction.

3615.2 REQUIREMENTS

Provide concrete building brick meeting the requirements of *ASTM C55*, *Standard Specification for Concrete Building Brick*. For architectural veneer and facing uses, provide concrete building brick meeting the requirements of *ASTM C1634, Standard Specification for Concrete Facing Brick*. In either case, provide "normal weight" brick unless otherwise required by the Contract.

3615.3 SAMPLING AND TESTING

Sample and test in accordance with the *Schedule of Materials Control*.

3616 SEWER BRICK (CONCRETE)

3616.1 SCOPE

Provide concrete brick to construct catch basins and manholes.

3616.2 REQUIREMENTS

Provide concrete brick meeting the requirements of *ASTM C139*, *Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes*, as modified by the following:

(1) Provide concrete brick with a compressive strength of at least 4,100 psi for any individual unit and an average compressive strength of 4,500 psi for 3 units, when delivered to the Project, and

(2) Use steam or water curing methods to cure the concrete, unless the Materials Engineer approves the use of a sealing membrane or other curing methods. If steam curing, maintain an atmospheric temperature in the curing chamber no greater than 160°F. Protect the concrete from freezing until the completion of curing. Continue curing until the concrete develops the compressive strength shown above in item (1) within 28 Calendar Days.

Use any standard size brick capable of producing the dimensions in the completed Structure as shown on the Plans.

3616.3 SAMPLING AND TESTING..... *ASTM C140*

Precast Concrete Units

3621 CONCRETE MASONRY UNITS

3621.1 SCOPE

Provide solid, precast, segmental concrete masonry units to construct catch basins and manholes.

3621.2 REQUIREMENTS

Provide concrete masonry units in accordance with 3616.2, "Sewer Brick (Concrete), Requirements," modified to provide units with dimensions as shown on the Plans and with wall thicknesses of 8 inches ±3/8 inch.

3621.3 SAMPLING AND TESTING 3616

3622 SECTIONAL CONCRETE MANHOLE AND CATCH BASIN UNITS

3622.1 SCOPE

Provide precast, reinforced concrete manhole/catch basin units consisting of riser sections and appurtenances such as grade rings, base slabs, tops, and special sections to construct sewer or water works.

3622.2 REQUIREMENTS

Provide reinforced concrete manhole/catch basin units meeting the requirements of *AASHTO M 199*, "Standard Specification for Precast Reinforced Concrete Manhole Sections," 3236, "Reinforced Concrete Pipe," manufactured in plants meeting the requirements of 3240, "Precast Concrete Manufacturing," and the following.

Notify the Materials Engineer according to the requirements of 3240, "Precast Concrete Manufacturing," before the manufacturer starts production to arrange for inspection.

A Physical Properties

Provide sectional concrete manhole/catch basin units in the dimensions, shape, wall thickness, type, and quantity of reinforcement as shown on the Plans.

The Contractor may use alternative spigot-up joint or alternative offset joint. Use the profile or pre-lubricated pipe seal system with the alternative offset joint.

Ensure test results show a compressive strength of at least 4,200 psi at 28 Calendar Days and before shipping the product to the Project Site.

B Manufacture

Provide units true to shape and with smooth, dense surfaces uniform in appearance. As soon as the forms are removed, use mortar to fill minor surface cavities or irregularities not impairing the service value of the unit and capable of being corrected without marring the appearance. Remove forms without damaging the unit.

When the manufacturer provides manholes with block outs or holes, provide additional steel in the remaining unit to prevent cracking. If the unit is cracked, remove the cracked portion and repair with mortar in accordance with the approved repair procedure in the *MnDOT QM Manual* and notify the Department Inspector for acceptance.

When manufacturing special design rectangular manholes, provide sections meeting the manufacturing requirements of 3238, "Precast Concrete Box Culverts."

3622.3 SAMPLING AND TESTING 3236

3630 PRECAST CONCRETE MEDIAN BARRIERS

3630.1 SCOPE

Provide precast concrete median barriers for use in construction Work zones.

Provide precast concrete median barriers manufactured at a precasting plant approved by the Materials Engineer.

A Materials

B Concrete Finish

If shown on the Plans or required by the Special Provisions, sandblast the precast barrier units and fill the surface imperfections with a grout-containing bonding agent in accordance with 2401.3F.2.a, "Ordinary Surface Finish." Begin sandblasting and grouting operations after stripping the forms and while the concrete barriers are still warm.

Joint Fillers and Sealers

3702 PREFORMED JOINT FILLERS

3702.1 SCOPE

Provide preformed filler Material for joints in concrete construction.

3702.2 REQUIREMENTS

Provide preform joint filler Material listed on the *Approved/Qualified Products List*.

Provide the following types of preformed joint filler Material:

(1) Type A – Cork meeting the requirements of *AASHTO M 153*, "Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction"
(2) Type B – Self-expanding Cork meeting the requirements of *AASHTO M 153*
(3) Type C – Sponge Rubber meeting the requirements of *AASHTO M 153*
(4) Type D-1 – Closed-cell Polyethylene Foam meeting the requirements of *ASTM D7174, Standard Specification for Preformed Closed-Cell Polyolefin Expansion Joint Fillers for Concrete Paving and Structural Construction*
(5) Type D-2 – Closed-cell Polypropylene Foam
(6) Type E – Bituminous Type meeting the requirements of *AASHTO M 213,* "Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)"

Provide the filler for each joint in a single piece for the full depth and width required for the joint unless otherwise approved by the Engineer. For pavement construction, provide filler in lengths equal to the width of the pavement lanes. Where dowel bars are necessary, provide joint filler with properly sized clean-cut punched holes correctly spaced to fit flush with the dowel bars.

Provide preformed filler Material meeting the requirements of Table 3702.2-1.

Table 3702.2-1
Preformed Joint Filler Requirements

Properties	Type					
	A	B	C	D-1	D-2	E
Compression	50-1500 psi *	50-1500 psi *	50-1500 psi *	5-300 psi ‖	30-60 psi *	100-750 psi *
Recovery	>90 percent	>90 percent	>90 percent	>95 percent	>80 percent	>70 percent
Extrusion	<0.25 inches	<0.25 inches	<0.25 inches	<0.5 inches	<0.25 inches	<0.25 inches
Density †	-	-	>30 pounds / feet cubed	-	>3.5 pounds /feet cubed	>19 pounds /feet cubed
Water Absorption	-	-	-	-	<1 percent	<15 percent
Asphalt Content	-	-	-	-	-	>35 percent
Expansion	-	>140 percent	-	-	-	-

* To 50 percent of the original thickness
‖ Compression requirements per *ASTM D7174, Standard Specification for Preformed Closed-Cell Polyolefin Expansion Joint Fillers for Concrete Paving and Structural Construction*
† Air-dried

3702.3 SAMPLING AND TESTING

Provide samples for testing meeting the requirements of the *Schedule of Materials Control*.

3719 HOT-POURED, CRUMB-RUBBER TYPE CRACK SEALER

3719.1 SCOPE

Provide hot-poured, crumb-rubber type crack sealer for sealing cracks in concrete and bituminous pavements and miscellaneous Structures.

3719.2 REQUIREMENTS

Provide crack sealer Material meeting the following requirements:

(1) On the *Approved/Qualified Products List*
(2) Consists of asphalt and crumb rubber blended together by the manufacturer to produce a homogeneous mixture
(3) When melted, the sealer does not separate or settle
(4) Uniform consistency suitable for filling joints and cracks without inclusion of large air holes or discontinuities

A Physical Requirements

Provide crack sealer meeting the requirements of *ASTM D6690, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements,* Type I with the following modifications in Table 3719.2-1 after one cycle of heating to the manufacturer's maximum heating temperature, cooling, and reheating to the manufacturer's maximum heating temperature.

Table 3719.2-1
***ASTM D6690, Type I* Modifications**

Test	Specification
Recycled rubber, mass	≥ 18 percent of asphaltic components
Bond Test, 50 percent extension at 0°F*	No adhesion or cohesion bond failure after 5 cycles
Resilience at 77°F	≥ 40 percent
Softening point	≥ 180°F
* Use sawed cement mortar blocks or asphalt HMA blocks prepared using the method found in the *Laboratory Manual*.	

B Packaging and Marking

Package and ship the sealer Material in boxes weighing no greater than 50 pounds. Mark the boxes with the following information:

(1) Material name
(2) Manufacturer name
(3) Brand name
(4) Weight
(5) Batch number
(6) Maximum heating temperature recommended by the manufacturer

3719.3 SAMPLING AND TESTING

A Sampling

Provide samples at rates and sizes meeting the requirements of the *Schedule of Materials Control* or as required by the Contract.

The Materials Engineer will perform tests on samples taken from the product proposed for use. Submit to the Engineer a manufacturer's Certificate of Compliance for each sealer batch.

B Methods of Test

Perform tests meeting the requirements of *ASTM D5329*, *Standard Test Methods for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphalt Pavements and Portland Cement Concrete Pavements*, except, perform the bond test using sawed cement mortar blocks or asphalt HMA blocks (consistent with the pavement type) prepared in accordance with the methods in the *Laboratory Manual*.

3721 PREFORMED ELASTOMERIC COMPRESSION JOINT SEALS FOR CONCRETE

3721.1 SCOPE

Provide preformed polychloroprene elastomeric joint seals for use in sealing joints in concrete pavements, Bridges, and other Structures.

3721.2 REQUIREMENTS

A Composition and Manufacture

Provide joint seals meeting the requirements of *ASTM D2628, Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements*, and as specified in this section.

Provide seals that are preformed and manufactured from a vulcanized elastomeric compound using polymerized chloroprene as the only polymer.

B Size and Shape

Provide preformed elastomeric compression joint seals in the size, shape, and dimensional tolerances of the seals as shown on the Plans or required by the Contract. The Contractor may use alternate shapes, if approved by the Engineer.

C Physical Properties

Unless the Contract requires otherwise, provide a 13/16 inch joint seal meeting the physical properties in accordance with *ASTM D2628, Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements,* and the following table:

Table 3721.2-1
13/16 inch Joint Seal Compression-Deflection Requirements

Property	Requirement
Force at 0.65 inches*	≥ 4 pounds/linear inch
Force at 0.41 inches*	≤ 20 pounds/linear inch
* Meeting the requirements of *ASTM D2628, Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements,* and the Compression-Deflection Test Method located in the *Laboratory Manual*.	

D Identification and Marking

Provide joint seals marked with the following at intervals no greater than 4 feet:

(1) Manufacturer's name or the manufacturer's trademark
(2) Lot number
(3) Date of production

For multiple die extrusion machines, identify the seal produced from each extrusion die as an individual sublot, in addition to the list above. Limit individual lot numbers or sublot numbers to 1 every 8 hour shift or every 6,000 feet, whichever results in the smallest lot size. Place a mark on the top surface of the seal at 1 foot intervals, to allow length measurements on each seal after installation.

Provide containers to package joint seals for shipment marked with the following information:

(1) Name of the manufacturer
(2) Lot number or sublot number
(3) Date of manufacture

E Lubricant-Adhesive

Provide lubricant-adhesive meeting the requirements of *ASTM D2835, Standard Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements*, to install the seals.

3721.3 SAMPLING AND TESTING

The Engineer in conjunction with the Materials Engineer may sample and test joint seals and lubricant adhesive Materials before or after delivery.

The Engineer in conjunction with the Materials Engineer may reject an entire lot or sublot if a test result for that lot or sublot fails.

A Sampling

Provide samples at rates and sizes meeting the requirements of the Schedule for Materials Control or as required by the Contract.

B Sample Preparation

The Materials Engineer will prepare test specimens meeting the requirements of *ASTM D2628, Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements*, and in accordance with the *Laboratory Manual*.

C Compression Deflection Test

Perform compression deflection testing on two specimens in accordance with the *Laboratory Manual*.

3722 SILICONE JOINT SEALANT

3722.1 SCOPE

Provide a silicone joint sealant for use in concrete pavement joints and cracks to protect the pavement from intrusion of water and incompressible Material.

3722.2 REQUIREMENTS

Provide silicone joint sealant meeting the requirements of *ASTM D5893, Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements*, and the following:

(1) Primer-less
(2) Low modulus
(3) Does not contain solvents or diluents that can cause shrinkage or expansion during curing
(4) Smooth and uniform in appearance with a consistency that allows application with air pressure guns or hand caulking applicators
(5) Capable of withstanding repeated joint movement from −50 percent to 100 percent without losing adhesion to the concrete and without cohesion failure
(6) Listed on the *Approved/Qualified Products List*

3722.3 SAMPLING AND TESTING

Provide samples at rates and sizes meeting the requirements of the *Schedule of Materials Control* or as required by the Contract.

3723 HOT-POURED, ELASTIC TYPE JOINT AND CRACK SEALER

3723.1 SCOPE

Provide hot-poured elastic type joint and crack sealer to seal joints and cracks in concrete and bituminous pavements, Bridges, and other Structures.

3723.2 REQUIREMENTS

Provide a sealant Material meeting the following requirements:

(1) Listed on the *Approved/Qualified Products List*
(2) Composed of a combination of polymeric Materials, fully reacted chemically to form a homogeneous compound
(3) When melted, ensure the sealant does not separate or settle and ensure the sealant does not contain a dispersed or settling component
(4) Maintains a uniform consistency to seal joints and cracks without large air holes or discontinuities

A Physical Requirements

Provide sealant meeting the requirements of *ASTM D6690, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements*, Type II and the following modifications:

Table 3723.2-1
***ASTM D6690,* Type II Modifications**

Test	Requirement
Cone penetration at 77°F, 150 grams, 5 seconds	60 – 90 dmm
Bond at −20°F, 3 cycles, 100 percent extension	No adhesion or cohesion bond failure after 3 cycles
Mandrel bend test at −29°F, 1 inch mandrel	No cracking
Resilience at 77°F	≥ 40 percent

B Packaging and Marking

Package and ship the sealant Material in boxes no greater than 50 pounds. Mark the containers with the following information:

(1) Material name
(2) Manufacturer name
(3) Brand name
(4) Weight
(5) Batch number
(6) Maximum heating temperature, as recommended by the manufacturer

3723.3 SAMPLING AND TESTING

A Sampling

Provide samples in rates and sizes meeting the requirements of the *Schedule of Materials Control*, or as required by the Contract.

The Materials Engineer will perform tests on samples taken from the product proposed for use. Submit to the Engineer a manufacturer's Certificate of Compliance with each sealant batch.

B Methods of Test

B.1 Bond Test

Perform tests meeting the requirements of *ASTM D5329*, *Standard Test Methods for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphalt Pavements and Portland Cement Concrete Pavements*, except perform the bond test using sawed cement mortar blocks or asphalt HMA blocks (consistent with the pavement type) prepared using the methods found in the *Laboratory Manual*.

B.2 Mandrel Bend Test *ASTM D522, Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings*, Method B

Perform the Mandrel Bend Test at −29°F using a 1 inch mandrel, bending the specimen 180° over 5 seconds. The Materials Engineer will prepare test specimens meeting the requirements of *D6690, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements*, Type II, Flow Test, and condition the specimens at −29°F for at least 4 hours.

3725 HOT-POURED, EXTRA LOW MODULUS, ELASTIC TYPE JOINT AND CRACK SEALER

3725.1 SCOPE

Provide hot-poured, extra low modulus, elastic type joint and crack sealer to seal joints in concrete pavement, Bridges, other Structures and rout and seal applications on bituminous pavements.

3725.2 REQUIREMENTS

Provide a sealant Material meeting the following requirements:

(1) Listed on the *Approved/Qualified Products List*
(2) Composed of a combination of polymeric Materials, fully reacted chemically to form a homogeneous compound
(3) When melted, ensure the sealant does not separate or settle
(4) Maintains a uniform consistency to seal joints and cracks without inclusion of large air holes or discontinuities

A Physical Requirements

Provide sealant meeting the requirements of *ASTM D6690, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements*, Type IV with the following modifications in Table 3725.2-1.

Table 3725.2-1
***ASTM D6690* Type IV Modifications**

Test	Requirement
Cone Penetration at 77°F, *ASTM D5329**	100 – 150 dmm
Cone Penetration at 0°F, *ASTM D5329** modified	≥ 25 dmm
Resilience, *ASTM D5329**	30 – 60 percent
NOTE: Ensure the Material meets these requirements after heating for 6 hours with constant mixing in a laboratory melter at the manufacturer's maximum heating temperature. * *ASTM D5329*, *Standard Test Methods for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphalt Pavements and Portland Cement Concrete Pavements*	

B Packaging and Marking

Package and ship the sealant Material in boxes weighing no greater than 50 pounds. Mark the boxes with the following information:

(1) Material name
(2) Manufacturer name
(3) Brand name
(4) Weight
(5) Batch number
(6) Maximum heating temperature recommended by the manufacturer

3725.3 SAMPLING AND TESTING

Provide samples at rates and sizes meeting the requirements of the *Schedule of Materials Control* or as required by the Contract.

The Materials Engineer will perform tests on samples taken from the product proposed for use. Submit to the Engineer a manufacturer's Certificate of Compliance with each sealant batch.

Perform tests meeting the requirements of *ASTM D5329*, *Standard Test Methods for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphalt Pavements and Portland Cement Concrete Pavements*, except perform the bond test using sawed cement mortar blocks or asphalt HMA blocks (consistent with the pavement type) prepared using the methods found in the *Laboratory Manual*.

3726 PREFORMED GASKET SEALS FOR CONCRETE PIPE

3726.1 SCOPE

Provide preformed gasket seals to construct watertight joints for concrete pipe.

3726.2 REQUIREMENTS

Provide preformed gasket type seals to construct flexible, watertight joints in concrete pipe meeting the requirements of *ASTM C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets*, and as shown in the Plans for the specific joint design of the pipe.

3726.3 SAMPLING AND TESTING

Sample and test in accordance with the *Schedule of Materials Control*.

3728 BITUMINOUS MASTIC JOINT SEALER FOR PIPE

3728.1 SCOPE

Provide cold applied, mineral filled, joint sealing compound for joints of bell and spigot or tongue and groove, concrete or clay Culvert, sewer, or drain pipe.

3728.2 REQUIREMENTS

Provide a bituminous mastic joint sealer consisting of refined petroleum asphalt meeting the requirements of *ASTM D4586*, *Standard Specification for Asphalt Roof Cement, Asbestos-Free*, except for the following modifications:

Table 3728.2-1
***ASTM D4586* Modifications**

Test	Requirement
Grease cone penetration (unworked) 150 grams, 77°F, 5 seconds, *ASTM D217**	175 dmm – 300 dmm
Density	≥ 8.75 pounds per gal
Non-volatile content	≥ 65 percent
Ash content, by ignition	25 – 45 percent
Cure Evaluation at 77°F	Tough, plastic coating, free of blisters
* *ASTM D217, Standard Test Methods for Cone Penetration of Lubricating Grease*	

Do not use coal tar products.

Provide Material exhibiting 100 percent adhesion and cohesion when applied to metal, concrete, or vitrified clay surfaces.

3728.3 SAMPLING AND TESTING

Submit to the Engineer a manufacturer's Certificate of Compliance.

Apply the bituminous mastic joint sealer in a layer 1/16 inch to 1/8 inch thick on a tinned metal panel. Cure the joint sealer at 77°F for 24 hours. An acceptable bituminous mastic joint sealer will set to a tough, plastic coating, free of blisters.

3731 CAULKING COMPOUND

3731.1 SCOPE

Provide caulking compound meeting the requirements of *Federal Specification A-A-272*, "Caulking Compounds," in the type required by the Contract. If the type is not specified, use Type III—Butyl Rubber or Type IV—100 percent Silicone.

3731.2 REQUIREMENTS

Apply the caulking compound in accordance with the manufacturer's recommendations.

Unless the Contract requires otherwise, use near white, light gray, or buff colored caulking compound.

3731.3 SAMPLING AND TESTING

Sample and test in accordance with the *Schedule of Materials Control*.

3733 GEOSYNTHETIC MATERIALS

3733.1 SCOPE

Provide geotextiles or geogrids as specified in the Contract.

3733.2 REQUIREMENTS

A General

Provide geosynthetics that are uniform in texture, thickness, and appearance, and free of defects, flaws, or abrasions. Deliver rolls of geosynthetics with an opaque plastic covering to protect from ultraviolet rays or contamination with mud, dirt, dust, or debris. Geosynthetics are required to be resistant to biological and chemical environments normally found in soils.

Label the geosynthetics on the outside wrap and inside the core in accordance with *ASTM D4873*, *Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples*, and with the following:

(1) Manufacturer
(2) Product name
(3) Roll number

B Geotextiles

Provide geotextiles made from woven, nonwoven, or knit fabric of polymeric filaments or yarns, such as polypropylene, polyethylene, polyester, or polyamide. Except for Type 1b (knit sock), provide geotextiles in compliance with the National Transportation Product Evaluation Program (NTPEP).

Provide geotextile meeting the requirements of Table 3733.2-1, Table 3733.2-2, or Table 3733.2-4 for the type required by the Contract. For Type 10, meet the requirements of AASHTO M288 Class 1A and a seam strength of 250 pounds/inch per *ASTM D4884, Standard Test Method for Strength of Sewn or Bonded Seams of Geotextiles*.

Table 3733.2-1
Geotextile Properties for Types 1, 3, 4, 5, 6, 7

Geotextile Property	ASTM Test Method Units	Type (a)						
		1		3	4	5	6	7 (c)
		Fabric	Knit sock (b)					
B1 Grab Tensile Strength minimum, each principal direction	*D4632* pounds	100	—	100	200	200	(d)	300
B2 Elongation minimum, each principal direction	*D4632* percent	—	—	50	50	—	(d)	50
B3 Seam Breaking Strength minimum (e)	*D4632* pounds	90	—	90	180	180	(d)	270
B4 Apparent Opening Size (AOS) maximum opening permitted (f)	*D4751** U.S. Std. Sieve size	40	40 as applied	50	50	30	20	50
B5 Permittivity minimum (g)	*D4491*‖ Method B Falling Head seconds^{-1}	0.7	2.75 relaxed	0.5	0.5	0.05	0.05	0.5
B6 Puncture strength minimum	*D6241*† pounds	—	180	—	—	—	—	—
B7 Wide Width Strip Tensile Strength minimum each principal direction	*D4595*‡ pounds/feet	—	—	—	—	—	(d)	—

(a) Minimum Average Roll Values (MARV) based on average of at least three tests per swatch.
(b) Provide socks made of knit polymeric Materials and meeting the requirements of *ASTM D6707-06*, *Standard Specification for Circular-Knit Geotextile for Use in Subsurface Drainage Applications*, for Type H as given for properties B4, B5 and B6 fabric. Ensure the sock exhibits minimum snag or run potential, is factory-applied to maintain uniform installed mass, and conforms to the outside diameter of the tubing with a snug fit.
(c) Needle-punched nonwoven. Do not use thermally bonded (heat-set) fabric.
(d) Requirements are site-specific and will be as specified in the Contract. The property values for B1 and B3 may not be less than shown for Type 5. If the Contract does not specify either B1 or B7, use a default value of 300 pounds for B1. If the Contract does not specify seam strength, use a default value of 270 pounds for B3.
(e) Adhere to this requirement if the Contract requires or allows seams. Strength Specifications apply to factory and field seams. Use thread for sewing that has strength of at least 25 pounds. Sew seams with a Federal Type 401 stitch (*ASTM D6193-16*, *Standard Practice for Stitches and Seams*) using a two-spool sewing machine, and install seams facing upward. For seaming with adhesives, see the *Approved/Qualified Products List* available at the Department's website.
(f) For U.S. Sieve sizes, the AOS Number must be equal to or greater than the Sieve size specified.
(g) Permittivity: P = K/L, where K = fabric permeability and L = fabric thickness.
* *ASTM D4751*, *Standard Test Methods for Determining Apparent Opening Size of a Geotextile*
‖ *ASTM D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity*
† *ASTM D6241*, *Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products using a 50-mm Probe*
‡ *ASTM D4595*, *Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method*

Table 3733.2-2
Type 8 Geotextile Properties

Property	Requirements	Test Procedure
Geotextile type	Nonwoven, needle-punched geotextile, no thermal treatment (calendaring or IR)	Manufacturer Certificate of Compliance
Color	Uniform/Nominally same-color fibers	Visual Inspection
Mass per unit area	≥ 14.7 ounce/square yard	*ASTM D5261**
Thickness under load (pressure)	At 0.29 psi : ≥ 0.12 inches At 2.9 psi : ≥ 0.10 inches At 29 psi : ≥ 0.04 inches	*ASTM D5199*‖
Wide-width tensile strength	≥ 685 pounds/feet	*ASTM D4595*†
Wide-width maximum elongation	≤ 130 percent	*ASTM D4595*†
Water permeability in normal direction under load (pressure)	At 2.9 psi : ≥ 3.3×10^{-4} feet/second	*ASTM D5493* MnDOT Modified‡ or *ASTM D4491*#
In-plane water permeability (transmissivity) under load (pressure)	At 2.9 psi : ≥ 1.6×10^{-3} feet/second At 29 psi : ≥ 6.6×10^{-4} feet/second	*ASTM D6574* MnDOT Modified§ or *ASTM D4716***
Weather resistance	Retained strength ≥ 60 percent	*ASTM D4355*‖‖ at 500 hours exposure
Alkali resistance	≥ 96 percent polypropylene/polyethylene	Manufacturer certification of polymer

* *ASTM D5261*, *Standard Test Method for Measuring Mass per Unit Area of Geotextiles*
‖ *ASTM D5199, Standard Test Method for Measuring the Nominal Thickness of Geosynthetics*
† *ASTM D4595, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method*
‡ *ASTM D5493*, *Standard Test Method for Permittivity of Geotextiles Under Load*
# *ASTM D4491*, *Standard Test Methods for Water Permeability of Geotextiles by Permittivity*
§ *ASTM D6574, Standard Test Method for Determining the (In-Plane) Hydraulic Transmissivity of A Geosynthetic by Radial Flow*
** *ASTM D4716, Standard Test Method for Determining the (In-Plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head*
‖‖ *ASTM D4355, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus*

Table 3733.2-3
Type 9 Geotextile Properties

Type 9 Requirements			
Property	**Test Method**	**Unit**	**Requirement (MARV*)**
Tensile Strength at Ultimate	*ASTM D4595*‖	pounds/feet	Machine Direction: 3,500 Cross Machine Direction: 3,200
Apparent Opening Size (AOS)	*ASTM D4751*†	U.S. Sieve	30
Permittivity	*ASTM D4491*‡	$second^{-1}$	0.8
Flow Rate	*ASTM D4491*‡	$gallon/minute/foot^2$	60
UV Resistance (at 500 hours)	*ASTM D4355*#	% strength retained	70
Seam Breaking Strength	*ASTM D4884*§	Pounds/inch	200**

* Minimum Average Roll Values (MARV) based on average of at least three tests per swatch
‖ *ASTM D4595, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method*
† *ASTM D4751, Standard Test Methods for Determining Apparent Opening Size of a Geotextile*
‡ *ASTM D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity*
# *ASTM D4355, , Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus*
§ *ASTM D4884, Standard Test Method for Strength of Sewn or Bonded Seams of Geotextiles*
** Use thread with a minimum strength of 25 pounds. Sew seams with a *ASTM D6193* Federal Type 401 stitch using a two-spool sewing machine, and install seams facing upward. For seaming with adhesives, see the *Approved/Qualified Products List* available at the Department's website.

C Geogrid

Provide geogrid consisting of woven, or punched and sheet drawn of polymeric filaments or yarns, or ribs such as polypropylene, polyethylene, polyester, or polyamide.

Provide biaxial geogrid meeting the requirements of Table 3733.2-4 for the type specified in the Contract.

Table 3733.2-4
Geogrid Properties

Geogrid Property	ASTM Test Method Units	Type 1	Type 2
Ultimate Tensile Strength minimum, MD direction	*D6637** pound/foot	850	1300
Ultimate Tensile Strength minimum, XMD direction	*D6637** pound/foot	1300	1950
Tensile Strength at 5 percent Strain minimum MD Direction	*D6637** pound/foot	550	800
Tensile Strength at 5 percent Strain minimum XMD Direction	*D6637** pound/foot	900	1300
Resistance to UV Degradation	*D4355‖ Percent*	100	100
Grid Aperture Size MD	*Nominal Inches*	1.0	1.0
Grid Aperture Size XMD	*Nominal Inches*	1.3	1.3

** ASTM D6637, Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method*
‖ ASTM D4355, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus

3733.3 SAMPLING AND TESTING

A Certificate of Compliance
For each shipment, provide a Certificate of Compliance.

For geotextiles, also provide a document stating the manufacturer's MARV.

B Sampling and Testing
Sample and test according to the *Schedule of Materials Control*. Cut samples across the full width of the roll. Do not sample the first full turn (outside layer) of the roll. For geotextiles, provide seam samples in addition to the regular sample and use the same machine, or an equal machine to the one on the Project, to produce seam samples.

3741 ELASTOMERIC BEARING PADS

3741.1 SCOPE
Provide elastomeric bearing pads for use in Bridges and other Structures.

3741.2 REQUIREMENTS

A General
The basis of design for bearing pads is in conformance with Method A of the *AASHTO LRFD Bridge Design Specifications*.

Before the start of Work, the supplier will be qualified on *Approved Suppliers for Fabricated Structural Metals Products* list as maintained by the Structural Metals Engineer on the Bridge Office website, or become qualified. To become qualified, the supplier is to submit a *MnDOT Quality Manual* (QM) to the Engineer for review and acceptance, at least 60 Calendar Days before beginning Work. The QM is to meet the requirements of the *MnDOT Supplier Qualification Standard* which will be the basis for acceptance by the Engineer. Upon acceptance of the QM, a supplier is qualified and will be listed on the *Approved Suppliers for Fabricated Structural Metals Products*. In addition to routine inspections, the

Engineer will audit suppliers with approved QMs on a biannual or annual basis or as otherwise directed by the Engineer to ensure the implementation of the QM.

The Department will invoke its Corrective Action Process if the routine inspections or audits indicate non-conformance. Corrective actions deemed appropriate by the Engineer, are effective immediately and apply to any Work remaining on a current Project and future Projects. If the Engineer determines that Work does not comply with the QM or that fabrication does not follow approved fabrication procedures, the Engineer will deem the Materials as non-conforming in accordance with 1503, "Conformity with Contract Documents," and 1512, "Unacceptable and Unauthorized Work." If the Engineer finds non-conforming Work, direct the supplier to immediately correct the procedure and submit a written non-conformance report, containing data required by the Engineer to ensure compliance with the QM, Specifications, and drawings. Perform additional testing as required by the Engineer at no additional cost to the Department. For repeat offences or negligence, the Department will require corrective action of hiring a third-party Quality Control Inspector at no additional cost to the Department. The Contractor may obtain a copy of the Department's Corrective Action Process from the Engineer.

Provide bearing pads no greater than 1/2 inch thick, fabricated of all elastomer. Plain elastomer pads may be cut from larger sheets cast to the thickness shown on the Plans. Avoid heating or damaging the Material when cutting. Ensure the cutting produces smooth edges at least meeting the requirements of ANSI 250 finish.

Provide bearings of laminated construction when pads are greater than 1/2 inch thick. Refer to *AASHTO M 251,* "Standard Specification for Plain and Laminated Elastomeric Bridge Bearings," for tolerances, dimensions, and configurations, except provide elastomer to a thickness of 1/4 inch within a range from +1/8 inch to –1/16 inch to cover the top and bottom steel plates.

Provide laminated pads meeting the following requirements or characteristics:

(1) Consisting of alternate Layers of elastomer and metal reinforcement integrally bonded together
(2) Containing reinforcement spaced as shown on the Plans, and parallel to the top and bottom surfaces of the pad
(3) Including the manufacturer's name or trademark molded into the edge of the pad
(4) Including elastomer lot number and grade on the edge of the pad using indelible ink or flexible paint of contrasting color

Do not expose the finished laminated pad to temperatures greater than 400°F.

Cover the edges of metal reinforcement with 1/4 inch of elastomer.

B Physical Properties

Substitute the requirements of sections 4.1 and 4.2 of *AASHTO M 251*; comply with B.1 & B.2 in this Specification.

B.1 Elastomer

Use elastomer compound containing only virgin crystallization resistant polychloroprene (neoprene) or virgin natural polyisoprene (natural rubber) as the raw polymer. Use only new Material with no reclaimed Material incorporated in the finished bearing.

Provide elastomer for bearing pads meeting the requirements of *AASHTO M 251* with durometer hardness of 60 on the Shore "A" scale. Provide elastomer compounds classified as Low-Temperature Zone D, Grade 4 or 5 meeting the requirements of *AASHTO LRFD Bridge Design Specifications*, Table 14.7.5.2-1, "Low-Temperature Zones and Minimum Grades of Elastomer."

Utilize cotton duck bearing pads (CDP) where *Bridge Details* Part 1 B310 and B354 are included in the Plans or when *Bridge Details* Part 1 B311 or B355 utilize plain (non-steel reinforced) elastomeric bearing pads. Test and manufacture CDP in accordance with *Military Specification MIL-C-882E*. For CDP, waive additional sampling and testing requirements listed in this Specification.

B.2 Properties

Test and accept sampled bearings in accordance with the following:

Table 3741.2-1
Elastomeric Bearing Requirements

		Natural Polyisoprene (Natural Rubber)	**Polychloroprene (Neoprene)**
Durometer		60±5	60±5
Physical properties	Hardness (*ASTM D2240#*)	60±5	60±5
	Tensile strength (*ASTM D412§*)	2250 psi	2250 psi
	Ultimate elongation (*ASTM D412§*), minimum	400 percent	400 percent
Heat resistance (*ASTM D573)**	Temperature / Aging Time	158°F/168 hours	212°F/70 hours
	Hardness, maximum Shore "A" points change	+10	+15
	Tensile strength, maximum percent change	–25	–15
	Ultimate elongation, maximum percent change	–25	–40
Compression set (*ASTM D395‖, Method B*)	22 hours at 158°F, maximum percent	25	NA
	22 hours at 212°F, maximum percent	NA	35
Low Temperature Test (*ASTM D746†, Procedure B*)	Brittleness at –54.4°F	No Failure	No Failure
Laminated Pad Adhesion Test (*ASTM D429‡, Method B*)	Bond Strength (Peel Test)	40 psi	40 psi

* *ASTM D573, Standard Test Method for Rubber-Deterioration in an Air Oven*
‖ *ASTM D395, Standard Test Methods for Rubber Property-Compression Set*
† *ASTM D746, Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact*
‡ *ASTM D429, Standard Test Methods for Rubber Property-Adhesion to Ridged Substrates*
# *ASTM 2240, Standard Test Method for Rubber Property-Durometer Hardness*
§ *ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension*

Compressive Strain of Laminated Bearings

Test each sampled laminated pad for compressive strain. The compressive strain in any Layer of a laminated pad shall not exceed 9 percent at 1250 pounds per square inch average unit pressure for the full size laminated pad.

Proof Load Testing

Proof load each bearing pad per *AASHTO M 251*, "Standard Specification for Plain and Laminated Elastomeric Bridge Bearings," Section 8.8.2. Use a compressive load of 1800 pounds per square inch for laminated pads and 1200 pounds per square inch for plain elastomeric pads. Reject bearing pads if bulging patterns imply laminate placement does not satisfy design criteria

and manufacturing tolerances, or if bulging suggests inadequate laminate bond. Also reject bearing pads if there are 3 separate surface cracks greater than 1/16 inches wide by 1/16 inches deep.

B.3 Metal Reinforcement
Provide mild steel plates at least 1/8 inch thick for use as metal reinforcement.

C Certification
Submit to the Engineer a manufacturer's Certificate of Compliance.

3741.3 SAMPLING AND TESTING

A Manufacturer Sampling and Testing
Sample and test in accordance with *AASHTO M 251*, Section 8 except as modified in this Specification. Destructive test finished laminated and plain bearing pads at a rate of 2 full size bearing pads per lot (produced from the same raw Material utilizing the same processes and procedures). A lot shall not exceed 100 pads and is not limited to finished sizes or thickness. Destructive testing is defined as any test that renders the product not usable for its intended purpose.

Provide bearing pad test data and certification prior to shipping. Test results of samples must verify compliance to product Specifications. Any bearing tested that does not meet the Specifications will result in the rejection of the entire lot. When applicable, the supplier shall retain a copy of the passing test results for one year and supply the document with subsequent jobs.

Concrete Curing Materials

3751 BURLAP CURING BLANKETS

3751.1 SCOPE
Provide burlap cloth for use as a curing cover on Portland cement concrete.

3751.2 REQUIREMENTS
Provide burlap cloth meeting the requirements of *AASHTO M 182*, "Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats," Class 3 for use as a curing cover on Portland cement concrete.

3751.3 SAMPLING AND TESTING
Provide samples for testing meeting the requirements of the *Schedule of Materials Control*.

3752 MEMBRANE CURING/SEALING COMPOUND FOR COLORED CONCRETE

3752.1 SCOPE
Provide a curing/sealing compound for spray application on Portland cement colored concrete surfaces.

3752.2 REQUIREMENTS
Provide membrane curing/sealing compound meeting the following requirements:

(1) Meets the requirements of *ASTM C1315, Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete*.
(2) Type I, Class A, with an Acrylate Polymer or Acrylate Copolymer resin.
(3) Meets the requirements of the Department's Curing/Sealing Compounds for Colored Concrete Approval Program, as listed in the *Approved/Qualified Products List*.

The Contractor may use this membrane curing/sealing compound in other applications as approved by the Engineer or as shown in the Special Provisions.

3752.3 SAMPLING AND TESTING

Provide a statement of compliance meeting the requirements of *ASTM C1315, Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete*, Type I, Class A, with an Acrylate Polymer or Acrylate Copolymer resin.

3753 TYPE 1-D MEMBRANE CURING COMPOUND

3753.1 SCOPE

Provide clear or translucent liquid membrane forming curing compounds with a Type 1-D fugitive dye for spray application on Portland cement colored or stamped concrete surfaces, where a finished white surface would mask the decorative finished concrete surface when exposed to the air.

3753.2 REQUIREMENTS

A General

Provide membrane curing compound meeting the following requirements:

(1) All membrane-curing compounds pre-approved by the Department before use. The most current approved lots and batches with product expiration dates are available on the *Approved/Qualified Products List*

(2) Meets the requirements of the Department's Curing Compound Manufacturer Approval Program, as listed in the *Approved/Qualified Products List*, including pre-testing of Materials by the manufacturer

(3) Meets the requirements of *ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete*, Type 1-D Curing Compound

(4) The Engineer will not allow the use of curing compound that is over 1 year from the manufacture date

The Contractor may use Type 1-D curing compound in other concrete applications as approved by the Engineer or as shown on the Special Provisions. Use of any other Type 1 curing compound is at the discretion of the Engineer, in conjunction with the Concrete Engineer.

3753.3 SAMPLING AND TESTING

Provide samples for testing meeting the requirements of the *Schedule of Materials Control*.

Test the Material at an application rate of 200 square feet per gallon.

3754 POLY-ALPHA METHYL STYRENE (AMS) MEMBRANE CURING COMPOUND

3754.1 SCOPE

Provide poly-alpha methyl styrene liquid membrane curing compounds for spray application on Portland cement concrete surfaces exposed to the air.

3754.2 REQUIREMENTS

Provide membrane-curing compound meeting the following requirements:

(1) All membrane-curing compounds pre-approved by the Department before use; the most current approved lots and batches with product expiration dates are available from the *Approved/Qualified Products List*

(2) Meets the requirements of the Department's Curing Compound Manufacturer Approval Program, including pre-testing of Materials by the manufacturer

(3) Meets the requirements of *ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete*, for the type required by the Contract
(4) The Engineer will not allow the use of curing compound that is over 1 year from the manufacture date
(5) White pigmented Type 2, Class B
(6) Resin is 100 percent poly-alpha methyl styrene and formulated to maintain the specified properties of Table 3754.2-1

Table 3754.2-1
Requirements for 3754, "Poly-Alpha Methyl Styrene (AMS) Membrane Curing Compound"

Properties	Range
Total solids, percent by weight of compound	≥ 42
Percent reflectance in 72 hours (*ASTM E1347*†)	≥ 65
Loss of Water, kilograms/square meter in 24 hours (*ASTM C156*‡)	≤ 0.15
Loss of Water, kilograms/square meter in 72 hours (*ASTM C156*‡)	≤ 0.40
Settling Test, millimeter/100 milliliter in 72 hours*	≤ 2
V.O.C. Content, grams/Liter	≤ 350
Infrared Spectrum, vehicle‖	100 percent α methyl styrene

* Test in accordance with the method on file at the Materials Laboratory.
‖ Match the infrared scan for the dried vehicle from the curing compound to the infrared scan on file at the Materials Laboratory.
† *ASTM E1347*, *Standard Test Method for Color and Color Difference Measurement by Tristimulus Colorimetry*
‡ *ASTM C156*, *Standard Test Method for Water Loss [from a Mortar Specimen] Through Liquid Membrane-Forming Curing Compounds for Concrete*

3754.3 SAMPLING AND TESTING

Provide samples for testing meeting the requirements of the *Schedule of Materials Control*.

Test the Material at an application rate of 200 square feet per gallon.

3755 LINSEED OIL MEMBRANE CURING COMPOUND

3755.1 SCOPE

Provide extreme service white pigmented, heavy bodied linseed oil emulsion for application as a membrane cure and sealer.

3755.2 REQUIREMENTS

Provide membrane curing compounds meeting the following requirements:

(1) All membrane-curing compound pre-approved by the Department before use; the most current approved lots and batches with product expiration dates are available on the *Approved/Qualified Products List*
(2) Meets the requirements of the Department's Curing Compound Manufacturer Approval Program, including pre-testing of Materials by the manufacturer
(3) Composed of a blend of boiled linseed oil and high viscosity, heavy bodied linseed oil emulsified in a water solution meeting the requirements of *ASTM C309, Standard*

Specification for Liquid Membrane-Forming Compounds for Curing Concrete, Type 2, except the Department will waive the drying time

(4) The Engineer will not allow the use of curing compound that is over 1 year from the manufacture date

(5) Sprayable at temperatures of at least 40°F

(6) Formulated to maintain the specified properties of Table 3755.2-1

Table 3755.2-1
Chemical Requirements of Linseed Oil Membrane Curing Compound
(volumes exclusive of added pigment)

Material Requirements	Percent by Weight
Oil phase (50± 4 percent by volume):	
Boiled linseed oil	80
Z-8 viscosity linseed oil	20
Water phase (50 ± 4 percent by volume)	100

3755.3 SAMPLING AND TESTING

Provide samples for testing meeting the requirements of the *Schedule of Materials Control*.

Test membrane curing compound at an application rate of 200 square feet per gallon.

3756 PLASTIC CURING BLANKETS

3756.1 SCOPE

Provide white polyethylene sheeting for use as a curing cover on Portland cement concrete.

3756.2 REQUIREMENTS

Provide white polyethylene sheeting meeting the requirements of *ASTM C171, White Opaque Polyethylene Film*.

3756.3 SAMPLING AND TESTING

Provide samples for testing meeting the requirements of the *Schedule of Materials Control*.

3757 MEMBRANE WATERPROOFING SYSTEM

3757.1 SCOPE

Provide a membrane waterproofing system to be used for waterproofing below-grade joints in concrete Structures, tunnels, and other below grade applications on concrete Structures.

3757.2 REQUIREMENTS

Provide a membrane waterproofing system meeting the following requirements:

(1) Listed on the *Approved/Qualified Products List*

(2) Consists of a primer, a rubberized asphalt membrane on a cross-laminated polyethylene carrier film, a pointing mastic, and a protection course

A Primer

Provide a solvent-based primer meeting the requirements of Federal and Minnesota Pollution Control Agency VOC regulations and specially formulated for use with the waterproofing system being used.

B Membrane

Provide waterproofing system with a membrane meeting the requirements of Table 3757.2-1:

Table 3757.2-1
Waterproofing Membrane Requirements

Property	Specification	Test Method
Thickness	≥ 56 mil	*ASTM D3767**,Method A
Tensile strength	≥ 250 psi	*ASTM D412*‖, Die C
Elongation	≥ 300 percent	*ASTM D412*‖, Die C
Composition	Rubber asphalt	Infrared scan

* *ASTM D3767, Standard Practice for Rubber-Measurement of Dimensions*
‖ *ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension*

C Carrier Film

Provide membrane waterproofing system with carrier film meeting the requirements of Table 3757.2-2:

Table 3757.2-2
Waterproofing Carrier Film Requirements

Property	Specification	Test Method
Thickness	≥ 4 mil	*ASTM D3767*, Method A
Composition	Polyethylene	Infrared scan

D Composite Membrane

Provide membrane waterproofing system with a composite membrane meeting the requirements of Table 3757.2-3:

Table 3757.2-3
Waterproofing Composite Membrane Requirements

Property	Specification	Test Method
Pliability, 180° bend, 1 inch mandrel at −25°F	Unaffected	*ASTM D146**
Permeance	< 0.05 Perms	*ASTM E96*‖, Method B
Peel adhesion	≥ 5 pounds/inch	*ASTM D903* Modified†
Water absorption	−0.1 percent, 72 hours	*ASTM D1970*‡

* *ASTM D146, Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing*
‖ *ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials*
† *ASTM D903, Standard Test Method for Peel or Stripping Strength of Adhesive Bonds*, Modified: 90 percent peel after 7 Calendar Days at 70°F, plus 7 Calendar Days at 120°F, plus 7 Calendar Days at 70°F (dry) (wet). The 180° peel strength is run at a rate of 12 inches per minute.
‡ *ASTM D1970, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection*

3757.3 SAMPLING AND TESTING

Provide samples in rates and sizes meeting the requirements of the *Schedule of Materials Control*, or as required by the Contract.

The Materials Engineer, may perform tests on samples taken from the product proposed for use or on samples submitted and certified by the manufacturer as representative of the membrane waterproofing system to be supplied.

3760 INSULATION BOARD (POLYSTYRENE)

3760.1 SCOPE

Provide extruded polystyrene insulation board for use on Highway insulation applications.

3760.2 REQUIREMENTS

Provide extruded polystyrene insulation board used for Highway insulation applications meeting the requirements of *AASHTO M 230*, "Standard Specification for Expanded and Extruded Foam Board (Polystyrene)," except the Department will not apply the requirement for flammability. The Contract will identify the selected type of insulation board and the insulation board strength as listed in *AASHTO M 230*.

3760.3 SAMPLING AND TESTING

Provide samples meeting the requirements of the *Schedule of Materials Control*.

Electrical Systems Materials

3801 RIGID STEEL CONDUIT (RSC)

3801.1 SCOPE

Provide rigid steel conduit and fittings constructed of galvanized steel 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,* "Electrical Rigid Metal Conduit – Steel," and *UL 514B*, "Conduit, Tubing, and Cable Fittings." 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 (IMC) and fittings for electrical systems.

3802.2 REQUIREMENTS

Use intermediate metal conduit listed and labeled by a NRTL, as defined by the U.S. Department of Labor, and meeting the requirements of *UL 6,* "Electrical Rigid Metal Conduit – Steel," and *UL 514B*, "Conduit, Tubing, and Cable Fittings." 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:

(1) NRTL listed meeting *UL 514B*, "Conduit, Tubing, and Cable Fittings" and *UL 651*, "Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings," for underground use
(2) Gray in color
(3) Smooth interior and exterior surfaces
(4) Schedule 80
(5) With the following marked on the outside:

(a) Manufacturers name
(b) Conduit size
(c) Conduit type
(d) NRTL certification mark

B High Density Polyethylene (HDPE) Conduit

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

(1) *ASTM F2160, Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)*
(2) NRTL listed meeting UL 651B
(3) Schedule 80
(4) Red or gray in color
(5) Smooth interior and exterior surfaces
(6) With the following marked on the outside:

(a) Manufacturers name
(b) Conduit size
(c) Conduit type
(d) NRTL certification mark

3804 LIQUID TIGHT FLEXIBLE NON-METALLIC CONDUIT (LFNC-B)

3804.1 SCOPE

Provide liquid tight flexible non-metallic (LFNC-B) conduit and fittings for electrical systems.

3804.2 REQUIREMENTS

Use liquid tight flexible non-metallic conduit meeting the following:

(1) Type LFNC-B
(2) Listed and labeled by NRTL as meeting the requirements of *UL 1660*, "Liquid-Tight Flexible Nonmetallic Conduit"
(3) Listed for 176°F in a dry location
(4) Listed for 140°F in a wet location

(5) Listed for 158°F in an oily location
(6) Sunlight resistant
(7) Rated for outdoor use
(8) CSA certified for use at 167°F in dry and oily locations and for 0°F low temperature applications

Do not provide conduit using a metallic integral reinforcement within the conduit wall.

3805 PVC COATED HOT DIPPED GALVANIZED RIGID STEEL CONDUIT (PVC COATED RSC)

3805.1 SCOPE

Provide Department-approved PVC coated RSC and fittings for electrical systems when specified in the Contract with approved hangers and supports.

3805.2 REQUIREMENTS

A PVC Coated RSC

Provide PVC coated RSC listed on *Approved/Qualified Products List* under "Lighting."

B PVC Coated RSC Fittings

Provide PVC coated RSC fittings listed on *Approved/Qualified Products List* under "Lighting."

Use fittings from the same manufacturer of the PVC coated RSC being used on the Project.

See 3839, "Conduit Expansion and Deflection/Expansion Coupling Fittings," for expansion and deflection/expansion coupling fittings.

C Hangers and Supports for PVC Coated Hot Dipped Galvanized Rigid Steel Conduit

Use conduit hangers, clamps, straps, U-bolts, strut and bar supports, threaded rod, inserts and miscellaneous hardware for PVC coated RSC in accordance with the NEC and as shown on the Plans or, if not shown, as directed by the Engineer.

3805.3 SAMPLING AND TESTING — BLANK

3806 UNDERGROUND NON-DETECTABLE MARKING TAPE

3806.1 SCOPE

Provide underground non-detectable marking tape as specified in the Contract.

3806.2 REQUIREMENTS

A General

Use underground non-detectable marking tape meeting the following:

(1) 3 inches wide
(2) Lead free
(3) American Public Works Association (APWA) Uniform Color Code for marking underground facilities
(4) 4.0 mil minimum thickness in accordance with *ASTM D2103-05, Standard Specification for Polyethylene Film and Sheeting*
(5) Tensile strength minimum 2.750 psi in accordance with *ASTM D882-02, Standard Test Method for Tensile Properties of Thin Plastic Sheeting*

(6) Elongation minimum 500 percent in accordance with *ASTM D882-75B, Standard Test Method for Tensile Properties of Thin Plastic Sheeting for Elongation*

(7) Printability ≥ 40 Dynes in accordance with *ASTM D2578, Standard Test Method for Wetting Tension of Polyethylene and Polypropylene Films*

B Communication Line Marking Tape

In addition to the general requirements for non-detectable marking tape in this section use marking tape for underground communication lines meeting the following:

(1) Orange

(2) Black lettering imprinted with the inscription, "CAUTION – MnDOT COMMUNICATION LINE BELOW"

C Electric Line Marking Tape

In addition to the general requirements for non-detectable marking tape in this section use marking tape for underground electric lines meeting the following:

(1) Red

(2) Black lettering imprinted with the inscription," CAUTION – MnDOT ELECTRIC LINE BELOW"

3806.3 SAMPLING AND TESTING

The Department reserves the right to sample, test, inspect, and accept or reject underground non-detectable marking tape based on its own tests.

3810 LUMINAIRES

3810.1 SCOPE

Provide luminaires for Lighting Systems as specified in the Contract.

3810.2 REQUIREMENTS

Use a complete and operational luminaire of the type and style as specified in the Contract.

Obtain the District Traffic Engineer's approval for use before installing luminaires.

Use luminaires listed on *Approved/Qualified Products List* under "Lighting," for the following:

A LED Roadway Lighting Luminaire

A.1 LED Roadway Luminaires (40 foot Mounting Height)

A.2 LED Roadway Luminaires (49 foot Mounting Height)

B LED Rest Area Luminaires

B.1 LED Parking Lot Luminaires

B.2 Rectangular LED Walkway Luminaires

C LED Roadway Underpass Luminaire

D LED High Mast Luminaires

D.1 LED Symmetrical High Mast Luminaires

D.2 LED Asymmetrical High Mast Luminaires

3810.3 SAMPLING AND TESTING — BLANK

3811 LIGHT POLES

3811.1 SCOPE

Design and provide Light Poles including shafts, mast arms, and base anchorages.

3811.2 REQUIREMENTS

A General

Provide a complete Light Pole and hardware required for installation as specified in the Contract and in accordance with *AASHTO's LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, First Editions 2015*. Provide Light Poles designed with a service life of at least 20 years and capable of withstanding a wind velocity of 90 mph with a 1.14 gust factor.

Submit manufacturer pole installation detail drawings illustrating the required hardware and bolt tightening patterns, sequencing, and methods to ensure proper anchor rod tension.

Provide breakaway Light Poles with certification from the manufacturer that the pole meets the breakaway specifications in the *AASHTO's LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, First Editions 2015*.

The Engineer will reject Light Poles that do not meet requirements as specified in the Contract.

B Light Poles

Provide mast arm or davit poles designed for a 60 pound luminaire with a projected area of 2.0 square feet.

Provide a Nominal 2 3/8 inch outside diameter (OD) schedule 40 or thicker tenon for slip fit luminaire installation.

For twin mast arm or davit poles, design for each arm to hold a 60 pound luminaire with the projected area of 3.2 square feet.

Provide a davit or mast arm with an upward angle from horizontal of 3 degrees ± 2 degrees.

Provide mast arms or davits fabricated from the same Material as the pole shaft. Provide mast arms or davits integral to the pole or connected to the pole shaft that gives an appearance of the pole being one continuous piece as shown on the Plans. If the mast arm or davit and pole shaft are two parts, provide a slip-fit type connection secured in place using an interference fit or two stainless steel through bolts. Ensure the mast arm or davit connected to pole shaft provides a watertight connection.

Provide a transformer base integral to the pole or as a separate component designed to attach to the pole shaft. Design and construct the base to provide internal space to accommodate a waterproof frame and a mount for fuses, and ballasts. Provide an access hole, with an opening of at least 100 square inches on one side of the base. Provide the access hole with a waterproof cover with positive closure. Place the access opening 180° from the mast arm unless otherwise specified in the Contract.

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

Provide each Light Pole with an electrical grounding lug or threaded hole for attaching a grounding lug with tang. Design and fabricate each Light Pole to provide electrical continuity to the grounding lug.

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

Provide Light Poles with at least the shell thicknesses and shaft diameters specified in the Contract or the design analysis for the following Material types:

B.1 Coated Steel Poles

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 after fabrication. Fabricate shafts with only 1 longitudinal seam unless otherwise allowed.

Provide mast arms made of Schedule 40 pipe meeting the requirements of *ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*, Grade A.

Paint or galvanize component parts of the pole, including hardware and fittings as specified in the Contract.

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

B.2 Aluminum Alloy Poles

Provide aluminum alloy poles meeting the requirements as follows:

(1) Shafts fabricated from seamless 6063-T6 or 6061-T6 aluminum alloy 0.188 in thick tapered tubing
(2) Mast arms fabricated from 6063-T6 or 6061-T6 seamless tubing
(3) Aluminum alloy poles with a factory installed vibration dampener and an aluminum wall thickness of 0.188 inch
(4) Transformer bases for breakaway designs fabricated from cast aluminum alloy 356-T6
(5) Stainless steel screws, nuts, bolts, washers, and other miscellaneous hardware, except for the anchor rod and T Base to pole assemblies, meeting the requirements of 3391.2, "Fasteners, Requirements," for stainless steel fasteners
(6) Aluminum alloy poles with a nonspecular, natural or sand belted (satin) finish

B.3 Stainless Steel Poles

Provide shafts, mast arms, transformer bases, and base slip fitters fabricated from Material meeting the requirements of *ASTM A240, Standard Specification for Chromium and Chromium-Nickle Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*, UNS Designation S20103, or an approved equal, with a yield strength of at least 50,000 psi. Provide a slip fitter accommodating the luminaire fabricated from Material meeting the requirements of *ASTM A511, Standard Specification for Seamless Stainless Steel Mechanical Tubing*, Grade MT 304L, Grade MT 316L, or an approved equal, as specified in the Contract.

Attach the transformer base to the shaft using a slip fitter at least 1 1/2 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 Pole 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 pole with a cleaning agent that will not damage the original mill finish.

3811.3 SAMPLING AND TESTING

Within 30 Calendar Days after the 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 pole and anchorage assembly components
(2) Dimensioned drawings of the pole and component details
(3) Manufacturing and assembly data for the pole and the components
(4) Data supporting the breakaway design features of the pole
(5) Anchor bolt test specimen that are representative of the designs
(6) Structural design computations for the lighting pole and components, including design criteria, allowable stresses, fatigue stresses, loading, and designed unit stresses
(7) A certification from a Professional Engineer, registered in Minnesota, competent in structural design certifying the structural adequacy of the proposed Light Pole

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 poles 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 Poles. 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 drawings of the Light Poles and anchor rods in accordance with 2471.3C.1, "General," and 2471.3C.3, "Submittal for Bridge Engineer's Review and Acceptance," to the Engineer for approval by the District Traffic Engineer. Submit final reproducible drawings in accordance with 2471.3C, "Shop 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
(5) District Traffic Engineer

Obtain the Engineer's approval before installing Light Poles.

3812 LIGHTING SYSTEM EQUIPMENT

3812.1 SCOPE

Provide miscellaneous lighting Equipment required for a complete Lighting System.

3812.2 REQUIREMENTS

Provide Equipment for Lighting Systems listed on *Approved/Qualified Products List* under "Lighting," for the following:

A Luminaire Wire Holders

B Insulated Wire Splice Connector Blocks

Provide breakaway type insulated wire splice connector blocks.

C Fuse Holders

D Photoelectric Controls

3812.3 SAMPLING AND TESTING — BLANK

3813 TRAFFIC SIGNAL AND LIGHTING SYSTEM ANCHORAGES

3813.1 SCOPE

Provide foundation anchor rods (bolts) and hardware as specified in the Contract.

3813.2 REQUIREMENTS

A Steel Screw-In Foundations

Provide steel screw foundations with manufacturer supplied bolts, nuts, and washers listed on *Approved/Qualified Products List* under "Lighting" for installation on steel screw-in foundations.

3813.3 SAMPLING AND TESTING — BLANK

3814 EMERGENCY VEHICLE PRE-EMPTION (EVP) EQUIPMENT

3814.1 SCOPE

Provide Emergency Vehicle Preemption/Priority (EVP) Equipment for traffic control signal systems.

3814.2 REQUIREMENTS

Use EVP systems and confirmatory indicator lights mounted on traffic control signal mast arms and traffic control signal pedestals as specified in the Contract. Use mounting hardware and attach to mast arms and pedestals as specified in the Contract and as approved by the Engineer.

A EVP Detectors

Use EVP systems listed on *Approved/Qualified Products List* under "Signals."

Deliver EVP phase selectors to the Department's Electrical Services Section at least 30 Business Days before the traffic control signal cabinet is required on the Project. The Department's Electrical Services Section will review the provided Equipment to ensure the proposed product is listed on the *APL*, and install the EVP phase selectors into the Department-provided traffic control signal cabinet.

B EVP Light Emitting Diode (LED) Confirmatory Indications

Only use LED EVP confirmatory indications listed on the *Approved/Qualified Products List* under "Signals."

C EVP Round Outlet Box

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

(1) Nominal 4 inch diameter by 1 1/2 inch deep
(2) Cast aluminum
(3) NRTL listed, for use in wet locations
(4) Threaded openings at the top, bottom, and 2 sides, with threaded caps, to support 3/4 inch conduit
(5) One threaded opening with threaded cap to support a 3/4 inch conduit on the back of outlet box
(6) Galvanized or zinc-plated screw-on cover for wet locations with weather seal
(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:

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

E EVP Confirmatory Indicator Lamp Holder

Use EVP confirmatory indicator lamp holders listed on *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 on *Approved/Qualified Products List* under "Signals."

Obtain the Engineer's approval of the EVP round outlet box or the EVP condulet outlet body before installation. Provide this documentation to the Engineer.

3815 CABLES AND CONDUCTORS

3815.1 SCOPE

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

3815.2 REQUIREMENTS

A General

Provide cables and conductors meeting the following requirements, unless otherwise specified in the Contract:

(1) Signal control cable listed by an 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) Stranded copper conductors
(3) Insulation rated for 600 V
(4) Meeting the requirements of ANSI, NEC, ASTM, and ICEA/NEMA Standards Publications
(5) Wire sizes for conductors based on the American Wire Gauge (AWG)
(6) Cables, except loop detector lead-in cables International Municipal Signal Association (IMSA) 50-2 and 3/C 20 AWG EVP Cable, with the following information ink printed on the jacket:

(a) Manufacturer name
(b) Year of manufacture (date code)
(c) Type of wire or cable
(d) Size and number of conductors
(e) Voltage rating
(f) Conductor insulation rating
(g) NRTL certification mark indicating that the cable is listed
(h) 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
(3) −31°F cold bend

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

Provide EVP detector cable (3/C 20 AWG) 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
(5) Foot markers

Repeat cable markings at intervals no greater than 24 inches on the jacket surface.

B Individual Conductors

B.1 Service, Feeder, and Branch Circuit Conductors

Provide individual conductors as specified in the Contract and the following:

(1) Individual conductors with a color coded continuous outer finish insulation meeting these color requirements:

(a) Black- line voltage ungrounded “hot” conductor
(b) Red- line voltage ungrounded “hot” conductor
(c) White- neutral “grounded” conductor
(d) Green- Equipment grounding conductor (EGC)

(2) Sized as specified in the Contract and the NEC. If conductor size is not specified in the Contract:

(a) Provide 8 AWG or larger for feeders
(b) Provide 12 AWG or larger for branch circuits.

(3) Type THW, THWN, or XHHW insulation

B.2 PVC Loop Detector Conductors

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

(1) 14 AWG
(2) Stranded copper
(3) Insulated with Type XLPE, or Type XHHW insulation in accordance with *UL 44*, “Thermoset-Insulated Wires and Cables”
(4) Marked with “XLPE,” “XLP,” or “XHHW” on the conductor
(5) Full compliance with the requirements of International Municipal Signal Association (IMSA) *Official Wire & Cable Specification Manual* 51-3 latest version is required

B.3 Saw Cut Loop Detector Conductors

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

(1) 14 AWG
(2) Stranded copper
(3) Insulated with filled chemically XLPE, or XHHW insulation in accordance with *UL 44*
(4) Contained in a black polyethylene tubing with a 1/4 inch outside diameter ± 10 mils and a minimum average wall thickness of 30 mils with no point less than 25 mils
(5) Marked with "XLPE," "XLP," or "XHHW" on the conductor
(6) Full compliance with the requirements of International Municipal Signal Association (IMSA) *Official Wire & Cable Specification Manual* 51-7 latest version is required
(7) No binding of the inner insulated loop conductor and the outer encasing tube is permitted

B.4 Bridge Deck Loop Detector Conductors

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

(1) 16 AWG
(2) Stranded nickel or silver plated copper conductors
(3) Insulated with at least 0.010 inches extruded Teflon meeting the requirements of MIL-W-16878D (Type E)

B.5 Grounding Conductors

(1) Provide Equipment grounding conductors (EGC) meeting the following:

(a) Type THW, Type THWN, or Type XHHW
(b) Green-colored insulated wire
(c) Wire gauge size as specified in the Contract
(d) Stranded (7 strands, Class B Stranding)
(e) Meeting the requirements of *ASTM B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft*, for stranded wires

(2) Provide bare solid grounding electrode conductors and bonding jumpers as specified in the Contract meeting the following:

(a) 6 AWG, unless otherwise specified elsewhere in the Contract
(b) Meeting the requirements of *ASTM B3, Standard Specification for Soft or Annealed Copper Wire,* Soft Annealed Copper

(3) Provide insulated stranded grounding electrode conductors and bonding jumpers as specified in the Contract meeting the following:

(a) Type THW, Type THWN, or Type XHHW
(b) Green-colored insulated wire
(c) 6 AWG, unless otherwise specified in the Contract
(d) Stranded (7 strands, Class B Stranding)

(e) Meeting the requirements of *ASTM B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft*, *8* for stranded wires

C Cables

C.1 Direct Buried Lighting Cable 4 Conductor 4 American Wire Gauge (4/C 4 AWG)

Provide shielded underground cable meeting the following:

(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*, "Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members"

(2) Four conductors

(3) Each conductor is 4 AWG

(4) Class C (19 Strand) soft drawn, bare copper wire conductors meeting the requirements of *ASTM B3, Standard Specification for Soft or Annealed Copper Wire,* and *ASTM B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft*

(5) Suitable for use in cable trays, aerial, or direct buried installations

(6) Rated for 600 volts

(7) Heat resistant

(8) Moisture resistant

(9) Sunlight resistant

(10) Insulation acceptable for use in wet and dry locations at 194°F

(11) Insulated conductors with chemically XLPE insulation

(12) Individual conductors constructed with circuit identification in accordance with Method 1 of *ICEA S-73-532 (NEMA WC-57)*, "Standard for Control, Thermocouple, Extension and Instrumentation Cable," Table E-1 (Black, White, Red, and Green)

(13) Single thickness copper tape shielding meeting the requirements of *ASTM B152, Standard Specification for Copper Sheet, Strip, Plat, and Rolled Bar*, with a thickness of at least 1/100 inch and a spiral overlap of at least 1/4 inch wrapped around the binder tape and under the outer jacket

(14) PVC outer jacket with an average thickness at least 80 mils and a thickness at any point at least 64 mils

(15) Constructed using a tape binder

(16) 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

(17) Containing a rip cord between the copper tape shield and the outer jacket

(18) 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

(19) Outer jacket surface ink printed with the following information:

(a) Manufacturer name

(b) Year of manufacture (date code)

(c) Type of cable

(d) Size and number of conductors

(e) Voltage rating

(f) Conductor insulation rating

(g) Labeled NRTL listed
(h) Labeled as sunlight resistant (Sun Res) and direct burial (Dir Bur)
(i) Foot markers

C.2 Temporary Overhead Lighting Cable

Provide quadruplex cable for the overhead distribution of circuits as specified in the Contract meeting the following:

(1) Four conductors
(2) Each conductor is 4 AWG
(3) Three thermoplastic insulated conductors
(4) The fourth conductor that is an ACSR (aluminum conductor, steel reinforced) Equipment ground messenger in accordance with the current edition of ANSI/NEMA/ICEA Specification for "Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy" (*ANSI/NEMA publication No. WC 70 ICEA publication No. S-95-658*)

C.3 Signal Control Cable __ Conductor 14 American Wire Gauge (3/C 14 AWG, 4/C 14 AWG, 6/C 14 AWG, 12/C 14 AWG)

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:

(1) *UL 44*
(2) *UL 1277*
(3) *UL 1685*, "Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables"
(4) *ICEA T-29-520*, "Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input Rate of 210,000B.T.U/Hour"
(5) *ICEA T-30-520,* "Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 70,000 B.T.U/Hour"
(6) ICEA S-73-532 (NEMA WC 57)
(7) Suitable for use at 194°F 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) 14 AWG
(14) Class B (7 strand) soft drawn, bare or tinned copper meeting the requirements of *ASTM B3, Standard Specification for Soft or Annealed Copper Wire*, *ASTM B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft*, and *ASTM B33, Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes*
(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:

(a) 3 Conductor:

(i) Black
(ii) White
(iii) Green

(b) 4 Conductor

(i) Black
(ii) White
(iii) Red
(iv) Black/red stripe

(c) 6 Conductor:

(i) Black
(ii) White
(iii) Red
(iv) Black/red stripe
(v) Orange
(vi) Blue

(d) 12 Conductor:

(i) Black
(ii) White
(iii) Red
(iv) Black/red stripe
(v) Orange
(vi) Blue
(vii) White/Black stripe
(viii) Red/Black stripe
(ix) White/Red stripe
(x) Orange/Black stripe
(xi) Blue/Black stripe
(xii) Black/White stripe

(16) Average insulation thickness of at least 30 mil
(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 inch. Outer jacket of the 6 conductor cable having a diameter no greater than 0.560 inch
(24) Carries an oil resistance level 1
(25) Meets a −31°F cold bend test
(26) Cables with a PVC jacket with a low migration grade of PVC
(27) Cable jacket passes the 7 Calendar Day [168 hours] oven age test at 249.8°F meeting the requirements of *UL 1581*, “Reference Standard for Electrical Wires, Cables, and Flexible Cords”
(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 2 Conductor 14 American Wire Gauge (2/C 14 AWG)

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" latest version for use in traffic control signal systems and traffic management systems.

C.5 Emergency Vehicle Pre-emption/Priority (EVP) Detector Cable 3 Conductor 14 American Wire Gauge (3/C 20 AWG)

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

(1) Consisting of twisted three-conductor shielded cable with ground drain wire
(2) Suitable for use at 167°F in wet or dry locations
(3) Suitable for direct burial
(4) Sunlight resistant
(5) Rated for 600 Volts
(6) 3/C 20 AWG (7x28) stranded, individually tinned copper, color coded yellow, blue, orange conductors
(7) 20 AWG (7x28) stranded, individually tinned copper ground drain wire
(8) Aluminized polyester shield with at least 0.170 inch overlap
(9) Black PVC jacket with a 0.04 inch Nominal wall thickness
(10) Cable outside diameter, Nominal 0.3 inch
(11) Drain and conductor DC resistance no greater than 11.0 Ω per 1,000 feet
(12) Capacitance from 1 conductor to other 2 conductors and shield no greater than 48 picofarads per foot
(13) Cable marked with the following:

(a) Manufacturer's name
(b) Year of manufacture (date code)
(c) Cable type
(d) Conductor size and number
(e) Voltage rating
(f) Conductor Insulation rating
(g) Sunlight resistant (Sun Res) and direct burial (Dir Bur)
(h) 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 22 AWG conductors and meeting *ANSI/ICEA S-80-576*, "Standard for Category 1 & 2 Individually Unshielded Twisted Pair Indoor Cables (With or Without an Overall Shield) for Use in Communications Wiring Systems Technical Requirements."

C.6.b Outdoor Conduit or Direct Buried Installation

C.6.b(1) Telephone Cable

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

(1) Gopher resistant
(2) Grease-filled
(3) Using 19 AWG conductors
(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)

C.6.b(2) Cable Shielding

Provide one of the following for cable shielding:

(1) 10 mil copper
(2) 5 mil or 6 mil copper-clad stainless steel
(3) 5 mil copper-clad alloy steel
(4) 6 mil or 7 mil 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 control signal cabinet or other type cabinet to the point of connection with the servicing telephone company conductors meeting the following:

(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"
(3) Approved by the local telephone company

C.6.d Ethernet Cable (Outside Plant)

Provide shielded Category 5e Ethernet cable for use in outdoor applications from the traffic control signal cabinet or other type cabinet to the point of connection with required Equipment in the system meeting the following.

(1) Four pairs of conductors

    (a) Stranded tinned copper
    (b) 24 AWG 7/32
    (c) Color coded pairs as follows:

        (i) Pair 1: Blue, White/Blue
        (ii) Pair 2: Orange, White/Orange
        (iii) Pair 3: Green, White/Green
        (iv) Pair 4: Brown, White/Brown

(2) H.D. Polyethylene conductor insulation

    (a) Conductor with insulation thickness of a Nominal 0.046 inches

(3) Inner tinned copper braid shielding 38 AWG with a minimum 75 percent coverage
(4) Outer aluminum / Polyester tape (foil in) shielding
(5) Black Thermoplastic Elastomer outer jacket with a Nominal thickness of 0.037 inches
(6) Cable assembly shall have an overall thickness of 0.301 ± 0.010 inches
(7) DC resistance maximum of 26.0 Ω /1000 feet
(8) Conductor to conductor capacitance of 13.5 picofarads/foot at 1 megahertz
(9) Impedance of 100 Ω ± 15 Ω at 1- 100 megahertz
(10) A minimum dielectric withstanding of 1500 Volts RMS
(11) A voltage rating of 600 Volts
(12) Temperature rating of -40˚F to 167˚F
(13) Pass a flex life test of 1 million cycles at 10 times the minimum radius of the outside diameter of the cable
(14) NRTL certified in accordance with *UL 1581*, section 1080 (VW-1) and be CMX certified or listed
(15) RoHS Compliant
(16) Label the outer jacket in accordance with 3815.2A, "Requirements, General," Note (6)

RJ 45 terminal ends used when terminating this cable must be in compliance with the cable manufacturer's requirements and recommendations.

C.7 Fiber Optic Cables

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

C.8 Armored Fiber Optic Pigtail

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

C.9 Microwave and Sonic Detector Cable (4/C 18 AWG)

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

(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:

(a) *UL 44*
(b) *UL 1277*
(c) *UL 1685*

(2) Suitable for use at 194°F 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) 18 AWG conductors
(10) Tinned conductors
(11) Class B (7X26 strand) soft drawn, tinned copper meeting the requirements of *ASTM B3, Standard Specification for Soft or Annealed Copper Wire*, *ASTM B8,*

Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft, and *ASTM B33, Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes*

(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 inches

(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:

- (a) Manufacturer name
- (b) Year of manufacture (date code)
- (c) Type of wire or cable
- (d) Size and number of conductors
- (e) Voltage rating
- (f) Conductor insulation rating
- (g) NRTL certification mark indicating the cable is listed
- (h) Labeled as sunlight resistant (Sun Res), oil resistant (Oil Res 1), direct buried (Dir Bur)
- (i) Foot markers

Repeat cable markings at intervals no greater than 24 inches on the jacket surface.

3815.3 SAMPLING AND TESTING

The Department reserves the right to sample, test, inspect, and accept or reject all 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.

3816 AIR OBSTRUCTION LIGHTS

3816.1 SCOPE

Provide air obstruction lights meeting Federal Aviation Administration (FAA) requirements.

3816.2 REQUIREMENTS

Provide air obstruction lights listed on *Approved/Qualified Products List* under "Lighting."

3816.3 SAMPLING AND TESTING — BLANK

3817 NAVIGATION LANTERNS

3817.1 SCOPE

Provide navigation lanterns meeting U.S. Coast Guard (USCG) requirements.

3817.2 REQUIREMENTS

Provide navigation lanterns listed on *Approved/Qualified Products List* under "Roadway lighting."

3817.3 SAMPLING AND TESTING — BLANK

3818 GROUNDING ELECTRODES

3818.1 SCOPE

Provide ground rod electrodes as specified in the Contract for use in traffic control signal systems, Roadway Lighting Systems, traffic management systems, sign control systems, automatic traffic recorder systems, and other electrical systems.

Provide plate electrodes when *NEC* installation requirements for rod electrodes are not practical.

Obtain the Engineer's approval for use before installation.

3818.2 REQUIREMENTS

A Ground Rod Electrodes

Provide ground rod electrodes meeting the following:

(1) Listed and labeled by an NRTL in accordance with *UL 467*, "Grounding and Bonding Equipment"
(2) Meeting the requirements of *ANSI/NEMA GR-1*, "Grounding Rod Electrodes and Grounding Rod Electrode Couplings"
(3) Diameter of 5/8 inches
(4) 15 feet long unless otherwise specified elsewhere in the Contract
(5) *ASTM A1018, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength*, cold drawn steel
(6) Minimum tensile strength of 80,000 psi
(7) Copper bonded (copper clad) outer coating
(8) Pointed
(9) Non-threaded

B Plate Electrodes

Provide plate electrodes meeting the following:

(1) Listed and labeled by an NRTL in accordance with *UL 96*, "ANSI/CAN/UL Standard for Lightning Protection Components"
(2) Meeting the requirements of *NEC* and *NESC*
(3) 100 percent copper
(4) Minimum plate dimensions of 12 inches by 24 inches
(5) Minimum thickness of 0.06 inches
(6) Solid bare 6 AWG CU by 10 foot pigtail connected to the plate with an exothermic weld connection

3818.3 SAMPLING AND TESTING — BLANK

3819 HANDHOLES

3819.1 SCOPE

Provide handholes as specified in the Contract. Use only handholes for non-deliberate heavy vehicular traffic unless otherwise shown on the Plans.

3819.2 REQUIREMENTS

A Handholes Non-Deliberate Heavy Vehicular Traffic

Provide handholes listed on *Approved/Qualified Products List* under "Signals."

Emboss "MnDOT Signals" on the cover for traffic control signals.

Emboss "MnDOT Lighting" on the cover for lighting.

Emboss "MnDOT TMS" on the cover for ITS.

Emboss "MnDOT Anti-Icing" on the cover for anti-icing.

B Handholes Deliberate Heavy Vehicular Traffic

Provide handholes in accordance with *Standard Plate 8117* that are in full compliance with Article 314.30 of the NEC and meet the requirements of "*AASHTO H-20* Deliberate Vehicular Traffic Applications."

Emboss "MnDOT Signals" on the cover for traffic control signals.

Emboss "MnDOT Lighting" on the cover for lighting.

Emboss "MnDOT TMS" on the cover for ITS.

3819.3 SAMPLING AND TESTING — BLANK

3820 PULLING VAULTS

3820.1 SCOPE

Provide pulling vaults as specified in the Contract.

3820.2 REQUIREMENTS

Provide Department-approved pulling vaults listed on *Approved/Qualified Products List* under "Traffic management systems/ITS."

Emboss "MnDOT Signals" on the cover for traffic control signals.

Emboss "MnDOT Lighting" on the cover for lighting.

Emboss "MnDOT TMS" on the cover for ITS.

Emboss "MnDOT Anti-Icing" on the cover for anti-icing.

3820.3 SAMPLING AND TESTING — BLANK

3821 SPLICE VAULTS

3821.1 SCOPE

Provide splice vaults as specified in the Contract.

3821.2 REQUIREMENTS

Provide splice vaults listed on *Approved/Qualified Products List* under "Traffic management systems/ITS."

Emboss "MnDOT Signals" on the cover for traffic control signal Projects.

Emboss "MnDOT Lighting" on the cover for lighting Projects.

Emboss "MnDOT TMS" on the cover for ITS Projects.

Emboss "MnDOT Anti-Icing" on the cover for anti-icing Projects.

3821.3 SAMPLING AND TESTING — BLANK

3831 TRAFFIC CONTROL SIGNAL MAST ARM POLES, MAST ARMS, LUMINAIRE POLE EXTENSIONS, AND LUMINAIRES

3831.1 SCOPE

Provide mast arm poles in accordance with *Standard Plates 8121, 8123, and 8133* and as shown on the Plans for supporting mast arm mounted and pole mounted vehicle and pedestrian signal heads, and supporting luminaires, as part of a traffic control signal system.

3831.2 REQUIREMENTS

A Mast Arm Poles

Use mast arm poles of the type specified in the Contract including the following:

(1) Transformer base
(2) Vertical pole shaft
(3) Traffic control signal mast arm
(4) If specified in the Contract use one of the following vertical pole extensions:

(a) Luminaire shaft extension with luminaire
(b) Luminaire and camera extension with luminaire
(c) Camera extension

Use mast arm poles designed and constructed in accordance with AASHTO's 2015 *LRFD Standard Specifications for Structural Supports* for Highway Signs, Luminaires, and Traffic Signals.

B Transformer Base

Use square transformer-type bases with an access hole that provides an opening, as specified in 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 3/4 inch half-coupling and plug on the top side of the traffic control signal mast arm at the location specified in the Contract.

If specified in the Contract, provide swing-away hinges with the traffic control signal mast arm. Obtain the Engineer's approval before installation. Install the swing-away hinges so the traffic control signal mast arm swings away from the Intersection.

C.1 Mast Arm Signal Head Mounts

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

Only use threaded hub and flange pole adaptors listed on *Approved/Qualified Products List* under "Signals."

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

Only use straight mount plumbizers listed on *Approved/Qualified Products List* under "Signals."

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

Only use angle mount plumbizers listed on *Approved/Qualified Products List* under "Signals."

C.2 Two-way Mast Arm Signal Head Mounts

Mount two-way vehicle signal heads on the extended end of traffic control signal mast arms as specified in the Contract, using high-strength cast aluminum, two-way plumbizer mounts.

Only use two way mount plumbizers listed on *Approved/Qualified Products List* under "Signals."

C.3 Vertical Pole Signal Head Mounts

Mount vehicle and pedestrian signal heads on the vertical pole using high-strength cast aluminum angle plumbizer mounts and threaded hub and flange adaptors.

Only use threaded hub and flange pole adaptors listed on *Approved/Qualified Products List* under "Signals."

If specified in the Contract, mount vehicle cluster head (dog house) style signal head assemblies on the vertical pole using angle plumbizer mounts with extended threaded pole adaptors.

Only use angle mount plumbizers listed on *Approved/Qualified Products List* under "Signals."

Only use extended threaded pole adaptors listed on *Approved/Qualified Products List* under "Signals."

D Luminaire Pole Extension

Provide luminaire pole extensions for luminaires atop mast arm pole standards as specified in the Contract and meeting the following:

(1) Designed for a 75 pound luminaire with a projected area of 3.2 square feet
(2) A Nominal 2 3/8 inches schedule 40 pipe slipfitter tenon
(3) A mast arm with an upward angle from horizontal of 3 degrees ± 2 degrees
(4) A 9 foot mast arm unless otherwise specified in the Contract

D.1 Luminaires

Provide LED Roadway Luminaires (40 foot mounting height) in accordance with 3810, "Luminaires," and as shown on the Plans.

D.2 Luminaire Wire Holder

Provide wire holders listed on *Approved/Qualified Products List* under "Signals."

3831.3 SAMPLING AND TESTING

Submit four complete sets of shop drawings of the mast arm pole standard, anchor rods, in accordance with 2471.3C.1, "General," and 2471.3C.3, "Submittal for Bridge Engineer's Review and Acceptance," 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) District Traffic Engineer

3832 TRAFFIC CONTROL SIGNAL PEDESTAL

3832.1 SCOPE

Provide traffic control signal pedestals (base and shaft) that support vehicle signal heads, pedestrian signal heads, and warning flashers.

3832.2 REQUIREMENTS

A Traffic Control Signal Pedestal

Provide traffic control signal pedestals in accordance with applicable provisions of 3832, "Traffic Control Signal Pedestal"; *Standard Plates 8112, 8122, 8129*; and as specified in the Contract.

Provide traffic control signal pedestals meeting the applicable requirements for structural supports specified in AASHTO's *2015 LRFD Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*.

Submit shop drawings in accordance with 2545.3A.2, "Shop Drawing Submittals," for the pedestal to obtain the Engineer's approval before procurement.

Provide traffic control signal pedestals with a shaft and a base.

B Pedestal Shaft

B.1 Steel Pedestal Shafts

Provide steel pedestal shafts in accordance with *Standard Plate 8122* and the Plans. 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. Finish paint the outside of the shaft with two coats of yellow paint in accordance with 3532, "Exterior Polyurethane Paint," unless otherwise specified in the Contract. Ensure a total thickness of the dried primer and finish coats at least 5 1/2 mil. 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 in accordance with *Standard Plate 8122* and as shown on the Plans.

C Pedestal Base

Provide pedestal bases in accordance with *Standard Plate 8122* and as shown on the Plans.

Provide traffic signal pedestal washers in accordance with *Standard Plate 8129*.

C.1 Ground Connector

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

Use a cross slot head screw to secure the ground wire to the connector. Ensure the connector accommodates a 6 AWG stranded copper wire. Install the connectors with the connector down. Ensure every device in the pedestal base is constructed from compatible Materials.

C.2 Reinforcing Collars

When required provide pedestal reinforcing collars, wind collars, listed on *Approved/Qualified Products List* under "Signals."

C.3 Painted Pedestal Base

Shop paint pedestal bases on the inner and outer surfaces with two coats of prime paint in accordance with 3532, "Exterior Polyurethane Paint," if specified in the Contract. Ensure the dried primer is 3 mil thick. Finish paint the outer surface with two coats of paint meeting the requirements of 3532, "Exterior Polyurethane Paint," or the equivalent manufacture's shop coat paint as specified in 2565.3U, "Painting." Ensure the combined thickness of the primer and finish coats is 5 1/2 mil.

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

C.4 Pedestal Base Access Door

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

C.5 Pedestal Cap

Provide aluminum pedestal caps listed on *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.6 Pedestal Slipfitter Collar

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

Before ordering from the signal supplier, ascertain from the Engineer the number of required 1 1/2 inch inside threaded hubs (side openings) in the pedestal slipfitter collar.

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 PUSH BUTTONS AND MOUNTING HARDWARE

3833.1 SCOPE

Provide touch-activated Accessible Pedestrian Signals (APS) with information signs and required mounting hardware to detect and instruct pedestrians.

3833.2 REQUIREMENTS

Locate and mount APS push buttons and information signs on vertical mast arm pole shafts, APS push button stations, traffic control signal pedestal shafts, or similar Equipment approved by the Engineer, or on separate mountings, as specified in the Contract.

Deliver APS Central control unit, interface panel, and required cable assemblies to Department's Electrical Services Section (ESS) at least 30 Business Days before the traffic control signal cabinet is required on the Project. The Department's Central Electrical Services Unit will review the provided Equipment to ensure the proposed product is listed on the *APL*, and install the EVP phase selectors into the Department-provided traffic control signal cabinet.

Use accessible pedestrian pole signal push buttons and mounting hardware listed on *Approved/Qualified Products List* under "Signals," for the following:

A APS Push Buttons

Provide backup copies of the voice messages contained in each push button on a compact disc or USB flash drive to Department's Electrical Services Section (ESS).

B APS Pole Adaptor

C APS Push Button Mounting Spacer

D APS Push Button Base

Use the anchorages and hardware provided with the APS Push Button Base.

3833.3 SAMPLING AND TESTING

Confirm and document the listing of the APS units and other components on *Approved/Qualified Products List* under "Signals." Obtain the Engineer's approval of the APS before installation.

3834 VEHICLE SIGNAL HEADS

3834.1 SCOPE

Provide standard traffic control signal heads to control vehicle movements as part of a traffic control signal system or Ramp control signal.

3834.2 REQUIREMENTS

A Standard ITE Vehicle Signal Heads

Use standard ITE black polycarbonate vehicle signal housings listed on *Approved/Qualified Products List* under "Signals," unless otherwise specified in the Contract.

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

Use vehicle signal heads made up of at least 3 separate vehicle signal sections. Ensure each vehicle signal section consists of a housing, housing door, visor, optical unit, and wiring.

Provide and install the required through-bolts for connecting the individual sections.

Fasten together the signal sections above or below the straight or angle mount by means of a noncorrosive 3-bolt mounting assembly. Use locknuts for the 3-bolt mounting assembly to prevent the assembly from loosening.

Use signal indications for traffic control signal systems of the Nominal size as specified in the Contract.

Arrange vehicle signal sections in a vehicle signal head in accordance with Part IV, "Highway Traffic Signals" of the *MN MUTCD*.

For each Intersection, install standard ITE vehicle signal heads from the same manufacturer.

Install and mount each vehicle signal head at the location shown on the Plans.

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

A.1 Visor

Provide each signal section of each signal head with a removable visor. Use visors meeting the following characteristics:

(1) Made from black polycarbonate 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 9 1/2 inches long for a Nominal 12 inch vehicle signal indication
(4) At least 7 inches long for a Nominal 8 inch vehicle signal indication

Mount the visor with twist-on slots and stainless steel screws positioned for vertical or horizontal mounting of the signal section, and with a downward tilt of at least 3 degrees.

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

A.2 Signal Indications

Use LED signal indications listed on *Approved/Qualified Products List* for "Signals" and as specified in the Contract.

A.3 Backplates (Background Shields)

Use backplates listed on *Approved/Qualified Products List* under "Signals."

B Mounting Vehicle and Pedestrian Signal Heads

Mount vehicle and pedestrian signal heads using straight, angle, or two-way plumbizer signal mounts. Provide signal head mounts and required appurtenances for mounting vehicle and pedestrian signal heads to mast arms, vertical pole shafts, and pedestal shafts as specified in the Contract.

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

Provide and install metal support plates on the inside of the signal section at the attachment point of the straight or angle mount plumbizers or signal bracketing.

Provide and install angle and straight mount caps when installing pedestrian indications. Only use angle and straight mount caps listed on *Approved/Qualified Products List* under "Signals."

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

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

C Signal Brackets and Pipefittings

If the Contract specifies signal brackets and pipe fittings for mounting vehicle and pedestrian signal heads, provide signal brackets and pipe fittings in accordance with the following:

(1) Use Nominal 1 1/2 inch diameter standard anodized aluminum pipe signal bracket and pipe fitting for signal brackets and pipe fittings for mounting vehicle and pedestrian signal heads
(2) Provide signal brackets long enough to provide vehicle and pedestrian signal head alignment, to allow programming of optically programmed vehicle signal heads, or of a length directed by the Engineer
(3) Provide locknuts, nipples, lock nipples, gaskets, washers, and other hardware used to fasten vehicle and pedestrian signal heads 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 control signal conductors, watertight, and free of sharp edges or protrusions to prevent damage to the traffic control signal conductor insulation

3834.3 SAMPLING AND TESTING

Obtain the Engineer's approval before installing the Material specified in this section.

3835 PEDESTRIAN SIGNAL HEADS

3835.1 SCOPE

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

3835.2 REQUIREMENTS

A General

Use standard ITE black polycarbonate pedestrian signal housings listed on *Approved/Qualified Products List* under "Signals," unless otherwise specified in the Contract.

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

B Signal Brackets and Pipe Fittings 3834.2C

3835.3 SAMPLING AND TESTING 3833

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

3836 RODENT INTRUSION BARRIER

3836.1 SCOPE

Provide a barrier in pole bases to prevent rodent intrusion in traffic signal mast arm poles and Light Poles.

3836.2 REQUIREMENTS

A Stainless Steel Woven Wire Cloth

Provide a stainless steel woven wire cloth for rodent intrusion barrier meeting the following:

(1) 0.5 by 0.5 per inch mesh
(2) 0.041 inch wire diameter
(3) 0.159 inch opening width
(4) 63.2 percent open area

B Rodent Intrusion Barrier for Light Poles

Rodent intrusion barrier listed on *Approved/Qualified Products List* under "Lighting" for poles with 10 inch and 10 3/4 inch diameter base plate openings may be used.

C Rodent Intrusion Barrier for Signal Mast Arm Poles

Rodent intrusion barrier listed on *Approved/Qualified Products List* under "Signals" for traffic signal mast arm poles with 10 inch and 10 3/4 inch base plate openings may be used.

3836.3 SAMPLING AND TESTING — BLANK

3837 SERVICE EQUIPMENT

3837.1 SCOPE

Provide 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, Lighting System, automatic traffic recorder system, or other electrical system.

3837.2 REQUIREMENTS

A Service Equipment

A.1 General

For the service, provide and install as specified in the Contract and the following:

(1) Meter socket
(2) Disconnecting means
(3) Two ground rods
(4) Grounding and bonding Materials
(5) Conduit
(6) Conduit fittings
(7) Service conductors

In addition, for wood poles, provide and install conduit risers and weather head as specified in the Contract.

For installations on wood poles, size the service 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 service conductors meet the requirements of the electric utility

company and extend beyond the weather head for connection to the service conductors from the source of power.

Provide parts of the service Equipment that use copper conductors and have connections that are NRTL listed for use with copper conductors. 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:

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

The electric utility company will provide and install the meter.

A.3 Circuit Breaker Load Center

Unless otherwise specified in the Contract, provide a disconnecting means meeting the following:

(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
(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 service 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 as specified in the Contract or the *NEC*. Ensure neutrals bond in accordance with *NEC*.

Provide and install circuit breakers in the load center as specified in the Contract.

Label the 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 as specified in the Contract or the *NEC*. Ensure bonding of the neutral in accordance with *NEC*.

If specified in the Contract, provide a disconnecting means with the following:

(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:

(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
(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 Main Circuit Breaker

If specified in the Contract, provide and install an enclosed main circuit breaker as 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:

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

If lugs are needed to connect the feeder 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:

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

Use signal service cabinets Type SSB listed on *Approved/Qualified Products List* under "Signals."

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

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

For signal service cabinets Type SSB, use the anchor rods and hardware supplied with the cabinets.

B Transformer and Circuit Breaker Assembly

B.1 Transformer

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

(1) Primary — 480 V, two 5 percent taps below 480 V
(2) Secondary — 120/240 VAC
(3) Rating — 7.5 KVA, single phase
(4) Size — 16 inches high, 12 inches wide, and 10 1/2 inches 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 specified in the Contract and as approved by the Engineer.

B.2 Enclosed Circuit Breaker

To protect the transformer provide the following:

(1) A circuit breaker mounted in a NEMA 3R rain tight enclosure rated for outdoor use
(2) 2-pole, 20 A, 480 VAC, thermo-magnetic circuit breaker
(3) NRTL-listed solder-less, set screw-type lugs for use with copper wire if lugs are needed for feeder conductor connections to the breaker
(4) Provisions for a padlock on the rain-tight enclosure
(5) Mount the circuit breaker enclosure as specified in 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
(6) Traffic control signal cabinet or other pad mount cabinet

3838 JUNCTION BOXES

3838.1 SCOPE

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

(1) Accessing wiring
(2) Facilitating installation of wiring
(3) Changing from field cable wiring to individual conductors

3838.2 REQUIREMENTS

A Metal Junction Boxes Attached to Bridges and Retaining Walls

See Special Provisions.

B Metal Junction Boxes on Wood Poles

Provide and install metal junction boxes with terminal blocks on wood poles for temporary traffic control signals, flashing beacons, advance warning flashers and signal indications for vehicle signal heads, pedestrian heads, and flashing signal heads.

Use metal junction boxes on wood poles meeting the following:

(1) Meeting the requirements of *NEC*
(2) NEMA, Type 3R
(3) At least 12 inch by 12 inch by 6 inch deep
(4) 1/4 inch drain hole on the bottom side
(5) Equipped with a cover with a gasket around the perimeter and attached with stainless steel screws
(6) Equipped with terminal blocks in accordance with 2565.3I, "Wiring," for terminating field conductors and traffic control 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 non-metallic conduit and conduit fittings in accordance with 3804, "Liquid Tight Flexible Non-Metallic Conduit (LFNC-B)," and as shown on the Plans. Install conduit between the metal junction box and each wood pole-mounted signal bracket.

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

For junction boxes mounted to Bridges, use PVC junction boxes meeting the following:

(1) Equipped with a cover attached by stainless steel screws
(2) At least 6 inch by 6 inch by 6 inch deep
(3) Attached to the Bridge as approved by the Engineer
(4) *NEC* compliant

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 AND DEFLECTION/EXPANSION COUPLING FITTINGS

3839.1 SCOPE

Provide PVC coated and urethane lined metallic conduit expansion fittings and PVC coated metallic deflection/expansion coupling fittings for PVC coated RSC runs encased in concrete, hanging, or surface mounted.

3839.2 REQUIREMENTS

Use fittings from the same manufacturer of the PVC coated RSC conduit used on the Project.

A Expansion Coupling Fittings

Provide expansion coupling fittings listed on *Approved/Qualified Products List* under "Lighting."

B Deflection/Expansion Coupling Fittings

Provide deflection/expansion coupling fittings listed on *Approved/Qualified Products List* under "Lighting."

3839.3 SAMPLING AND TESTING

Obtain the Engineer's approval before installing the expansion and the deflection/expansion coupling 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:

(1) *ANSI 2051, Personal Sound Amplification Performance Criteria*
(2) The length shown on the Plans
(3) Class II, unless otherwise specified in the Contract
(4) In accordance with Table 3491.2-1
(5) Treated with preservative in accordance with 3491, "Preservatives and Preservative Treatment of Wood Products"

3840.3 SAMPLING AND TESTING 3491

3841 SPONGE RUBBER EXPANSION JOINT

3841.1 SCOPE

Provide *AASHTO M 153*, "Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction," Type 1 sponge rubber expansion joint for wrapping conduit expansion and deflection/expansion fittings.

3841.2 REQUIREMENTS

Provide sponge rubber expansion joint meeting the following:

(1) *AASHTO M 153*, Type 1
(2) *ASTM D1752*, *Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction*, Type 1
(3) *Corps of Engineers CRD-C 509*, *Polyvinylchloride Waterstops*, Type 1
(4) FAA Specification Item P-610-2.7

(5) Federal Specification *HH-F-341 F*, *Filler, Expansion Joint, Bituminous (Asphalt and Tar) and NonBituminous (Preformed for Concrete)*, TYPE II
(6) 1/4 inches thick
(7) Gray in color
(8) Uniform thickness
(9) Blown sponge rubber
(10) Density of not less than 30 pounds/cubic foot
(11) Easily compressed and has a recovery of 95 percent or more

3841.3 SAMPLING AND TESTING

The Department reserves the right to sample, test, inspect, and accept or reject sponge rubber expansion joint based on its own tests.

3842 ELECTRICAL SYSTEMS COMPOUNDS AND LUBRICANTS

3842.1 SCOPE

Provide the required electrical systems compounds and lubricants to Materials as specified in the Contract for lubricating and preventing corrosion and oxidation.

3842.2 REQUIREMENTS

A Anti-seize and Lubricating Compound "Bridge Grease"

Use an approved anti-seize and lubricating compound listed on *Approved/Qualified Products List* under "Bridge" and specified as "Bridge grease."

B Conductor Anti-oxidant Joint Compound

Before terminating conductors, coat conductor ends and connectors with anti-oxidant joint compound meeting the following:

(1) Color: Black-Gray
(2) Temperature Range: -22°F to 2,450°F
(3) Thickener Type: Calcium Complex
(4) Particle Size: 3.5 Mil Maximum (75 microns)
(5) Density (G/CM3): 1.31 to 1.39
(6) *ASTM D92, Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester*, Flash Point: >475°F
(7) *ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus*, Salt Fog Test, Hours: 4,000
(8) *ASTM D130, Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test*, Copper Corrosion Test at 212°F, 24 hours: No Corrosion
(9) *ASTM D217, Standard Test Methods for Cone Penetration of Lubricating Grease*, Work Penetration, 60 Strokes at 77°F: 260-310
(10) *ASTM D217,* NLGI Grade: 1/2
(11) *ASTM D566*, *Standard Test Method for Dropping Point of Lubricating Grease*, Dropping Point: 572°F
(12) Torque Coefficient (K factor): 0.11
(13) *ASTM D1264, Standard Test Method for Determining the Water Washout Characteristics of Lubricating Grease*, Water Washout, percent loss at 100°F: <1.00
(14) *ASTM D1264, Water Washout*, percent loss at 175°F: <2.75
(15) *ASTM D1743, Standard Test Method for Determining Corrosion Preventative Properties of Lubricating Greases*, Bearing Rust Test: Pass
(16) *ASTM D2596, Standard Test Method for Measurement of Extreme Pressure Properties of Lubricating Grease (Four Ball Method),* Four Ball EP Load Wear Index: 127.3
(17) *ASTM D2596,* Four Ball EP Last Non-Seizure Load (scar): 100 kgf

(18) *ASTM D2596,* Four Ball EP Last Seizure Load (scar): 620 kgf
(19) *ASTM D2596,* Four Ball EP Weld Load: 800 kgf
(20) *ASTM D4170, Standard Test Method for Fretting Wear Protection by Lubricating Greases*, Fretting Wear at 73°F, 22 hours, milligram loss: 7.15

C Ferrous Metal Electrically-Conductive Corrosion Resistant Compound

Provide a brush on ferrous metal electrically-conductive corrosion resistant compound on metal threaded conduit fittings to prevent corrosion, oxidation, improve conductivity, and the integrity of electrical connections.

(1) Color: Copper
(2) Content: 65 – 70 percent lubricating greases, 25 – 30 percent Copper, and less than 1 percent Zinc
(3) Flash Point: >590°F
(4) Initial Boiling point: >599°F
(5) Blend of pure polished colloidal copper, rust, and corrosion inhibitors
(6) Can be brushed on at – 50°F and 250°F
(7) Meeting *NEC* Article 300.6

3842.3 SAMPLING AND TESTING

The Department reserves the right to sample, test, inspect, and accept or reject electrical systems compounds and lubricants based on its own tests.

3844 LABELS

3844.1 SCOPE

Provide the required labels as specified in the Contract.

3844.2 REQUIREMENTS

Provide labels meeting the following:

(1) Self-adhering label
(2) Machine printed numbers and letters
(3) Suitable for placement in damp locations
(4) Paper based labels are not acceptable
(5) Placed on the inside of the service cabinet on the dead front door so it is visible when the dead front door is closed

A Light Pole and Luminaire Numbering Labels

Provide labels in accordance with 2545.3M.1 “Lighting System Numbering” and 2545.3M.2.c “Labeling Luminaires,” Note (2).

Use approved labels listed on *Approved/Qualified Products List* under “Lighting.”

B Arc Flash Warning Labels

Provide arc flash warning labels for service cabinets based on the following potential ampacity conditions.

B.1 Arc Flash Warning Labels ≤ 25,000 Amps

Provide labels with the following information when calculated available fault current is ≤ 25,000 amps:

(1) Warning
(2) Arc Flash Hazard
(3) Appropriate PPE Required

(4) Arc Flash Boundary 19 inches
(5) Arc Flash PPE Category _____
(6) Working Distance 18 inches
(7) Arc Flash Personal Protection Equipment (PPE)
(8) List required clothing for a Min Arc Rating of 4 cal/cm², and required protective Equipment in accordance with Table 130.7(C)(16) Personal Protective Equipment (PPE) from the current edition of *NFPA 70E Standard for Electrical Safety in the Workplace*
(9) Equipment ID: _____

B.2 Arc Flash Warning Labels > 25,000 Amps

Provide labels with the following information when the calculated available fault current is > 25,000 amps:

(1) Warning
(2) Arc Flash Hazard
(3) Appropriate PPE Required
(4) Arc Flash Boundary Feet
(5) Arc Flash PPE Category _____
(6) Working Distance 18 inches
(7) Arc Flash Personal Protection Equipment (PPE)
(8) List required clothing for a Min Arc Rating of _ (fill in the blank based on calculated available fault current) __ cal/cm², and required protective Equipment in accordance with Table 130.7(C)(16) Personal Protective Equipment (PPE) from the current edition of *NFPA 70E Standard for Electrical Safety in the Workplace*
(9) Equipment ID: _____

C Available Fault Current Calculation Labels

Provide labels for service cabinets in accordance with 2565.3J.1, "Service Cabinet Arc Flash Hazard Labeling" and 2545.3M.2.e, "Available Fault Current Calculation Labeling."

Containing the following information:

(1) Transformer Size in kVA
(2) Available fault current in amps at the terminations of the utility transformer
(3) Available fault current in amps at the line side of the meter socket
(4) The date the calculations were made

3844.3 SAMPLING AND TESTING

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

3850 LIGHTING SERVICE CABINET

3850.1 SCOPE

Provide 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

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:

(1) Complete and operational as specified in the Contract
(2) NEMA 3R rated for the enclosure
(3) Provides electrical service for lighting
(4) Listed and labeled by the NRTL as in compliance with *UL 508*, "Standard for Industrial Control Equipment," and *UL 508A*, "Standard for Industrial Control Panels"
(5) Listed and labeled by the NRTL as suitable for use as service Equipment
(6) Listed and labeled by the NRTL as approved for outdoor use
(7) Circuit breakers in each available position the cabinet was designed for

Use service cabinets listed on *Approved/Qualified Products List* under "Lighting," for Type L1 Service Cabinet, Type L2 Service Cabinet, Type Rural Lighting and Flasher (RLF) Service Cabinet, and Type B Service Cabinet.

3850.3 SAMPLING AND TESTING

The Department reserves the right to test, inspect, and accept or reject Lighting Service Cabinets that are not in compliance with requirements as defined in the cabinet Specifications posted on *Approved/Qualified Products List* under "Lighting."

Planting Materials

3861 PLANT STOCK

3861.1 SCOPE

Provide species and varieties of trees, shrubs, vines, and perennials suitable for Roadside landscape planting.

For the purpose of the Work specified in section 3861, "Plant Stock," the Department defines 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 MnDOT 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 2571.2A.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 any of 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

(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 Quality and Condition

Provide a Certificate of Nursery Inspection from the Department of Agriculture of the state of plant origin in accordance with 2571.2A.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 inches. Train a new central leader in conifers delivered with multiple or missing leaders.

E 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 bind 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 2571.3F, "Installation of Plants."

F 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
(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. Dimensions may vary by the Contract:

A Type 1 — Compost

Provide compost berms meeting the following requirements and characteristics:

(1) Grade 2 Compost per 3890, “Compost”
(2) Trapezoidal shape with 5 foot base width
(3) Minimum height 2 feet in loose volume
(4) 2:1 (Vertical:Horizontal) side slopes

B Type 2 — Slash Mulch

Provide slash mulch berms meeting the following requirements and characteristics:

(1) Type 5 Mulch per 3882, “Mulch Material”
(2) Trapezoidal shape with 5 foot base width
(3) Minimum height 2 feet in loose volume
(4) 2:1 (Vertical:Horizontal) side slopes

C Type 3 — Rock Weeper System

Provide rock weeper systems meeting the following requirements and characteristics:

(1) Type 4 Geotextile Fabric per 3733, “Geosynthetic Materials”
(2) Trapezoid shape with 8.0 foot base width
(3) Maximum height 2.0 feet.
(4) 2:1 (Vertical:Horizontal) side slopes
(5) Front half composed of coarse filter Aggregate per 3149.2H, “Coarse Filter Aggregate”
(6) Back half composed of Class I Riprap per 3601, “Riprap Material.”

D Type 4 — Topsoil

Provide topsoil filter berm meeting the following requirements and characteristics:

(1) Topsoil excavation Material per 2106, “Excavation and Embankment – Compacted Volume Method”
(2) Trapezoid shape with 7 foot base width
(3) Minimum height 2 feet
(4) 2:1 (Vertical:Horizontal) side slopes

E Type 5 — Rock

Provide rock filter berm meeting the following requirements and characteristics:

(1) Type 4 Geotextile fabric per 3733, “Geosynthetic Materials,” as a liner
(2) Class II Riprap per 3601, “Riprap Material”
(3) Trapezoid shape with 5 foot base width
(4) Maximum Height 2.0 feet
(5) 2:1 (Vertical:Horizontal) side slopes

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

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 per 3874.2C, “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
(3) Surrounded by clean rock from 1 inch to 2 inches, for the entire height of the riser pipe

Install a trash guard on the top overflow.

A.3 Floating Head Skimmer

Provide a schedule 40 PVC pipe at least 1.5 inch diameter for the floating head skimmer. Provide a flocculant per 3898, "Flocculants" with a floating head skimmer for additional treatment, if shown in the Plans.

A.4 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 cubic feet of storage per gallon 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
(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 gallon barrel with 12 inch slits cut into the base. Install a sleeved 8 inch diameter perforated pipe in the barrel. Provide a flocculant sock per 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 inch to 2 inches. Place the clean rock on a 1:2 (Vertical:Horizontal) slope around the barrel.

B.2 In-line Flocculant Sock

Provide a flocculant per 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 – BLANK

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 MN 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 1 1/2 inches so that it can pass through a drill seeder without plugging
(4) Supplied on a Pure Live Seed (PLS) basis
(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:

(a) 1510.0050
(b) 1510.0060
(c) 1510.0070
(d) 1510.0080
(e) 1510.0090
(f) 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 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 Seed Mix Designations

A.1 Standard Seed Mixes

Use seed of the species and germplasm meeting the requirements of the *Seeding Manual* and the Seed Mixture Components Requirements Table, or as specified in the Special Provisions.

Table 3876.2-1
State Seed Mixes

Category & Mix No.	PLS Rate, pounds/acre	Name
21-111	100	Oats Cover Crop
21-112	100	Winter Wheat Cover Crop
21-113	110	Soil Building Cover Crop
22-111	30	Two-year Stabilization
22-112	40	Five-year Stabilization
25-121	61	Sandy General Roadside
25-131	220	Low Maintenance Turf
25-141	59	Mesic General Roadside
25-142	45	Agricultural Roadside
25-151	200	High Maintenance Turf
32-241	38	Native Construction
33-261	35	Stormwater South and West
33-262	44	Dry Swale / Pond
33-361	35	Stormwater Northeast
34-171	5.3	Wetland Rehabilitation
34-181	5	Emergent Wetland
34-261	31.5	Riparian South & West
34-262	14.5	Wet Prairie
34-271	12	Wet Meadow South & West
34-361	31.5	Riparian Northeast
34-371	12.5	Wet Meadow Northeast
35-221	36.5	Dry Prairie General
35-241	36.5	Mesic Prairie General
35-421	11	Dry Prairie Northwest
35-441	11	Mesic Prairie Northwest
35-521	12.5	Dry Prairie Southwest
35-541	12	Mesic Prairie Southwest
35-621	11	Dry Prairie Southeast
35-641	12	Mesic Prairie Southeast
36-211	34.5	Woodland Edge South & West
36-311	33.5	Woodland Edge Northeast
36-411	35.5	Woodland Edge Northwest
36-711	35.5	Woodland Edge Central

A.2 Site Specific Seed Mixes

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

B Blending

Provide uniformly blended seed mixes as required by the Contract and meeting the requirements of the *Seeding Manual*. Blend mixes meeting the requirements of the Department's Approved Seed Vendor Agreement.

B.1 Non-native mixes and cover crop mixes

Combine all components of non-native mixes and cover crop mixes

B.2 Native seed mixes

Blend and package components of native seed mixes 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
(4) Combine large seeds of cover crop species such as oats and winter wheat for installation with the grain box

C 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 Seed Mixture Component Requirements Table.

D 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 document *Seed Mixture Component Requirements* which includes approved substitutions and is available on the Department website.

Where native species occur in predominately non-native mixes, use seed varieties as listed in the Seed Mixture Component Requirements 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:

Table 3876.2-2
Native Species from Adjacent States

State	Counties
North Dakota	Barnes, Benson, Cass, Cavalier, Dickey, Eddy, Foster, Grand Forks, Griggs, Lamoure, Nelson, Pembina, Ramsey, Ransom, Richland, Sargent, Steele, Stutsman, Towner, Trail, Walsh
South Dakota	Aurora, Beadle, Bon Homme, Brookings, Brown, Clark, Clay, Codington, Davison, Day, Deuel, Douglas, Grant, Hamlin, Hanson, Hutchinson, Jerauld, Kingsbury, Lake, Lincoln, Marshall, McCook, Miner, Minnehaha, Moody, Roberts, Sanborn, Spink, Turner, Union, Yankton
Iowa	Allamakee, Bremer, Buena Vista, Butler, Cerro Gordo, Cherokee, Chickasaw, Clay, Clayton, Dickinson, Emmet, Fayette, Floyd, Franklin, Hancock, Howard, Humboldt, Kossuth, Lyon, Mitchel, O'Brien, Osceola, Palo Alto, Plymouth, Pocahontas, Sioux, Winnebago, Winneshiek, Worth, Wright
Wisconsin	Ashland, Barron, Bayfield, Buffalo, Burnett, Chippewa, Clark, Crawford, Douglas, Dunn, Eau Claire, Grant, Iowa, Iron, Jackson, La Crosse, Lafayette, Monroe, Pepin, Pierce, Polk, Price, Richland, Rusk, Saint Croix, Sawyer, Taylor, Trempealeau, Vernon, Washburn

D.1 Range-Limited seed mixes

If a seed mix is identified on the Plans as Range-Limited, supply seed in accordance with the following requirements as specified on the Plans:

(1) Range-Limited 150: At least 85 percent of native components have a genetic origin from within 150 miles of the Project
(2) Range-Limited 75: At least 85 percent of native components have a genetic origin from within 75 miles of the Project
(3) Range-Limited 25: At least 85 percent of native components have a genetic origin from within 25 miles of the Project

E Substitutions

The Contractor may substitute species or germplasm listed in the *Seeding Manual* with corresponding species or germplasm listed in the Seed Mixture Component Requirements Table.

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 3876.2C, "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 retesting at no additional cost to the Department.

B Labeling

Label each container of seed with the following information (in addition to information required by the Minnesota Seed Law, MN Statutes Section 21.82):

(1) Total PLS weight for the container
(2) Net weight for the container
(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) When listing origin of mix components, list County of genetic origin for native species
(5) PLS percent for each component
(6) Variety of each component for which a variety is required according to the Seed Mixture Component Requirements Table

List the following information for each mix component that is 5 percent or less of the seed mix (include on the label for each container or supply as a separate sheet for each seed mix lot):

(1) Species
(2) Variety
(3) Origin (production area for introduced species; County of genetic origin for native species)
(4) Pure seed (percent)
(5) Germination (percent)
(6) Hard (dormant) seed (percent)
(7) PLS (percent) for each component

When bags of small seeded species are placed inside larger bags of large-seeded species of the same mix, mark smaller bags to clearly identify the components contained in the bag and what mix they belong to. Attach the Department Approved Seed Vendor tag and the seed label to the outer bag.

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 Department 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 MATERIAL

3877.1 SCOPE

Provide topsoil Material for use as a medium to establish 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 loam to sandy loam topsoil from Type A and/or Type B horizon soils defined in the soil profile section of the *Grading and Base Manual*, from alluvial deposits, or blended from defined sand, compost, and loam to sandy loam topsoil sources. Manufactured topsoil's in section E, F, G, and H are blended on a volume basis of Materials. When the individual components have been verified to meet the appropriate Specification, the blended Material in the ratio indicated shall meet this Specification. 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."

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

A Common Topsoil Borrow

Provide common 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 3877.2-1. Common topsoil borrow Material is a blend of Type A and/or Type B horizon soils defined in the soil profile section of the *Grading and Base Manual*, and is similar to topsoil found adjacent to the Project.

Table 3877.2-1
Common Topsoil Borrow Requirements

Requirement	Range	Test Method
Material passing No. 4 inch	≥ 85 percent	—
Clay	5 – 35 percent	*ASTM D422**
Silt	5 - 70 percent	*ASTM D422**
Sand	10 - 75 percent	*ASTM D422**
Organic matter	3 – 15 percent	*ASTM D2974*‖
pH	6.1 – 7.8	*ASTM G51*†
Largest Materials size dimension not to exceed 2.5 inches * *ASTM D422, Standard Test Method for Particle-Size Analysis of Soils* ‖ *ASTM D2974, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils* † *ASTM G51, Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing*		

B Loam Topsoil Borrow

Provide topsoil borrow consisting mostly of loam ranging into sandy clay loam, sandy loam, Silt loam, and clay loam soils as a plant growing medium for landscape and planting beds and in accordance with Table 3877.2-2:

Table 3877.2-2
Loam Topsoil Borrow Requirements

Requirement	Range	Test Method
Material Passing the 3/4 inch	100 percent	*ASTM D422**
Material passing No. 4	≥ 90 percent	-
Clay	5 – 35 percent	*ASTM D422**
Silt	10 – 60 percent	*ASTM D422**
Sand	15 – 60 percent	*ASTM D422**
Organic matter	3 – 15 percent	*ASTM D2974*‖
pH	6.1 – 7.5	*ASTM G51*†
Soluble salts	≤ 0.15 siemens/meter	—

* *ASTM D422, Standard Test Method for Particle-Size Analysis of Soils*
‖ *ASTM D2974, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils*
† *ASTM G51, Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing*

C Sandy Clay Loam Topsoil Borrow

Provide topsoil borrow mostly consisting of a sandy clay loam and ranging into clay loam, sandy loam, and loam soils for use as a plant growing medium in critical areas, such as steep slopes and as a top dressing for turf reinforcement mats, and in accordance with Table 3877.2-3:

Table 3877.2-3
Sandy Clay Loam Topsoil Borrow Requirements

Requirement	Range	Test Method
Screened	—	—
Material passing the 3/4 inch	100 percent	*ASTM D422**
Material passing No. 4	≥ 95 percent	*ASTM D422**
Clay	10 – 35 percent	*ASTM D422**
Silt	0 – 40 percent	*ASTM D422**
Sand	30 – 75 percent	*ASTM D422**
Organic matter	3 – 15 percent	*ASTM D2974*‖
pH	6.0 – 7.5	*ASTM G51*†
Soluble salts	≤ 0.15 siemens/meter	—

* *ASTM D422, Standard Test Method for Particle-Size Analysis of Soils*
‖ *ASTM D2974, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils*
† *ASTM G51, Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing*

D Rooting Topsoil Borrow

Provide topsoil borrow consisting of three blended components of loam topsoil, sand, and compost for use as a well-drained coarse sand medium for vegetative plant restoration, plant preservation, or 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 3149.2I.2, “Fine Filter Aggregate”; or 3149.2J, “Sand Cover”
(2) Twenty percent Grade 2 compost in accordance with 3890, “Compost”
(3) Twenty percent topsoil meeting the requirements of loam topsoil borrow

Supplement with root additives to stimulate root establishment in water quality treatment facility.

E Boulevard Topsoil Borrow

Provide topsoil borrow containing three blended components consisting of loam topsoil, 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 topsoil meeting the requirements of loam topsoil borrow
(2) One-third sand accordance with 3149.2I.2, "Fine Filter Aggregate"; or 3149.2J, "Sand Cover"
(3) One-third compost in accordance with 3890.2B, "Grade 2 Compost"

F Filter 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 at least 4 inches/hour. The components consist of the following by volume:

(1) 60-80 percent sand meeting the gradation requirements of 3126, "Fine Aggregate for Portland Cement Concrete"
(2) 20-40 percent Grade 2 compost per 3890, "Compost"

G Organic Topsoil Borrow

Provide topsoil borrow containing two blended components of topsoil, and compost for a plant growing medium to enhance existing soils. The components by volume consist of:

(1) 50 percent existing salvaged topsoil
(2) 50 percent compost meeting requirement of 3890.2B "Grade 2 Compost."

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

3877.3 SAMPLING AND TESTING

Provide Material from vendors that have been approved by the Erosion and Storm Water Management Unit or 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. Submit preapproval test results to the Office of Environmental Stewardship, Erosion & Stormwater Management Unit. If federal or State chemical or biological requirements conflict, provide Material meeting the most stringent requirement.

Test blended topsoil for each individual component before blending.

The Contractor shall conduct fertility testing in accordance with the standard testing procedures of the University of Minnesota Soils Testing Laboratory, Soil Science Department.

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 inches wide and 3/4 inches 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 inch to 3 inches.

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 hours 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) Maximum grass blade widths 0.2 inch
(5) Weed-free
(6) Maximum thatch thickness 0.2 inch over the base soil
(7) Consists of a blend of 4 or 5 fine leafed turf grasses
(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 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
(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

C 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

(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"

D Native Sod

Provide native sod meeting the following requirements:

(1) Commercially produced from native grass and flower seed mixtures per 3876, "Seed," and as shown on the Plans
(2) Seeded and grown in turf reinforcement mats or natural organic mats for at least 30 Calendar 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 D2974, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils*.

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 (calcite or dolomite)
(2) Burned lime
(3) Slaked lime
(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 Sieve
(2) At least 60 percent passes through a No. 20 Sieve
(3) At least 50 percent passes through a No. 60 Sieve
(4) A maximum water content of 10 percent
(5) ALM with a rating of at least 1,000 pounds effective neutralizing power (ENP) per ton 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, accurate within 3 percent
(6) Weight or cubic yards of ALM distributed and weight per cubic yard

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, accurate to within 3 percent
(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 Sieve, No. 20 Sieve, and No. 60 Sieve
(3) Percent dry matter
(4) The weight in pounds ENP per ton of ALM rating

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

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

When:

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

Fineness Index (FI) =
$0.2(\%passNo.8-\%passNo.20)+0.6(\%passNo.20-\%passNo.60)+1(\%passNo.60)$

PDM = percent dry matter = 100 − percent moisture

W = weight, pounds (lb) ENP

T = Ton 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 label shall contain the requirements of each type and at least the minimum

analysis shown on the Plans. The fertilizer 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.

Fertilizer supplied in closed containers shall have the following clearly marked on the containers and in accordance with Minnesota Department of Agriculture (MDA) regulations:

(1) The weight
(2) The type of nutrients
(3) The manufacturer's guaranteed analysis

Fertilizer supplied in bulk shall 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 meeting the requirements for 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
(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
(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
(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 Sieve to No. 30 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
(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 and Certificate of Compliance of each type supplied. 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

Provide Type 1 mulch with the following characteristics:

(1) Grain straw, hay, cuttings of agricultural grasses, and legumes
(2) Free of noxious weeds as defined by the rules and regulations of the Minnesota Department of Agriculture (MDA)
(3) Free of cattail (Typha sp), reed canary grass (Phalaris arundinacea), birds-foot trefoil (Lotus corniculatus), crown vetch (Coronilla varia), and Queen Anne's lace (Daucus carota)
(4) In an air-dried condition at the time of delivery

B Type 3

Provide Type 3 mulch with the following characteristics:

(1) Clean agricultural grain straw, (Wheat, Oats, Rye, Barley) or clean straw harvested from native grass production fields, certified by the Minnesota Crop Improvement Association (MCIA) to be free of noxious weeds
(2) Free of cattail (Typha sp), reed canary grass (Phalaris arundinacea), birds-foot trefoil (Lotus corniculatus), Crown vetch (Coronilla varia), and Queen Anne's lace (Daucus carota)
(3) Bales are in an air-dried condition at the time of delivery
(4) Attached to each bale is the MCIA inspection tag

C Type 4

Provide Type 4 mulch with the following characteristics:

(1) Type 1 or Type 3 mulch
(2) Hydraulic Stabilized Fiber Matrix, meeting the requirements of 3884, "Hydraulic Erosion Control Products"

D Type 5

Provide Type 5 mulch with the following characteristics:

(1) Raw wood slash from hard or soft timber harvested during clearing and grubbing operations on the Project
(2) Product of a mechanical chipper, hammermill, or tub grinder
(3) Maximum length of individual pieces shall not exceed 20 inches
(4) Maximum width of individual pieces shall not exceed 2 inches

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 Minnesota Department of Agriculture (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. Contact MDA for more information.

E Type 6

Provide Type 6 mulch with the following characteristics:

(1) Raw wood Material from hard or soft timber and that is the product of a mechanical chipper, hammermill, or tub grinder
(2) Material is free of mold, dirt, sawdust, and deleterious Material
(3) Do not use wood Material in an advanced state of decomposition, chipped-up manufactured boards or chemically treated wood; including wafer board, particle board, Chromated Copper Arsenate (CCA), or penta-treated wood
(4) Material is air dried
(5) Do not allow unattached bark, green-leaf composition to exceed 20 percent by mass
(6) Maximum length of individual pieces shall not exceed 12 inches
(7) Maximum width of individual pieces shall not exceed 2 inches

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. Contact MDA for more information.

F Type 8

Provide Type 8 mulch with the following characteristics:

(1) Consisting of prairie hay
(2) Has not been thrashed to remove seeds so it consists of directly-bailed Material
(3) Harvested from native stands or from native grass fields
(4) Free of noxious weeds as defined by the rules and regulations of the Minnesota Department of Agriculture (MDA)
(5) Free of cattail (Typha sp), reed canary grass (Phalaris arundinacea), birds-foot trefoil (Lotus corniculatus), crown vetch (Coronilla varia), and Queen Anne's lace (Daucus carota)

G Type 9

Provide Type 9 mulch with the following characteristic:

(1) Consists of naturally occurring mineral Materials
(2) Contains no topsoil or organics
(3) Aggregate ranging in size from 3/8 inch to 2 inches, with 5 percent by mass passing the 3/8 inch Sieve

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 D4444, Standard Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters*, and Sieve analysis in accordance with *ASTM D422, Standard Test Method for Particle-Size Analysis of Soils*.

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) Non-corrosive to hydraulic application Equipment
(2) Non-foaming or containing mixture enhancers to prevent foaming and mixing problems during agitation in the application Equipment
(3) Safe to the applicator, adjacent workers, and the environment if properly applied in accordance with the Environmental Protection Agency (EPA) and OSHA

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

Manufacture of polyacrylamide tackifier, organic fiber matrix, bonded fiber matrix, and reinforced fiber matrix shall certify applicator's of their product and provide them an "Applicator's Certificate."

A Hydraulic Tackifiers

A.1 Natural Tackifier

Provide any of 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; at least 95 percent guar gum by weight and the remaining weight consisting of dispersing and cross-link additives
(4) Starch; non-ionic, cold-water soluble, pre-gelatinized granular cornstarch
(5) Psyllium; finely ground mucilloid coating of plantago seeds applied as a dry powder or a wet slurry to the surface of the soil
(6) Pitch; non ionic emulsion with a solids content of at least 48 percent
(7) Rosin types blended with gelling and hardening agents, consisting of at least 26 percent of the total solids content
(8) Water soluble blends of hydrophilic polymers, viscosifiers, sticking aids, and other gums

Use non-corrosive, water-diluted emulsion soil stabilizer capable of curing to water-insoluble binding and cementing agent upon application.

A.2 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
(8) Air cures within 48 hours

A.3 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:

(a) Linear, anionic copolymer of acrylamide and sodium acrylate
(b) Residual monomer content of the PAM no greater than 0.05 percent by weight
(c) Formulated as a water-in-oil emulsion containing at least 2.6 pounds pure PAM per gal, and containing at least 30 percent active pure PAM
(d) Formulated as a liquid dispersed polyacrylamide (LDP), containing at least 4.4 pounds pure PAM per gallon, and containing at least 35 percent active pure PAM

(4) Drying time no greater than 4 hours

B Hydraulic Matrix

Tracer dyes or pigments when provided with product to facilitate application and metering shall be water soluble, non-toxic, and non-leachable.

B.1 Organic Fiber Matrix (OFM)

Provide hydraulic organic fiber matrix meeting the following characteristics and requirements:

(1) Shall be premixed formulation
(2) Contains a minimum of 88 percent organic Material that may be derived from compost, peat moss, wood cellulose, straw fibers, wood bark, biochar, flax fibers, or other organic fibers
(3) Product shall be phyto-sanitized to eliminate potential pathogens and weed seeds
(4) Contains one or more of the following: humus, enzymes, vitamins, natural sugars, plant proteins, auxins, amino acids
(5) Contains an approved tackifier
(6) Contains zero ecotoxicity as per EPA 2021.0 in 48 hours
(7) Passes EPA 503 Metal Limits
(8) Passes 40 CFR 503 Class A for pathogen reduction
(9) Provides a homogeneous slurry mixture
(10) Contains 15 percent maximum moisture as per *ASTM D7367, Standard Test Method for Determining Water Holding Capacity of Fiber Mulches for Hydraulic Planting*

B.2 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 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 Sieve, at least 50 percent retained on the Sieve
(5) Functional for no greater than 3 months after application

B.3 Stabilized Fiber Matrix (SFM)

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:

(a) Soil flocculants
(b) Crosslinked hydro-colloidal polymers
(c) 5 percent Crosslinked tackifiers

(2) Contains 15 percent maximum moisture by weight
(3) Cure time within 48 hours
(4) Functional for at least of 3 months

B.4 Bonded Fiber Matrix (BFM)

Provide bonded fiber matrix meeting the following requirements and characteristics:

(1) Composed of wood fibers or wood byproducts
(2) At least 25 percent of the fibers average 0.4 inches long and with at least 50 percent retained on No. 25 Sieve
(3) Contains 10 percent + 1 percent blended hydrocolloid crosslinked polymers
(4) Contains slow-release and agricultural based fertilizers or other proprietary chemicals no greater than 2 percent by volume
(5) Binder and crosslinked polymers do not dissolve or disperse upon rewetting
(6) Contains moisture content no greater than 15 percent by weight
(7) Functional for at least 6 months

B.5 Reinforced Fiber Matrix (RFM)

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

(1) Defibrated organic fibers
(2) Cross-linked insoluble or linear hydro-colloidal tackifiers
(3) Reinforcing natural or synthetic fibers
(4) Cure time within 2 hours
(5) Functional for at least 12 months

3884.3 SAMPLING AND TESTING

Follow *Schedule of Materials Control*.

3885 ROLLED EROSION PREVENTION PRODUCTS

3885.1 SCOPE

Provide erosion prevention blankets, turf reinforcement mats, and other products to prevent erosion, stabilize soils, reinforce vegetation, and aid in the establishment of vegetation, where applicable. Ensure that net openings are small enough to retain uniformly distributed fill Material but large enough to allow seedling emergence and reduce animal entanglement.

3885.2 REQUIREMENTS

A Temporary Erosion Prevention Blanket

Use only natural fibers in the manufacture of netting and fill Material for temporary products. Provide blankets that conform to the general requirements listed in Table 3885.2-1, Table 3885.2-2, and Table 3885.2-3.

Table 3885.2-1
Temporary, Straw-based Products

Criteria	Category 10	Category 20	Category 30
Net Number (upper/lower)	1	2	2
Fiber Fill Material	100 percent Straw	100 percent Straw	70 percent Straw, 30 percent Coconut/hemp
Mass, minimum*‡ (pound per square yard)	0.43	0.43	0.42
Reported Fiber Length, 80 percent greater than (inch)	3	3	3
Reported Functional Longevity, 75 percent remaining (month)	3	4.5	9
Reported Target Service Life (month)	4	9	12
Permissible shear, unvegetated# (pound per square foot)	1.50	1.75	2.00
Flow, probable maximum# (feet per second)	4.5	6	8
Machine Direction (MD) Tensile Strength, minimum§ (pounds per foot)	130	170	200
TD Tensile Strength, minimum§ (pounds per foot)	80	130	150
Permissible Anchor Type	Wood or biodegradable ‖ plant based plastic barbed, glue, U or round head metal, 11-13 gage	U or round head metal, 11-13 gage, Washer/60D (6 inch) Nail†	Helical twist pin, Washer/60D (6 inch) Nail†
Minimum anchor embedment length	4 inches	6 inches	8 inches

*Dry mass at time of manufacture following ASTM protocols.
‖ Biodegradable means the product will decompose under ambient soil conditions into carbon dioxide, water, and other naturally occurring Materials within one year of installation.
†Winter Utilization.
‡ *ASTM D6475, Mass per Unit Area of Erosion Control Blankets.*
# *ASTM D6460, Performance in Protecting Earthen Channels from Stormwater-Induced Erosion.*
§ *ASTM D6818, Ultimate Tensile Properties of Rolled Erosion Control Products.*

Table 3885.2-2
Temporary, Wood Fiber-based Products

Criteria	Category 15	Category 25	Category 35	Category 45
Net Number (upper/lower)	Netless	2	2	2
Fiber Fill Material	100 percent Cellulose, Agricultural products, hemp, wood	100 percent Wood* Fiber	100 percent Wood* Fiber	100 percent Wood* Fiber
Mass, minimum ‖# (pound per square yard)	0.40	0.57	0.76	1.25
Reported Fiber Length, 80 percent greater than (inch)	Varies, 0.5 to 6	6	6	6
Reported Functional Longevity, 75 percent remaining (month)	1.5	6	12	24
Reported Target Service Life (month)	3	12	24	36
Permissible shear, unvegetated§ (pound per square foot)	1.00	2.10	2.50	3.25
Flow, probable maximum§ (feet per second)	2	7	8	11
MD Tensile Strength, minimum** (pounds per foot)	4	170	220	280
TD Tensile Strength, minimum** (pounds per foot)	4	130	150	200
Permissible Anchor Type	Wood or biodegradable† plant based plastic barbed, glue U or round head metal 11-13 gage	U or round head metal, 11-13 gage, Washer/60D (6 inch) Nail‡	Helical twist pin, Washer/60D (6 inch) Nail‡	Helical twist pin, Washer/60D (6 inch) Nail‡
Minimum anchor embedment length	4 inches	6 inches	8 inches	10 inches

* Derived from hardwood (Aspen spp.) or softwoods (pine).
‖ Dry mass at time of manufacture following ASTM protocols.
† Biodegradable means the product will decompose under ambient soil conditions into carbon dioxide, water, and other naturally occurring materials within one year of installation.
‡ Winter Utilization.
 # ASTM D6475, Mass per Unit Area of Erosion Control Blankets.
§ *ASTM D6460, Performance in Protecting Earthen Channels from Stormwater-Induced Erosion.*
** *ASTM D6818, Ultimate Tensile Properties of Rolled Erosion Control Products.*

Table 3885.2-3
Temporary, Extended Duration Open Weave Textile Based Products*

Criteria	Category 37	Category 47	Category 57
Textile Fiber Material	100 percent Coir or Hemp Fiber	100 percent Coir or Hemp Fiber	100 percent Coir or Hemp Fiber
Mass‖, minimum† (pounds per square yard)	0.75	1.2	1.7
Water Absorbency, percent, minimum‡	160	165	130
Light Penetration, percent, minimum#	38	35	18
Calculated Open Area, percent, minimum	60	40	35
Reported Functional Longevity, 75 percent remaining (month)	36	36	48
Reported Target Service Life (month)	60	72	72
Permissible shear, unvegetated§ (feet per second)	3	4.5	5
Flow, probable maximum, unvegetated§ (feet per second)	8	11	16
Tensile Strength, Dry, minimum, MDxTD** (pounds per foot)	500x480	1200x900	1600x1100
Tensile Strength, Wet minimum, MDxTD** (pounds per foot)	450x360	920x680	1200x930
Elongation at Failure, percent maximum, MDxTD**	36x32	45x40	50x40

* Anchoring to be done according to manufacturer's recommendations.
‖ Dry mass at time of manufacture following ASTM protocols.
† *ASTM D5261, Mass per Unit Area of Geotextiles.*
‡ *ASTM D1117, Evaluating Nonwoven Fabrics.*
\# *ASTM D6567, Light Penetration of a Rolled Erosion Control Product.*
§ *ASTM D6460, Performance in Protecting Earthen Channels from Stormwater-Induced Erosion.*
** *ASTM D6818, Ultimate Tensile Properties of Rolled Erosion Control Products.*

B Permanent Products

Provide turf reinforcement mats and other permanent products that conform to the general requirements listed in Table 3885.2-4, Table 3885.2-5, and Table 3885.2-6.

Table 3885.2-4
Permanent, Synthetic Based, Surface Applied Products

Criteria	Category 50	Category 55	Category 60
Net Number (upper/lower)	Stitched 2 or 3 Layer, synthetic	Stitched 2 or 3 Layer, synthetic	Stitched or bonded 2 or 3 Layer synthetic
Fiber Fill Material	Bio-composite of natural agricultural products, HECP – RFM, coconut, hemp, and synthetic elements	Wood Fiber‖	Synthetic elements
Mass, minimum*† (pound per square yard)	0.64	0.75	0.5
Fiber Length, 80 percent greater than (inch)	3	6	DNA
Functional Longevity, 75 percent remaining (month)	12 biological > 36 synthetic	24 biological > 36 synthetic	>36
Target Service Life (month)	>36	>36	>36
Permissible shear, unvegetated‡ (pound per square foot)	3.00	3.25	2.50
Flow, probable maximum‡ (feet per second)	10	11	6
MD Tensile Strength, minimum# (pounds per foot)	370	800	290
TD Tensile Strength, minimum# (pounds per foot)	180	800	190
Permissible Anchor Type	Helical twist, Hooked No. 3 rebar, or cable	Helical twist, Hooked No. 3 rebar, or cable	Helical twist, Hooked No. 3 rebar, or cable
Minimum anchor embedment length	12 inches	12 inches	12 inches

*Dry mass (as appropriate) at time of manufacture following ASTM protocols.
‖ Derived from Hardwoods (Aspen spp.) or softwoods (pine).
† *ASTM D6475, Mass per Unit Area of Erosion Control Blankets.*
‡ *ASTM D6460, Performance in Protecting Earthen Channels from Stormwater-Induced Erosion.*
# *ASTM D6818, Ultimate Tensile Properties of Rolled Erosion Control Products.*

Table 3885.2-5
Permanent, Synthetic Based, Soil, or Organic Fiber Media Filled Products

Criteria	Category 70	Category 72	Category 74	Category 76
Net Number* (upper/lower)	TRM	TRM	TRM	TRM
Fill Material‖	3877.2C, "Sandy Clay Loam Topsoil Borrow," 3890.2B, "Grade 2 Compost," 3884.2B.1, "Organic Fiber Matrix (OFM)"			
Mass, minimum† (pound per square yard)	0.5	0.5	0.5	1.20
80 percent test chamber strength retained‡ (hours)	500	1000	3000	3000
Target Service Life‡	Permanent	Permanent	Permanent	Permanent
Permissible shear, unvegetated# (pound per square foot)	4.00	6.00	8.00	10.00
Flow, probable maximum# (feet per second)	10	12	14	16
MD Tensile Strength, minimum§ (pounds per foot)	150	240	1400	3000
TD Tensile Strength, minimum§ (pounds per foot)	130	200	1100	3000
Permissible Anchor Type	Helical twist metal hooks, Hooked No. 4 rebar, tension cable	Helical twist metal hooks, Hooked No. 4 rebar, tension cable	Tension cable per manufacturer specification	Tension cable per manufacturer specification
Minimum anchor embedment length	18 inches	18 inches	18 inches	18 inches

*Provide mats with cells at least 3/8-3/4 inches in depth to allow soil filling and retention, composed of nylon, polypropylene, polyolefin, polyester, or rust inhibited metal.
‖ See 2575, "Establishing Vegetation and Controlling Erosion," for approximate quantities to achieve a 0.5-1 inch Layer filling all voids on product surface.
† *ASTM D6566, Mass Per Unit Area of Turf Reinforcement Mats.*
‡ *ASTM D4355, Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus.*
# *ASTM D6460, Performance in Protecting Earthen Channels from Stormwater-Induced Erosion.*
§ *ASTM D6818, Ultimate Tensile Properties of Rolled Erosion Control Products.*

Table 3885.2-6
Permanent, Ultra High Performance Products

Criteria	Category 80	Category 90
Net Number (upper/lower)	Multilayered, Bonded Geogrid*	Bonded synthetic Layer
Fiber Fill Material	Concrete ‖ units (D6684†), with bottom attached‡ (80A) Category 25 with Category 60, or (80B) 3733, "Geosynthetic Materials," Geotextile Type 5	Concrete Polymer# 90A 0.20 inch 90B 0.30 inch 90C 0.50 inch
Topsoil infilling, 3877.2C, "Sandy Clay Loam Topsoil Borrow"	Yes	No
Mass, minimum§ (pound per square yard)	0.64	0.5
Fiber Length, 80 percent greater than (inch)	Varies based on subcategory	DNA
Functional Longevity, 75 percent remaining** (month)	>36	>36
Target Service Life** (month)	>36	>36
Permissible shear, unvegetated‖‖ (pound per square foot)	24	25
Flow, probable maximum†† (feet per second)	30	35
MD Tensile Strength, minimum (pounds per foot) ##	2055	1200
TD Tensile Strength, minimum (pounds per foot) ##	2055	440
Permissible Anchor Type	Bent No. 4 rebar, tension cable	Per Manufacturer
Minimum anchor embedment length	24 inches	Per Manufacturer

* Geogrid, see Table 3885.2-7.
‖ Concrete, see 3885.2B.2, "Concrete."
† *ASTM D6684, Standard Specification for Materials and Manufacture of Articulating Concrete Block (ACB) Systems.*
‡Functional equivalent for shear, flow, and functional longevity.
Concrete Fabric Mat, see 3885.2B.3, "Concrete Fiber Mat."
§ *ASTM D6475, Mass per Unit Area of Erosion Control Blankets.*
** *ASTM D4355, Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus.*
‖‖ *ASTM D6459/6460, Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Hillslopes from Rainfall-Induced Erosion/Performance in Protecting Earthen Channels from Stormwater-Induced Erosion.*
†† *ASTM D6460, Performance in Protecting Earthen Channels from Stormwater-Induced Erosion.*
ASTM D6637, Tensile Properties of Geogrids.

B.1 Bonded Geogrid
Provide bonded geogrid with the physical characteristics shown in Table 3885.2-7.

Table 3885.2-7
Geogrid Characteristics

Criteria	Requirement
Mass/Unit Area (minimum)*	0.43 pounds per square yard
Measured Aperture Size (minimum)	1.6 by 1.6 inch
Wide Width Tensile Strength Elongation at Break‖ (maximum)	6 percent
Tensile Strength at 2 percent Machine Direction (MD)‖ (minimum)	822 pounds per foot
** ASTM D5261, Mass per Unit Area of Geotextiles*	
‖ ASTM D6637, Tensile Properties of Geogrids	

B.2 Concrete

Provide wet cast blocks meeting 2461, "Structural Concrete," and the following:

(1) Manufactured in a plant with a Department-Certified Ready-mix Program
(2) Design air content of 6.5 percent
(3) Absorption no greater than 7.0 percent when tested in accordance with *ASTM C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units*
(4) Minimum design strength of 4000 psi at 28 Calendar Days when tested in accordance with *ASTM C140*

The Contractor shall inspect the flexible concrete mats upon delivery. Flexible concrete mats missing more than 4 concrete blocks per 80 square feet section shall be rejected.

B.3 Concrete Fiber Mat

Provide concrete fabric mat (CFM) that is a cement impregnated fabric that hardens when hydrated to form a water resistant mat. It can be installed underwater and has a working time of several hours after hydration.

It shall meet the following requirements of Table 3885.2-8 and Table 3885.2-9.

Table 3885.2-8
Physical Characteristics

Type	Thickness (inch)	Dry Weight (pound per square foot)	Hydration, minimum water volume (gallons per square foot)
A	0.20	1.43	0.2
B	0.30	2.42	0.3
C	0.50	3.78	0.5

Table 3885.2-9
Concrete Characteristics

Criteria	Requirement
Freeze Thaw*	3400 pounds
Working Strength‖	Length = 60 pounds per square foot Width = 20 pounds per square foot
Puncture Resistance†	350 pounds
Manning's N#	0.011
Taber Abrasion§	7 times greater than 2500 pounds per square inch OPC
Compressive Strength, 10 Calendar Day** (pound per square inch)	5800

* *ASTM C1185,* Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards
‖ *ASTM D5035, Breaking Force and Elongation of Textile Fabrics*
† *ASTM D6241, Static Puncture Strength of Geotextiles*
\# *ASTM D6460, Performance in Protecting Earthen Channels from Stormwater-Induced Erosion*
§ *ASTM C1353, Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform Abraser*
** *ASTM C473-07, Physical Testing of Gypsum Panel Products*

Provide rolls capable of handling from spreader beams or bars. Provide proper storage and handling methods capable of dry storage until placement. Provide means capable of cutting into Structure configurations and openings prior to hydration and again after placement as necessary for proper fit and transport of flowing water.

B.3.a Overlap and Lap-Joint Bonding Agents

Provide appropriate sealant capable of bonding to both the PVC backing and fiber surface of the concrete fabric mat. The sealant must work in both wet and dry conditions prior to hydration and remain functional during hydration.

B.3.b Hydration Water

Provide water to the concrete fabric capable of surface saturation when no longer applying water for 2 minutes. Provide sufficient water 1 hour later on fabrics thicker than 0.5 inches, ditch grades greater than 2 percent, slopes greater than 3:1, and temperatures greater than 80°F to complete the hydration process.

3885.3 SAMPLING AND TESTING

All approved products must be current in the National Transportation Product Evaluation Program (NTPEP), with a testing cycle of every 3 years. Approved products for this Specification are on file on the *Approved/Qualified Products List*.

Provide documentation of the following for all products:

1) A published C-Factor appropriate to each category following requirements of Erosion Control Technology Council (ECTC) Method 2 Rainfall, extrapolated to a 3 inch per hour rainfall or *ASTM 6459, Standard Test Method for Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Hillslopes from Rainfall-Induced Erosion*
(2) Proof that the product enhances plant growth according to *ASTM D7322, Standard Test Method for Determination of Erosion Control Product (ECP) Ability to Encourage Seed Germination and Plant Growth Under Bench-Scale Conditions*
(3) Evidence that the product meets ECTC smolder resistance guidelines

Target service life is the estimated time period that a product can be anticipated to prevent erosion, independent of vegetation, under environmental conditions occurring in Minnesota. These conditions include variations in temperature, moisture, light, soils, biological Activity, vegetation establishment, etc.

Functional longevity is the proxy for measuring target service life (due to a lack of standard test methods). Seventy five percent of the product must remain in-place for the specified duration under normal environmental conditions.

No field substitutions are permitted between categories unless following the requirements of 1401, "Intent of Contract."

3886 SILT FENCE

3886.1 SCOPE

For the purpose of the Work specified in 3886, "Silt Fence," the Department defines MARV as two standard deviations below the mean value of the rolls tested.

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
(5) Meets the requirements specified in Table 3886.2-1

Table 3886.2-1
Silt Fence Requirements

Silt Fence Type	Width, inches	Grab Tensile (machine direction), pounds *	Apparent Opening Size ‖	Puncture Strength †	UV Stability, 500 hour, percent ‡	MAX Permittivity #	Flow Rates, gpm/square foot
MS, HI woven geotextile §	36	130	No. 30 Sieve	—	70	1.0 s^{-1}	100
PA woven geotextile	36	100	No. 30 Sieve	—	70	0.1 s^{-1}	5
SD woven or non-woven geotextile **	36	100	No. 30 Sieve	—	70	—	—
TB polyester or polyvinyl Fabric	60	200	—	90 pounds	70	impervious	—

Values in table are Minimum Average Roll Values (MARV).
* *ASTM D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.*
‖ *ASTM D4751, Standard Test Methods for Determining Apparent Opening Size of a Geotextile*, Maximum average roll value.
† *ASTM D4833, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products*.
‡ *ASTM D4355, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus.*
# *ASTM D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.*
§ Provide MS, HI woven geotextile with monofilament in both directions. Do not make substitutions.
** Meeting 3733, "Geosynthetic Materials," Types 3, 4, 5, or 7, or poly/poly-reinforced sheeting meeting 3888, "Poly Sheeting."

For TB fabric, width is finished width with a 4 inch overlap heat sealed hem pocket at the top.

B Fasteners

Provide fasteners with a tensile strength of at least 50 pounds. Use plastic ties to fasten geotextile to posts on MS, HI, and TB applications. Use wire ties or plastic ties to fasten geotextile to anchor points on SD applications.

C Supports

Provide steel posts for MS, HI, and TB Silt fence types per 3403, "Hot-Rolled Steel Fence Posts," and the following:

Table 3886.2-2
Steel Silt Fence Post Requirements

Characteristic	Requirement
Type	T-post
Weight	0.95 pound/foot
Length	≥ 5.0 feet
Embedment	≥ 24 inches
Post spacing	<6.0 feet

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

Table 3886.2-3
Wooden Silt Fence Post Requirements

Characteristic	Requirement
Type	Hardwood
Size	≥ 2 inches by 2 inches
Length	≥ 4.0 feet
Embedment	≥ 18 inches
Post Spacing	< 5.0 feet

D Portable Precast Concrete Jersey Barriers

For SD, use portable precast concrete barriers per 2533, "Concrete Median Barriers," 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 pounds 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 inch galvanized steel cable with a breaking strength of at least 9,800 pounds. Incorporate into the 4 inch hem pocket at top of fabric.

3886.3 SAMPLING AND TESTING

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

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

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 Table 3887.2-1

Table 3887.2-1
Flotation Silt Curtain Requirements

Characteristic	Type	
	Light Duty	**Heavy Duty**
Curtain fabric Material type	Impermeable, vinyl-nylon laminate	Impermeable, vinyl-coated nylon
Weight, ounce per square yard	18	0.22
Grab tensile strength, pounds*	300	500
Depth of curtain ‖	2 feet-10 feet	2 feet-10 feet
Flotation, inches	6 diameter marine quality expanded polystyrene	8 diameter marine quality expanded polystyrene
Net buoyancy, pounds per foot	13	20
Top load carrying components	Fabric only	Fabric plus 5/16 inches galvanized steel cable at least 9,800 pound break strength
Ballast	≥0.7 pounds per foot enclosed 1/4 inches galvanized chain	≥1.1 pounds per foot enclosed 5/16 inches galvanized chain
Connection between sections	Laced grommets	Aluminum collar reinforced quick disconnects
* Minimum average roll value meeting the requirements of *ASTM D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles*. ‖ As required by the Contract.		

Remove the curtain upon completion of Work. Do not allow resuspension 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 floatation Silt curtain and components.

3888 POLY SHEETING

3888.1 SCOPE

Provide poly sheeting for temporary soil stabilization.

3888.2 REQUIREMENTS

A Poly Sheeting

Provide plastic sheeting meeting the following requirements;

(1) Minimum thickness of 6 mil (0.15 millimeter)
(2) Reinforced polyethylene sheeting or reinforced polyester tarps
(3) Targeted service life of 6 months

B Anchors

Provide anchor system consisting of non-puncture type anchor weights or sand bags with cords or ropes of adequate strength to support the weights on the slope, new or used chain link fence, metal posts, and rebar or wood stakes sufficient to keep poly sheeting from lifting from soil surface.

3888.3 SAMPLING AND TESTING – BLANK

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 one of the following sets of requirements:

Option 1:

The US Composting Council Seal of Testing Assurance (STA) Program requirements for animal or plant based feedstocks. Facilities accepting SSOM for composting are required to comply with the US Composting Council Seal of Testing Assurance Program. STA testing is optional for facilities accepting only leaves or yard waste.

SSOM means compostable Materials in accordance with MN Administrative Rule 7035.0300, Subp. 105a.

Option 2: (Not Available for facilities accepting SSOM)

(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 1 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 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 inch 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 (MN Administrative 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 MN Administrative Rules Chapter 7045 (Hazardous Waste). Compost 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 percent of individual chemical or chemical mixture Hazard Index, Hazard Quotient, or acceptable cancer risk level). Chemical contaminant, including pesticides, cannot 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 and animal byproducts
(3) Texture similar to a highly Organic Soil
(4) Meeting the requirements of Table 3890.2-1

Table 3890.2-1
Grade 1 Compost Requirements

Requirement	Range
Organic matter content (dry weight)	≥ 30 percent
C/N ratio	6:1-20:1
NPK ratios* (percent dry weight)	2:2:1-4:4:2
pH	5.5-8.0
Moisture content	35-55 percent
Bulk density	700 pounds per cubic yard – 1,600 pounds per cubic yard
Inert Material	≤ 3 percent at 0.15 inch
Soluble salts	≤ 10 mmho per centimeter
Germination test‖	80-100 percent
Screened particle size	≤ 3/4 inch
* 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, lettuce, or cucumber seed used.	

B Grade 2 Compost

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

(1) Derived from the decomposition of leaves, yard wastes, SSOM, or a blend
(2) Texture similar to a shredded peat
(3) Meeting the requirements of Table 3890.2-2

Table 3890.2-2
Grade 2 Compost Requirements

Requirement	Range
Organic matter content (dry weight)	≥ 30 percent
C/N ratio	6:1-20:1
NPK ratios (Maximum percent dry weight)	1:1:1
pH	5.5-8.5
Moisture content	35-55 percent
Bulk density	700 pounds per cubic yard – 1,600 pounds per cubic yard
Inert material *	< 3 percent at 0.15 inches
Soluble salts	≤ 10 mmho per centimeter
Germination test ‖	80-100 percent
Screened particle size	≤ 3/4 inch
* Includes plastic bag shreds. ‖ Germination test must list the species of cress, cucumber, or lettuce seed used.	

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

Follow *Schedule of Materials Control*.

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

3892 TEMPORARY SLOPE PIPE DRAIN

3892.1 SCOPE

Provide Material for temporary slope pipe 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:

A.1 Corrugated Polyethylene Pipe (CP) 3247
Provide non perforated CP pipe

A.2 Corrugated Polyethylene Drainage Tubing (PE)..... 3278

A.3 Thermoplastic Pipe (TP) 3245

A.4 Corrugated Steel Pipe 3226
Provide each slope drain with the same diameter pipe over the entire length of the drain. Size temporary slope drains in accordance with Table 3892.2-1.

Table 3892.2-1
Slope Drain Sizing

Drainage Area, acres	Pipe Diameter, inch
0–0.5	12
> 0.5–1.5	18
> 1.5–2.5	21
> 2.5–3.5	24

Place slope drain in conjunction with diversion mounds or dykes.

B Joints

Use watertight connecting bands or joint to connect pipe sections.

C Anchors

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

(1) Nominal 2 inches by 2 inches cross-section
(2) At least 3 feet long
(3) Pointed end

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 3893.2-1:

Table 3893.2-1
Polypropylene Fabric Properties

Property	Test, *ASTM* number	Minimum Tolerance
Grab Tensile Strength	*D4632**	420 N
UV Stability	*D4355*‖	70 percent
* *ASTM D4632, Standard* Test Method for Grab Breaking Load and Elongation of Geotextiles ‖ *ASTM D4355, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus*		

Provide sandbags with an overall size of at least 14 inches by 26 inches.

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)
(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 Calendar Days in the soil
(4) One of the following:

(a) Potassium polyacrylate/polyacrylamide copolymer
(b) Sugar alcohols
(c) Polysaccharides
(d) Humates
(e) Alpha-hydroxy propionic 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
(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 glomus 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
(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 contaminates based on Pikovskave, SS Malate Medium
(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 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, "Compost," and containing the following biological organisms based on certified test results:

(1) Active bacteria: At least 15 microgram per gram of compost
(2) Total bacteria: At least 150 microgram per gram of compost
(3) Active fungi: At least 15 microgram per gram of compost
(4) Total fungi: At least 150 microgram per gram of compost
(5) Average fungal hyphal diameter: At least 1/8 inch
(6) Individual fungal hyphal diameter: At least 3/32 inch
(7) The following types of protozoa:

    (a) At least 8,000 flagellates per gram of compost

(b) At least 8,000 amoebae per gram of compost
(c) 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
(2) Green Materials including the following:

(a) Manure
(b) Grass clippings
(c) Legumes including alfalfa, peas, clover, and bean plant residues
(d) 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
(3) Shredded wood Material including the following:

(a) Wood chips
(b) Saw dust
(c) Paper products

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

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

A Straw
Provide straw logs meeting the following requirements and characteristics:

(1) Type 3 mulch in accordance to 3882, “Mulch Material”
(2) Encased in photodegradable synthetic or natural netting with a service life from 6 months to 9 months and with openings 1/2 inch by 1/2 inch
(3) Diameter from 8 inches to 9 inches

(4) Consisting of at least 80 percent of the fiber Material at least 3 inches long
(5) Dry weight of 2 to 4 pounds per cubic foot

B Wood Fiber

Provide wood fiber logs with the following requirements and characteristics:

(1) Excelsior wood fibers
(2) Encased in a photodegradable synthetic or natural netting with a service life from 6 to 9 months and with openings 1/2 inch by 1/2 inch
(3) Diameter from 6 inches to 9 inches
(4) Consisting of at least 80 percent of the fiber Material at least 6 inches long
(5) Dry weight from 1.4 pounds per cubic foot to 5.7 pounds per cubic foot

C Wood Chip

Provide wood chip logs meeting the following:

(1) Type 6 mulch in accordance to 3882, "Mulch Material"
(2) Encased in a photodegradable synthetic or natural fiber casing with 1/8 inch to 3/8 inch openings with a service life from 12 months to 24 months
(3) Diameter of 8 inches to 10 inches

D Compost

Provide compost logs meeting the following characteristics and requirements:

(1) Consisting of the following blend of compost and wood chips;

  (a) From 30 percent to 40 percent, Grade 2 compost in accordance with 3890, "Compost," with at least 70 percent compost retained on the 3/8 inch Sieve
  (b) From 60 percent to 70 percent, Type 6 mulch in accordance to 3882, "Mulch Material"

(2) Encased in photodegradable synthetic woven or natural fiber casing with 1/8 inch to 3/8 inch openings, with a target service life from 12 to 24 months
(3) Diameter of 7 inches to 9 inches

E Rock

Provide rock logs meeting the following requirements and characteristics:

(1) Washed, 3/4 inch to 1 1/2 inch, Class A, B, C, or D rock in accordance with 3137 "Coarse Aggregate for Portland Cement Concrete"
(2) Encased in a geotextile Material with a minimum grab tensile strength of 130 pounds. *ASTM D6818, Standard Test Method for Ultimate Tensile Properties of Rolled Erosion Control Products*, and a minimum Mullen Burst Strength of 175 pounds per square inch
(3) Diameter from 4 inches to 6 inches

F Coir

Provide coir logs meeting the following requirements and characteristics:

(1) Coir fibers placed in coir netting
(2) Service life of at least 5 years
(3) Diameter of at least 8 inches
(4) Dry weight of at least 5 pounds per cubic foot

G Wood Fiber and Blanket

Provide wood fiber log placed on top of a rolled erosion prevention product meeting the following requirements;

(1) Meet requirements of 3897.2B, "Wood Fiber," log
(2) Meet requirements of 3885, "Rolled Erosion Prevention Products," Category 3, minimum blanket roll width of 6 feet
(3) Blanket staple pattern every 1 foot

H Anchoring

Provide wood stakes for A, B, D, and G with the following dimensions; 1 inch by 2 inch and 22 inch to 24 inch long with a pointed end.

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 gallon 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.

Miscellaneous Materials

3902 FORM COATING MATERIAL

3902.1 SCOPE

Provide form coating Material that will prevent bonding between a form, dowel, or other object and concrete.

3902.2 REQUIREMENTS

Provide form coating Material listed on the *Approved/Qualified Products List* and meeting the following requirements:

(1) Made of a chemical release agent that does not contain ordinary lubrication oil, conventional form oil, fuel oil, or kerosene, and has a flash point of at least 149°F when tested in accordance with *ASTM D92, Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester*
(2) Prevents bonding to concrete
(3) Does not penetrate, stain, or leave a residual film on the concrete surface
(4) Does not attract dirt or other deleterious matter

Apply the form coating Material at a rate recommended by the manufacturer to provide a smooth surface free of dusting action caused by reactions of the chemical release agent.

As a substitute for a form coating Material listed on the *Approved/Qualified Products List*, the Contractor may provide epoxy coated dowel bars utilized in dowel bar baskets and dowel bar retrofits (DBR) coated with a factory applied, Department-approved petroleum, paraffin based lubricant with a manufacturer stated use as a bond breaker.

3902.3 SAMPLING AND TESTING — BLANK

3906 WATER FOR CONCRETE AND MORTAR

3906.1 SCOPE

Provide water for use in mixing and curing Portland cement concrete and mortar.

3906.2 REQUIREMENTS

Provide water for mixing concrete meeting *ASTM C1602, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete*, and the following:

(1) Not salty or brackish
(2) Clean
(3) Free of injurious quantities of deleterious substances such as oil, acid, alkali, and organic matter

Provide water for use in curing concrete that does not contain impurities at concentrations that cause discoloration or surface etching.

A Potable Water

For the purpose of the Work specified in section 3906, “Water for Concrete and Mortar,” the Department defines potable water as water suitable for human consumption. The Engineer will allow potable water without testing.

B Non-potable Water

For the purpose of the Work specified in section 3906, “Water for Concrete and Mortar,” the Department defines non-potable water as water not fit for human consumption or contains quantities of

substances that discolor, make it smell, or have an objectionable taste. Non-potable water does not contain water from concrete production operations. The Engineer may conduct testing to determine allowable use of a non-potable Contractor proposed water source.

Provide non-potable water meeting the requirements of *ASTM C1602, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete*, Table 1.

C Clarified Water

For the purpose of the Work specified in section 3906, "Water for Concrete and Mortar," the Department defines clarified water as water from concrete production operations that was processed by filtration or a settling system such as a pond or weir(s) to clarify the water.

Supply clarified water only from sources listed on the *Approved/Qualified Products List*.

Provide clarified water meeting the requirements *ASTM C1602, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete*, Table 1 and Table 2. The density of the combined mixing water must not exceed 1.03.

3906.3 SAMPLING AND TESTING

Provide representative samples of water in clean containers to the Engineer for testing as required by the *Schedule of Materials Control*.

3910 ROCK SALT

3910.1 SCOPE

Provide rock salt for use as a deicer for Road construction and maintenance purposes.

3910.2 REQUIREMENTS

Provide rock salt meeting the following requirements at the time of delivery:

(1) *ASTM D632, Standard Specification for Sodium Chloride*, for Type 1, Grade 1 Material
(2) Free of lumps, aggregations, and foreign matter
(3) With no greater than 1.5 percent moisture content

3910.3 SAMPLING AND TESTING

The Engineer may sample and inspect the rock salt at the supplier's unloading and storage facilities or at the point of delivery.

The Engineer, in conjunction with the Materials Engineer, will perform the following:

(1) Sampling meeting the requirements of *ASTM D632, Standard Specification for Sodium Chloride*, as modified by the *Laboratory Manual*
(2) Moisture testing in accordance with the *Laboratory Manual*
(3) Sieve analysis meeting the requirements of *ASTM C136, Standard Test for Sieve Analysis of Fine and Coarse Aggregates*, for Sieve analysis of fine and coarse Aggregate, as modified by the *Laboratory Manual*
(4) Chemical analysis for determination of sodium chloride content meeting the requirements of the Rapid Test Method for Sodium Chloride by Silver Nitrate Potentiometric Titration or the Reference Method for Chemical Analysis of Sodium Chloride as modified by the *Laboratory Manual*

3911 CALCIUM CHLORIDE

3911.1 SCOPE

Provide liquid and solid calcium chloride for use in dust control, accelerating the hardening of concrete, and other purposes.

3911.2 REQUIREMENTS

Provide liquid or solid calcium meeting the requirements of *AASHTO M 144,* "Standard Specification for Calcium Chloride," for the type and grade required by the Contract. Unless the Contract requires otherwise, provide liquid calcium chloride with at least 38 percentanhydrous CaCl2 by weight. Provide liquid calcium chloride that is clear and free of solid matter.

3911.3 SAMPLING AND TESTING

Provide samples at rates and sizes meeting the requirements of the *Schedule of Materials Control* or as required by the Contract.

Perform sampling in accordance with *ASTM D345, Standard Test Method for Sampling and Testing Calcium Chloride for Roads and Structural Applications*.

The Materials Engineer will perform tests meeting the requirements of *ASTM D345, Standard Test Method for Sampling and Testing Calcium Chloride for Roads and Structural Applications*.

3912 MAGNESIUM CHLORIDE SOLUTION

3912.1 SCOPE

Provide magnesium chloride solution for dust control or other purposes.

3912.2 REQUIREMENTS

Provide magnesium chloride solution meeting the following characteristics and requirements:

(1) Water clear
(2) Free of deleterious substances
(3) Consists primarily of magnesium chloride
(4) Anhydrous magnesium chloride content of at least 28 percent by mass
(5) SO4 sulfate content no greater than 3.5 percent by mass
(6) Alkali chlorides content no greater than 5 percent by mass

3912.3 SAMPLING AND TESTING

A Sampling

Provide samples at rates and sizes meeting the requirements of the *Schedule of Materials Control* or as required by the Contract.

B Testing

The Materials Engineer will perform testing meeting the following requirements:

B.1 Magnesium chloride, MgCl2 .....*Laboratory Manual*

B.2 Sulfate, SO4 .....*Laboratory Manual*

B.3 Alkali chlorides, as NaCl ..... *ASTM E449*

Traffic Management Center

3973 BURIED CABLE SIGNS

3973.1 SCOPE

Provide buried cable signs to mark the route of underground fiber optic cables.

3973.2 REQUIREMENTS

A Buried Cable Sign

Install aluminum signs meeting the following requirements and characteristics:

(1) In accordance with 3352, "Signs," and 2564, "Traffic Signs and Devices"
(2) Meeting the requirements of *Standard Signs and Markings Manual*
(3) 8 inches by 12 inches
(4) Black legend on a non-reflective orange face

Before purchasing the buried cable signs, obtain the Engineer's approval of the sign design.

Install the ground mounted signs to 2.6 pounds per foot galvanized steel fence posts in accordance with 3401, "Flanged Channel Sign Post." If installing the signal mounted signs to the Ramp control signal, use stainless steel bands and fittings.

B Legend and Logo Size

Provide an 8 inch by 12 inch aluminum buried cable sign with black legend silk screened on an orange face meeting the requirements of the *Standard Signs and Markings Manual* and the following:

Table 3973.2-1
Buried Cable Sign Legend

Line Number	Line Text	Character Size and Color, inches	Background Size and Color, inches
1	CAUTION	1.1875, orange	1.5 by 7, black*
2	BURIED	0.9375, black	—
3	FIBER OPTIC	0.9375, black	—
4	CABLE	0.9375, black	—
5	BEFORE DIGGING	0.65625, black	—
6	CALL	0.65625, black	—
7	GOPHER STATE ONE CALL	0.5, black	—
8	811	0.90625, black	—
9	MnDOT LOGO ‖	—	—

* Center the information on the background.
‖ The MnDOT logo is a circle with a diameter of 1.03125 inches and the phrase "MINNESOTA DEPARTMENT OF TRANSPORTATION" in black letters in the margin with an orange background. The left half of the logo inside the margin has an orange silhouette of the left one half of a coniferous tree on a black foreground. The right half of the logo inside the margin has an orange five point star silhouette inside a black foreground.

C Sign Placement

Place the signs no greater than 500 feet apart, and at each change of direction, along the route of direct buried fiber optic cable.

END OF VOLUME 1

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