STANDARD SPECIFICATIONS
FOR
ROAD AND BRIDGE CONSTRUCTION

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MONTANA
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SECTION 101

DEFINITIONS AND TERMS

101.01 GENERAL

The Standard Specifications are written to the Contractor. They define the Contractor's responsibility in meeting each specification. The short sentences, written in the active voice, explain what the Contractor must do. The Specifications outline the expectations of the Department, and explain what the Contractor must provide the Department. Unless otherwise noted, all actions are to be performed by the Contractor. "Will" statements mean the Department is responsible or will perform the action.

The Standard Specifications are written in dual units with English units first, followed by Metric units in parenthesis. The contract will be in one of the two units. All submittals and documentation provided to the Department must be in English or Metric units as shown in the contract.

The active voice writing style is recommended by the Federal Highway Administration Technical Advisory 5080.16. Examples of the writing styles are as follows:

A. Passive Voice: The Contractor shall construct the temporary detour as specified in the contract.

B. Active Voice: Construct the temporary detour as specified in the contract.

The titles and headings of the sections, subsections, and sub-parts are for the convenience of reference and do not necessarily have a bearing on their interpretation.

When a publication is specified, it refers to the most recent date of issue, including interim publications, before the date of bid receipts for the project unless the issue of a specific date or year is specified.

101.02 ACRONYMS AND ABBREVIATIONS

Whenever the following acronyms and terms are used in the contract, the intent and meaning is interpreted as follows:

AAN .....American Association of Nurserymen
AAR .....Association of American Railroads
AASHTO .....American Association of State Highway and Transportation Officials
ACI.....American Concrete Institute
AGC.....Associated General Contractors of America
AISC .....American Institute of Steel Construction, Inc.
AISI.....American Iron and Steel Institute
ANSI .....American National Standards Institute, Inc.
ARA .....American Railway Association
AREA.....American Railway Engineering Association
ARM.....Administrative Rules of Montana
ARTBA.....American Road and Transportation Builders Association
ASC .....Activities Schedule Chart
ASCE.....American Society of Civil Engineers
ASME.....American Society of Mechanical Engineers
ASTM.....American Society for Testing and Materials
ATTSA .....American Traffic Safety Services Association
AWPA .....American Wood Preservers Association
AWS.....American Welding Society
AWWA .....American Water Works Association
BMP .....Best Management Practice

CAS .....Construction Administration Services
CES .....Construction Engineering Services
CFR .....Code of Federal Regulations
CMP.....Corrugated Metal Pipe
CO .....Change Order
COE.....U.S. Army Corps of Engineers
CPM.....Critical Path Method
CRSI .....Concrete Reinforcing Steel Institute
CTEP .....Community Transportation Enhancement Program
CUF .....Commercially Useful Function
CWI.....Certified Welding Inspector
D/A .....Dust to Asphalt ratio
DBE .....Disadvantaged Business Enterprise
DCE .....District Construction Engineer
DEQ.....Montana Department of Environmental Quality
DMS.....District Materials Supervisor
DNRC .....Montana Department of Natural Resources and Conservation
EBS .....Electronic Bid System
EEO .....Equal Employment Opportunity
EPA .....Environmental Protection Agency
ESAL .....Equivalent Single Axle Load
FETS .....Flared End Terminal Section
FHWA.....Federal Highway Administration
FSS.....Federal Specifications and Standards
FWP.....Montana Department of Fish Wildlife and Parks
HDPE.....High Density Polyethylene Pipe
IES.....Illuminating Engineering Society
IMSA.....International Municipal Signal Association
ITE.....Institute of Transportation Engineers
MASH .....Manual for Assessing Safety Hardware
MCA.....Montana Code Annotated
MDT.....Montana Department of Transportation
MPDES.....Montana Pollutant Discharge Elimination System
MSDS .....Material Safety Data Sheet
MT .....Montana Test Method
MUTCD.....Manual on Uniform Traffic Control Devices
NBS .....National Bureau of Standards
NCHRP.....National Cooperative Highway Research Program
NEC .....National Electric Code
NEMA .....National Electrical Manufacturers Association
NOI .....Notice of Intent
NPDES .....National Pollutant Discharge Elimination System
OHV.....Off Highway Vehicles
OSHA .....Occupational Safety and Health Administration
PCC .....Portland Cement Concrete
PCCP.....Portland Cement Concrete Pavement
PCI .....Pre-stress Concrete Institute
PGAB.....Performance Graded Asphalt Binder
PTW.....Presently Traveled Way

PVC .....Polyvinyl Chloride Pipe
QA.....Quality Assurance
Q&A .....Contractor's Question and Answer Forum
QPL.....Qualified Products List
RAP .....Recycled Asphalt Pavement
RCP .....Reinforced Concrete Pipe
ROW or R/W ..Right of Way
SAE.....Society of Automotive Engineers
SHPO.....State Historic Preservation Office
SPA.....Stream Protection Act
SSPC .....Society for Protective Coatings
SWPPP.....Storm Water Pollution Prevention Plan
TESC .....Temporary Erosion and Sediment Control
TMECC .....Test Methods for Evaluating Compost and Composting
TMP .....Traffic Management Plan
TRM.....Turf Reinforcement Mat
UL .....Underwriters Laboratory
USASI .....United States of America Standards Institute
VE.....Value Engineering
VFA.....Voids Filled with Asphalt
VMA.....Voids in Mineral Aggregate
VTM .....Voids in the Total Mix
WASHTO .....Western Association of State Highway Transportation Officials
WAQTC .....Western Alliance for Quality Transportation Construction
WN.....Written Narrative
WWPA .....Western Wood Products Association

The Department uses the following abbreviations in the Schedule of Items for the respective units of measurement:

TABLE 101-1
MEASUREMENT ABBREVIATIONS

English		Metric		English		Metric	
Length				**Area**			
inch	in.	millimeter	mm	square inch	in^2	square millimeter	mm^2
foot	ft.			square foot	ft^2		
yard	yd.	meter	m	square yard	yd^2	square meter	m^2
mile	mi.	kilometer	km	acre	acre	hectare	ha
course mile	CR. mi.	course kilometer	CR km	square mile	mi^2	square kilometer	km^2
Volume				**Weight**			
cubic inch	in^3	cubic millimeter	mm^3	ounce	oz.	gram	g
cubic foot	ft^3			pound	lb.	kilogram	kg
cubic yard	yd^3	cubic meter	m^3	ton	t.	metric tonne	MT
Liquid Measure				**Temperature**			
ounce	fl. oz.	milliliter	ml	degree Fahrenheit	°F	degree Celsius	°C
gallon	gal.	liter	L				
Speed				**Pressure**			
miles per hour	mph	kilometers per hour	kph	pounds per square inch	psi	kilopascals	kPa

101.03 DEFINITIONS

ACTUAL COST

The cost incurred by the Contractor in the performance of work. Actual cost includes labor, material, actual ownership cost of equipment determined from the owner's records, or invoiced rental rates, and administrative overhead.

ADDENDUM OR AMENDMENT

Contract revisions developed after advertisement and before opening proposals.

ADDITIONAL WORK

Additional work is an increase in the quantity of a contract item.

ADMINISTRATOR

The District Administrator, or the authorized representative, is responsible for the administrative oversight of the project.

ADVERTISEMENT

The public announcement inviting proposals for the advertised work.

AWARD

The acceptance of a proposal by the Commission.

AQUATIC RESOURCES

Aquatic resources may include, but are not limited to, wetlands, springs, streams (perennial, ephemeral, and intermittent drainages), rivers, lakes, ponds, reservoirs, agricultural irrigation systems and associated riparian areas.

BASE

One or more layers of specified material placed on the subgrade to support the surface course.

BIDDER

Any individual or entity submitting a proposal for advertised work.

BID DOCUMENTATION

Any writings, working papers, computer printouts, computer generated and/or computer stored information, electronically stored information, charts, schedules of any kind (e.g. CPM, bar chart, etc.), and any data compilations, computerized or not, used by the bidder to determine the bid submitted for a contract. Bid documents includes, but is not limited to, the following:

- Bidder equipment internal rates for ownership;
- Bidder overhead rates;
- Labor rates;
- Cost coding;
- Equipment and manpower loading of activities;
- Efficiency or productivity factors;
- Scheduling calculations;
- Review or analysis of the site of work;
- Analysis of how the work should be performed
- Arithmetic extension;
- Worksheets used to prepare the bid (identifying by name and edition any software programs used to prepare them); and
- All quotations to the extent that these items were used in formulating and preparing the amount of the bid.

Bid Documents also includes identification of all manuals used by the bidder in preparing the bid for this contract, referenced by title, author, edition, date, and page or section number. The term does not include bid documents provided by the owner (e.g. plans, specifications, etc.) for use by the bidder in preparation of the bid proposal. Convert electronic information into paper copies for submittal purposes.

BRIDGE

A structure, including supports, erected over a depression or an obstruction, such as water, a highway, or a railway, and having a track or passageway for carrying traffic or other moving loads and a length measured along the center of roadway exceeding 20 feet (6.1 m) between under-copings of abutments or extreme ends of openings for multiple boxes.

The bridge length is the overall length measured along the line of survey stationing between backs of abutment backwalls or between ends of the bridge floor, but never less than the total clear opening of the structure.

The bridge roadway width is the clear width measured at right angles to the longitudinal centerline of the bridge between the bottom of curbs or guard timbers or, in the case of multiple heights of curb between the bottoms of the lower risers.

BUSINESS DAY

All days are considered business days except Saturdays, Sundays and holidays.

CALENDAR DAY

Every day shown on the calendar, beginning and ending at midnight.

CHANGE ORDER

A written order issued to the Contractor covering changes to the original contract, and establishing the agreed-upon basis of payment and time adjustments for the work affected by the changes.

CHIEF ENGINEER

The Highways Engineering Division Administrator is designated “Chief Engineer” for the Department who establishes engineering policy, resolves technical issues and resolves Contractor disputes.

CLAIMS REVIEW BOARD

The Board consists of the Chief Engineer, the Preconstruction Engineer and the Chief Counsel, with the CES Engineer as Secretary to the Board. The FHWA Field Operations Engineer and Construction Engineer are non-voting members.

COMMISSION

As provided by Section 2-15-2502 MCA, (as amended), the Transportation Commission is a quasi-judicial board assigned to the Department of Transportation for administrative support only.

COMPLETION DATE

The fixed calendar date that all work on the project is to be complete.

CONFORMITY

Is compliance with:

A. Reasonable and customary manufacturing and construction tolerances where working tolerances are not specified; or

B. The specified working tolerances.

CONTRACT

The written agreement between the Commission and the Contractor detailing the obligations of the parties for the performance of the prescribed work.

The contract includes the proposal; contract form; contract bond; specifications; general and detail plans; Detailed Drawings; Notice to Proceed; Materials Manual; and all change orders, extra work orders, including authorized contract time extensions, that are required to complete the project.

CONTRACT BOND

The approved security on the Department’s form, executed by the Contractor and its surety or sureties, guaranteeing the complete execution of the contract and all supplemental agreements thereto and payment of all legal debts pertaining to the construction of the project.

CONTRACT ITEM (PAY ITEM)

A specific unit of work for which a price is provided in the contract.

CONTRACT TIME

The number of working days, calendar days, or the fixed completion date allowed for completing the contract, including authorized time extensions.

CONTRACTOR OR PRIME CONTRACTOR

The individual or legal entity contracting with the Commission to perform the prescribed work. When used in the specifications, Prime Contractor has the same meaning as Contractor.

CULVERT

Any structure not classified as a bridge that provides an opening under the roadway.

DELAY

Any event, action, force, or factors that causes the contract work to extend beyond the specified contract time.

A. Compensable Delay. An excusable delay for which the Contractor may be entitled to additional compensation.

B. Excusable (Non-compensable) Delay. A delay to the contract or milestone/phase completion date that was beyond the Contractor's control and for which a contract or milestone time extension may be granted.

C. Non-excusable Delay. A reasonably foreseeable delay to the contract completion date within the Contractor's control. No monetary compensation or time extension will be granted.

DEPARTMENT OF TRANSPORTATION

The State of Montana, Department of Transportation, acting through the Director and the Commission when the State is the awarding authority. Where Department is used alone, it means the Montana Department of Transportation. The Department's mailing address is: Montana Department of Transportation, 2701 Prospect Avenue, P.O. Box 201001, Helena, MT 59620-1001.

DETAILED DRAWINGS

An edition of special drawings, including necessary detailed instructions that pertain to certain items of work contained in Department projects.

DIFFERING SITE CONDITIONS

Subsurface or latent physical conditions at the site that:

A. Differ materially from those indicated in the contract; or

B. Differ materially from conditions normally encountered or, those conditions generally recognized as inherent in the nature of the work required in the contract; or

C. Unknown physical site conditions of an unusual nature. This does not refer to non-physical conditions (e.g. working relationships, etc.)

DIRECTOR

The chief administrative officer of the Department, as established by law and the Director's authorized agents.

ENGINEER

The highest ranking professional engineer in the district office, usually the administrator, DCE, or their authorized representative, responsible for engineering and administrative supervision of the project.

EQUIPMENT

All machinery, tools, apparatus, and supplies necessary for the upkeep, maintenance, construction, and completion of the project.

EQUITABLE ADJUSTMENT

An adjustment in the contract price or time.

EXTRA WORK

Work added to the original contract required for the completion of the contract.

EXTRA WORK ORDER

A written agreement amending the contract that identifies work to be paid for at agreed prices or by force account under Subsection 109.04.

FORCE ACCOUNT WORK

A basis of payment to perform extra work when procedures of negotiation are unsuccessful. Force account work will be paid for under Subsection 109.04.2.

HOLIDAYS

Legal holidays are defined in the State of Montana laws (Section 1-1-216 MCA). All holidays are defined as No Work Days, unless approved by the Engineer.

INSPECTOR

The Engineer or Project Manager's authorized representative assigned to make inspections of work and materials furnished.

INVITATION FOR BIDS

The advertisement for proposals for work or materials on which bids are requested. The advertisement goes out to interested parties to allow potential bidders an opportunity to examine the site, material sources, etc. It will indicate the estimated quantities and location of the work to be done or character and quantity of the material to be furnished and the time and place of the opening of proposals.

JOINT VENTURE

An agreement between two or more persons or entities to be jointly and severally responsible for the performance of a contract.

LABORATORY

The Department testing laboratory or other testing laboratory designated by the Engineer.

MAJOR ITEM

Individual bid items having an original contract value equal to or exceeding 5% of the total original contract amount.

MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD)

The FHWA *Manual on Uniform Traffic Control Devices* its current edition and its revisions. It includes the basic principles for the design and use of traffic control devices, but recognizes that engineering judgment is essential to the proper use of traffic control devices. The manual may be supplemented by Standard or Supplemental Specifications, Special Provisions, and by project circumstances when approved by the Engineer (See MUTCD, Section 2A.03 Standardization of Application).

MATERIALS

Substances specified for use in the construction of the project. Furnish new materials unless otherwise specified or approved.

MEDIAN

The portion of a divided highway separating the traveled ways for traffic in opposite directions. Separation may be by open ground, raised median, or paint not including centerline stripping.

NO WORK DAYS

No work days are holidays, Sundays, or during the winter shutdown. Work on holidays or Sundays must be approved by the Engineer. Travelway maintenance, stormwater BMP maintenance, and providing protection for the public are exempt and this work may be accomplished on no work days without assessment of contract time. Do not work after 12:00 noon on Friday, or on Saturday and Sunday prior to Memorial Day (last Monday in May) and Labor Day (first Monday in September). Do not work after 12:00 noon on Friday, or on Saturday or Sunday prior to Independence Day (July 4th) when July 4th is on a Saturday, Sunday, or Monday.

NOTICE TO PROCEED

Written notice to the Contractor to proceed with the contract work including the starting date of contract time.

OFF-HIGHWAY VEHICLE

A vehicle that exceeds legal weight limits, or cannot be legally registered or licensed to operate on public roadways.

PAVEMENT STRUCTURE

The combination of base course and surface course placed on a subgrade to support and distribute the traffic load to the roadbed.

PLANS

The approved contract drawings showing the location, type, dimensions, and details of the work required under the contract.

PROFILE GRADE

The trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.

PROJECT

The specific section of the highway or location on which construction is to be performed under the contract.

PROJECT MANAGER

The Project Manager is the authorized representative of the Engineer. The Project Manager is responsible for direct oversight and documentation of the project. The Project Manager is the Contractor's first contact for all project related issues unless another person or agency is specifically stated in the contract.

PROJECT RECORDS

All correspondence, reports, proposals, minutes, articles, logs, calendars, diaries, computations, tabulations, computer printouts, bills, statements, invoices, vouchers, bills of lading, schedules, purchase orders, contracts, agreements, accounts, checks, tape recordings, photostats, video recordings, photographs, sketches, drawings, charts, graphs, transcripts, and other similar objects, any of which pertains to a project or project costs, of a Contractor and its subcontractors.

PROPOSAL

A written offer by a bidder, on Department furnished forms, to complete the project at the quoted prices within the specified contract time. Also called "Bid Proposal."

PROPOSAL FORM

The approved form on which bids must be prepared and submitted.

PROPOSAL GUARANTY

The security furnished with a proposal to guarantee that the bidder enters into the contract if its proposal is accepted.

QUALITY ASSURANCE

A. **Acceptance Plan.** A statistically based procedure for evaluating acceptance test results.
B. **Lot.** A discrete quantity of material evaluated for acceptance.
C. **Price Reduction.** A pre-established decrease in payment to the Contractor for a contract bid item in which the quality and workmanship, determined by statistical means is at the lower limit of the acceptance range.
D. **Quality Assurance.** A statistical based process to determine the acceptability of a given product. Also known as “lot by lot” or “lot” basis or system.
E. **Quality Incentive Allowance.** A pre-established increase in payment to the Contractor for a contract bid item in which a superior level of quality and workmanship, determined statistically, was performed.
F. **Random Sampling.** A selection procedure in which all potential samples have an equal chance of being selected for testing.

QUALITY CONTROL

A. **Quality Control.** Operational techniques and activities used to control the quality of a product or service in order to satisfy given requirements.
B. **Quality Control Plan.** A Contractor prepared plan describing the type and frequency of Contractor inspection, sampling, and testing necessary to measure and control the various properties governed by the contract specifications.

RENTAL RATES

Hourly rates approved by the Department for furnishing and operating various types of construction equipment.

RESOURCES

The labor, equipment, and material necessary to perform work on a contract bid item or other contract work element.

RESPONSIVE BID

A bid that meets all requirements of the Proposal and Instructions to Bidders.

RESPONSIBLE BIDDER

A bidder that the Department determines has the skill, ability, and integrity to perform the project. The Department’s standards of responsibility are in Section 18.3.201, ARM.

RIGHT-OF-WAY

Land, property, or interest, acquired for or devoted to a highway.

ROAD, HIGHWAY OR STREET

A public way for vehicular travel, including the entire area within the right-of-way.

ROADBED

The graded portion of a highway within the top and side slopes prepared as a foundation for the pavement structure and shoulders.

ROADSIDE

The areas between the outside edges of the shoulders and the right-of-way boundaries and other areas within the right of way not intended for motorized travel.

ROADSIDE DEVELOPMENT

Those items necessary for:

A. The preservation of landscape materials and features;

B. The rehabilitation and protection against erosion of areas disturbed by construction through seeding, sodding, mulching, composting, and the placing of other ground covers; and suitable plantings; and

C. Other improvements that increase the effectiveness and enhance the appearance of the highway.

Unless specified different in the contract, the following are the roadside areas:

A. **Area 1.** Areas with slopes of 3:1 and flatter.

B. **Area 2.** Areas with slopes steeper than 3:1.

C. **Area 3.** A 15.0-foot (4.5 m) wide strip adjacent and parallel to the finished pavement, along both roadsides.

ROADWAY

The portion of a highway within the limits of construction.

SHOULDER

The portion of the roadway adjacent to the traveled way for accommodation stopped vehicles for emergency use and for lateral support of base and surface courses.

SIDEWALK

That portion of the right of way constructed for pedestrian use.

SPECIAL PROVISIONS

Modifications to the Standard and Supplemental Specifications applicable to an individual project.

SPECIFICATIONS

The compilation of provisions in this book, the Supplemental Specifications, and Special Provisions for the performance of the project.

STATE

The State of Montana acting through its authorized representative.

STRUCTURES

Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, endwalls, buildings, sewers, service pipes, underdrains, foundation drains, and other features that may be encountered in the work.

SUBCONTRACTOR

An individual or legal entity, to which a Contractor subcontracts, assigns or otherwise disposes of any part of the work. This includes subcontractors at any contract tier, such as sub-subcontractors, etc.

SUBGRADE

The top surface of a roadbed upon which the pavement structure, shoulders, and curbs are constructed.

SUBSTRUCTURE

All of the structure below the bearings of simple and continuous spans, skewbacks of arches, and tops of footings of rigid frames, together with the backwalls, wingwalls, and wing protection railings.

SUPERINTENDENT

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

SUPERSTRUCTURE

The entire structure except the substructure as defined in this section.

SUPPLEMENTAL SPECIFICATIONS

Approved additions and revisions to the standard specifications.

SURETY

The legal entity or individual, other than the Contractor, executing a bond furnished by the Contractor (see Section 28-11-401 MCA).

SURFACE COURSE

One or more layers of a pavement structure designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion, and the disintegrating effects of climate. The top layer is sometimes called the "wearing course."

TITLES (OR HEADINGS)

The titles or headings of the divisions, sections, and subsections are for convenience of reference and do not have any bearing on their interpretation.

TOPSOIL

Topsoil under Section 203 is soil that supports normal plant growth.

Topsoil under Section 610 is soil that supports normal plant growth and meets Subsection 713.05 requirements.

TRAVELED WAY OR PRESENT TRAVELED WAY

The existing paved or graveled roadway section in use including the shoulders and auxiliary lanes. Also referred to as the PTW.

UNBALANCED BID

A. **Materially Unbalanced.** A bid that generates a reasonable doubt that award to the bidder submitting a mathematically unbalanced bid results in the lowest ultimate cost to the Department.
B. **Mathematically Unbalanced.** A bid containing lump sum or unit bid items that do not reflect reasonable actual costs plus a reasonable proportionate share of the bidder's anticipated profit, overhead costs, and other indirect costs.

UNUSUALLY SEVERE WEATHER

Unusually severe weather is weather that is more severe than the adverse weather anticipated for the season or location involved.

WINTER SHUTDOWN

All calendar days from November 16th through April 15th, inclusive.

WORK

The furnishing of all resources necessary to complete the project.

WORKING DAY

All days are considered working days except Saturdays, no work days, and days on which the Contractor is specifically required by the contract to suspend construction operations. Working days will be charged during no work days for each day construction activities occur that have any impact on the traveling public, exclusive of traffic flowing unimpeded on approved detours or emergency and maintenance repairs to the project, when the time requirements under Subsection 104.05.2 are met.

WORKING DRAWINGS

Stress sheets, shop drawings, erection plans, falsework plans, framework plans, cofferdam plans, bending diagrams for reinforcing steel, or other supplementary plans or similar data that the Contractor is required to submit to the Project Manager.

SECTION 102

BIDDING REQUIREMENTS AND CONDITIONS

102.01 JOINT-VENTURE BIDS

Execute a “Declaration of Joint Venture and Power of Attorney” form, available from the Department’s Contract Plans Bureau, to submit bid packages for highway construction as a joint venture. Designate the joint venture business name and specifically authorize a person to execute all bid packages and contracts with the Transportation Commission on behalf of all individuals and legal entities of the joint venture. Authorize this person to receive all monies due under the contract and issue binding receipts and releases with the Department. Include joint-venture affidavits in the proposal.

Joint venture firms do not need to separately incorporate.

102.02 CONTENTS OF BID PACKAGE

The bid package ordinarily includes the following:

1. Proposal;
2. DBE Requirements;
3. Schedule of Items;
4. Special Provisions;
5. Current Supplemental Provisions;
6. Wage rate schedules;
7. Other documents included by reference but not attached;
8. FHWA Form 1273 (Required Contract Provisions for Federal-aid Construction Contracts), when applicable;
9. EEO Affirmative Action Requirements on Federal and Federal-aid Construction Contracts; and
10. Contract Plans.

102.03 CONTRACTOR REGISTRATION

Montana law requires all contractors to register with the Montana Department of Labor & Industry.

Register before executing a contract on federal-aid projects.

Register before submitting a bid on state-funded projects.

Contact the Department of Labor & Industry at (406) 444-7734 for more information.

102.04 ISSUANCE OF PROPOSALS

The Department reserves the right to refuse to issue a bid package to a bidder for any of the following reasons:

A. Uncompleted work that the Department determines might hinder or prevent the prompt completion of additional work;
B. Default under previous contracts;
C. Failure to reimburse the Department for an overpayment made on any contract or contracts after written notification of the overpayment that is due;
D. Failure to pay, or satisfactorily settle, all bills due for labor and material on any contract in force at the time of issuance of proposals;
E. Unsatisfactory performance on a previous or current contract; or
F. Misconduct that is of such a serious nature as to adversely affect the Contractor’s ability to perform future work.

Request bid packages from the Department.

Pay the Department the sum stated in the Invitation for Bids for each copy of the bid package.

102.05 QUANTITIES OF WORK IN THE PROPOSAL

Submit unit bid prices for the estimated quantities.

Estimated quantities may be increased or decreased under the contract.

Payment is made for the actual quantities of work performed and accepted or materials furnished and accepted under the contract.

102.06 EXAMINATION OF DOCUMENTS AND SITE OF WORK

Examine the proposed work site including the existing field staking and documents before submitting a proposal. Submitting a proposal is an affirmative statement by the bidder that the bidder has examined the site and is satisfied with the conditions to be encountered in performing the work and the bid package requirements.

The Department is not bound by any statement or representation concerning conditions or description of the work unless included in the bid package. Do not rely on oral explanations or instructions given by Department employees or agents before award of the contract. Accept these as non-binding oral explanations or instructions and relying on them is solely at the Bidder's risk.

Mass diagrams and dirt runs are for informational purposes only and are not part of the contract. The Department does not guarantee the accuracy of these documents. The information contained in the mass diagrams and dirt runs are only one example of how the project can be built.

The Contractor is responsible for using its own means and methods for determining how the job is to be built. The Contractor's reliance on these documents is at their own risk.

Immediately submit any request for an explanation of the meaning or interpretation of the bid package to the Department's Q & A Forum found at http://www.mdt.mt.gov.

The records of any subsurface investigation conducted by the Department are available for inspection as a public document. When not included in the bid package, inspect available records at the Materials Bureau, Bridge Bureau in Helena, or the District where the project is located.

The records of subsurface investigations are not a part of the bid package or contract, but are available to all bidders for informational purposes only. There is no warranty or guaranty, either expressed or implied, that the subsurface investigation records disclose the actual conditions that will be encountered during the performance of the work. Department subsurface investigation results may differ from a bidder's independent subsurface evaluation due to different sampling techniques, the date of the investigation, etc. Using or relying on Department subsurface investigations is at the bidder's risk. The bidder must perform and rely on its independent subsurface evaluation made before submitting a bid proposal. Submittal of a bid is an affirmative statement that an independent subsurface evaluation was made and Department subsurface investigations were not relied on. Individual test boring log data included in the Department's subsurface investigation records apply only to that particular boring taken on the date indicated. The character of any material or conditions between or around test borings on the date of the site examination is not conclusive.

Submission of a bid waives any potential claim of the above, including a claim of justifiable reliance on such information or materials.

Do not take advantage of an apparent error, omission or ambiguity in the bid package. Upon discovery, immediately submit the discovery to the Department's Q & A Forum found at http://www.mdt.mt.gov if an error, omission, or ambiguity exists and why it appears erroneous, omitted, or ambiguous. Advise bidders submitting a subcontract quotation of this obligation and

clarify their responsibility to include this information with their subcontract quotation. The Department will clarify the error, omission, or ambiguity and, if necessary and possible, issue an addendum to all prospective bidders before opening bid packages.

Do not submit a bid proposal or a subcontract quote without receiving clarification. Failure to provide written notification is a waiver of the error, omission or ambiguity, and additional compensation or contract time will not be allowed.

The Department, for most projects, prepares preliminary bid packages (plans and special provisions) to provide advance notice to prospective bidders of the general requirements for those projects. Preliminary packages are not in final form, and there may be substantial changes between the preliminary and final bid package released for bid letting. Use the preliminary packages only for general familiarization with the project. Request final bid packages for use in bidding. Do not base any bid on a preliminary package.

102.07 BIDDING REQUIREMENTS

Submit bids only using the Electronic Bid System (EBS) that generates the required Proposal, Schedule of Items, DBE requirements, and indicates acknowledgement of addenda if applicable.

A. Distribution Procedures. The Department will make electronic bid files and addendum files available to prospective bidders. Bidders may obtain EBS packages free of charge from the Department's Contractor's System Internet Site, http://www.mdt.mt.gov. Hardcopy bid packages are available for a fee from the Contract Plans Bureau.

B. Bidding Requirements. Ensure bids submitted using the EBS format contain a Proposal guarantee, an EBS generated Proposal, Schedule of Items, and DBE requirements when applicable.

Ensure the EBS Schedule of Items is a single continuous printout for each individual bid, evidenced by all Schedule of Items sheets having the same check number. Written changes to the Schedule of Items, or a bidder's non-submission of every page from the Expedite Bid EBS file, (including all Schedule of Items pages and all DBE pages), automatically renders the bid non-responsive, and the bid will not be read or considered.

Acknowledge addenda using the amended EBS project file to generate the Proposal, Schedule of Items and DBE requirements. The printout indicates acknowledgment of receipt of addenda when the correct project file is used. Return a computer disk containing the complete project files for all projects bid with the bid package. It is the bidder's responsibility to ensure that they acquire and apply addenda files when applicable.

C. Determination of Bid Responsiveness. Bids are opened at the designated time and inspected to determine if the following requirements are met:

1. **Schedule of Items.** Unit Prices are provided for all required bid items. A complete and verifiable Schedule of Items is provided. Each sheet of the Schedule of Items must contain the same check number, to ensure that the unit bid prices correspond with the total. There are no written changes to the Schedule of Items.
2. **Proposal Guarantee.** The bid bond is on the most current version of the Department-furnished form; is signed and sealed in the proper places; a copy of the agent's Power of Attorney for the insurance company is attached; and contains the correct and complete project number; all signatures are original (stamped signatures are unacceptable). If using Bid Submission via Internet and Bid Express™, a qualified Surety Company must verify the Contractor bond.

An electronic bid bond may be filed in lieu of completing the paper Bid Bond area of the Proposal Bid form. Submit on the most current Department-provided hard copy Electronic Bid Bond Form CPB_102_07.

3. **Addenda.** All addenda are acknowledged by using the correct electronic file.
4. **Proposal.** The proposal is signed and notarized in the designated places or in acceptable digital format; and all signatures are original (stamped signatures are unacceptable).

A bid is non-responsive if any of the above requirements is not met.

For non-responsive bids, only the Contractor's name, and the reason for the non-responsiveness determination, will be announced at the letting. The Department retains non-responsive bids.

Submission of a bid is a statement by the bidder that sufficient time was available to adequately prepare a Proposal and conduct a complete investigation of the work site and all contract documents.

102.08 REJECTION OF BID PROPOSALS

The Commission reserves the right to reject bid Proposals, waive technicalities, or advertise for new Proposals.

A Proposal is irregular and will be rejected as non-responsive for any of the following:

A. Failure to complete the bid bond form, or Proposal, provided by the Department, by all specified persons, including notaries, in the correct blocks.

B. There are unauthorized additions, conditional or alternate bids, or irregularities that make the bid package incomplete, indefinite, or ambiguous.

C. The Proposals for two or more projects advertised separately are connected or made contingent one upon the other so that the Proposal for one project carries a provisional deduction in the bid price on one or more of the other projects.

D. Any unauthorized provisions are added reserving the right to accept or reject an award or to enter into a contract pursuant to an award.

E. More than one Proposal for the same work from an individual, firm, corporation, partnership, or joint venture under the same or different name is submitted using the same format.

F. Evidence of collusion among bidders exists. Participants in collusion will not receive recognition as bidders, either singly or as a joint venture, for future Department work until reinstated as qualified bidders.

G. Bidder fails to properly complete and sign, by original signatures, on the most current Department-furnished Proposal and appropriate bid bond forms. Stamped signatures are not authorized.

H. Failure to acknowledge receipt of electronic addenda by using the correct electronic files.

I. Failure to provide a complete Schedule of Items, or an unverifiable Schedule of Items. Each sheet of the Schedule of Items must contain the same check number, to ensure that the unit bid prices correspond with the total.

J. The bidder does not submit all pages from the Expedite Bid EBS file.

A bid Proposal is considered irregular and may be rejected as non-responsive for any of the following:

A. The Department-furnished Proposal is altered.

B. Bidder fails to include a name and mailing address.

C. The unit prices contained in the Proposal are mathematically and/or materially unbalanced.

D. Information entered in the Proposal by the bidder is not legible.

E. There are changes in the Proposal such as erasures, strikeouts, and whiteouts that are not initialed in ink.

F. Non-compliance with the DBE requirements.
If Bid Express™ Software indicates an error, the Department will determine if the Proposal is non-responsive.

102.09 PROPOSAL GUARANTY

Make the Proposal guaranty unconditionally payable to the Department for no less than 10% of the Proposal. Provide the guaranty by bid bond with the Proposal. The guaranty must be a bid bond executed by a surety corporation authorized to do business in the State of Montana.

102.10 DELIVERY AND PUBLIC OPENING OF PROPOSALS

Bid Proposals are opened and read publicly at the place, time, and date specified in the "Invitation for Bids."

Deliver by the date and hour set for the opening of bid Proposals to the Department officials conducting the bid opening. Bid Proposals received after the specified time are returned to the bidder unopened.

The clock designated by the Department bid opening officials determines the bid opening time.

Do not submit bid Proposals by facsimile machines.

A Proposal not properly addressed and identified is returned to the bidder after it is opened.

A. Bid Submission by Sealed Envelope. Place the bid Proposal in a sealed envelope plainly marked to indicate the contents. Proposals must be received by the Department's official conducting the bid opening before the bid opening time. Bids may be delivered to: Montana Department of Transportation, Contract Plans Bureau, 2701 Prospect Avenue, Helena, Montana.

If mailed, the Department's mailing address is: Montana Department of Transportation, Contract Plans Bureau, P.O. Box 201001, Helena, Montana 59620-1001.

The Contractor is solely responsible for the Proposal's delivery to the Department's official conducting the bid, prior to bid opening.

B. Internet Bid Submission Via the Internet and Bid Express™. (Optional Bid Submission Procedure)

1. Access to the electronic bidding information is available on Bid Express™ at www.bidx.com and the MDT Contractors System Internet Site at http://www.mdt.mt.gov.
2. When installing the Bid program, enter the vendor code that was issued by the Department. Before running the electronic bidding programs, read the on-line help documentation for the Expedite software.
3. Acknowledge all addenda in the electronic bid submitted.
4. Select tools and then check bid from the Windows Expedite menu to check the bid and ensure there are no errors prior to submitting the electronic bid. The electronic bid may be changed and resubmitted electronically to Bid Express ™ as many times as desired before the advertised cutoff time. The last bid submitted for a given Bid opening as of the cutoff time will be the only bid considered. If a bidder chooses to submit Proposal using Bid Express™ and also submits a hard copy bid, the electronic copy of the bid controls.
5. Make no claim against the Department in the event it is unable to submit its bid to Bid Express™ and/or Bid Express™ is unable to submit the bid(s) to the Department. The Department reserves the right to postpone or cancel the public opening and reading of bids in the event of internet, Bid Express™ or Department technical difficulties.

102.11 WITHDRAWAL OF PROPOSALS

Submit withdrawal requests to the Department in writing before the time set for opening bid proposals. A bidder may withdraw any Proposal in person or through an authorized agent before any bid Proposal on that project is read.

If a bidder discovers a material (factual, not judgmental) mistake in its bid after the bids have been opened, the bidder understands and agrees that it may either perform the contract as originally bid or request permission from the Transportation Commission to withdraw its bid.

The request must be received by the Contract Plans Bureau no later than 4:30 p.m. 2 business days after the day of the bid opening (not counting the day of the opening). The notice must be by a notarized affidavit, under penalty of false swearing, signed by the bidder and accompanied by all worksheets used in the preparation of the bid, requesting relief from forfeiture of the bid bond and the responsibilities of award. The affidavit must describe the specific error(s), how they were made and who made them, and must certify that the worksheets provided are those that were used in preparing the erroneous bid.

The Department will make its recommendation to the Commission, who will review the request to determine if a mistake occurred, was material and factual, and whether the bid should be allowed to be withdrawn. If the Commission does not concur in the error or determines that the error has not been sufficiently proven, it may award the contract. If the bidder refuses to execute the contract as it was bid, the bid bond will be forfeited as stated under Section 18-1-204 MCA.

102.12 DEBARMENT

Federal statutes and regulations adopted pursuant to federal statutes, require that any firm or individual submitting a bid on a federal-aid project certify compliance with Part XI of FHWA Form 1273 (Required Contract Provisions - Federal-aid Construction Contracts) and that firm or individual must obtain and furnish the Department certification that all subcontractors, material suppliers, vendors, and other lower tier participants used are in compliance with Part XI of FHWA Form 1273.

Make certification part of each subcontract, material supply agreement, purchase order, and other covered lower tier transaction. Covered lower tier transactions include primary material purchases for contract items incorporated into the work.

The Department's debarment policies and procedures begin at Section 18.3.101 ARM.

102.13 MATERIALS GUARANTY

The successful bidder may be required to furnish a complete statement of the origin, composition, and manufacture of materials to be used in the construction of the work, together with samples to be tested for conformance with the contract requirements. Include the costs of furnishing the statements and samples in the bid.

102.14 RESERVED

102.15 VENUE

In the event of any dispute concerning a project, whether over its advertisement, bidding, award, execution, or claim, any litigation filed by or against the Department has venue only in Lewis and Clark County.

102.16 CONSENT TO CONTRACT PROVISIONS

The submission of a bid is an affirmative statement that the bidder and its proposed Subcontractor(s) consent to the entire bid package provisions upon which the bidder has submitted its bid. That consent extends to all portions of the bid package and applies to all the bidder's subcontractors. Do not submit a bid proposal unless consent to all the bid package provisions is given.

102.17 PUBLIC WORKS CONTRACT

Department projects under these specifications are public works contracts. Projects under these specifications require Contractors to provide all resources necessary to complete the project, fully complying with its plans and specifications. They are not “sales”, nor are they sales of “goods”, as those terms are used in Montana’s Uniform Commercial Code (UCC). The UCC, particularly its Chapter 2, does not apply to these projects, and the contractor concurs with that by submitting its bid.

SECTION 103

AWARD AND EXECUTION OF CONTRACT

103.01 CONSIDERATION OF PROPOSALS

Bid proposals will be compared on the basis of the summation of the item total prices shown in the bid schedule.

103.02 AWARD OF CONTRACT

The contract will be awarded within 45 calendar days after the bid opening to the lowest responsive, responsible, and qualified bidder whose bid proposal complies with all the requirements. The successful bidder will be notified in writing of the acceptance of the proposal and the award of the contract.

If the contract is not awarded within 45 calendar days, all bid proposals are void. The Commission can extend the 45-day time period.

In the event two or more qualified bids are exactly equal for the lowest bid, the successful bidder will then be determined by totaling the major bid items listed on their schedule of items. The contract will be awarded to the bidder having the lowest total of major bid items. A major bid item is defined in Subsection 101.03.

103.03 ASSIGNMENT OF CLAIMS

In consideration of being awarded the contract, the Contractor, on its own behalf and on behalf of its subcontractors, assigns to the Department all claims or causes of action for any antitrust law violations, or damages arising there from, as to goods, materials, and services purchased under the terms of the contract or any change order that may result from the contract.

103.04 CANCELLATION OF AWARD

The award of the contract may be canceled at any time before the execution of the contract by all parties without liability against the Department.

103.05 RELEASE OF PROPOSAL GUARANTY

All proposal guaranties will be void immediately following opening and checking of the proposals. The successful bidder's proposal guaranty will be void after a satisfactory contract bond has been furnished and the contract has been executed.

103.06 CONTRACT BOND

Furnish an executed contract bond or bonds in a sum equal to the contract amount under Subsection 103.07. Use a form provided by the Department and executed by a surety company authorized by law to transact business in the State.

The contract bond will remain in effect until the certificate of completion is executed and the contract is accepted by the Commission, plus any time period specified by Montana law.

The statutory time for filing claims against the contract bond is 90 calendar days from the date of the Commission acceptance of the project. See Sections 18-2-201 to 18-2-208 MCA.

103.07 EXECUTION AND APPROVAL OF CONTRACT

Return to the Contract Plans Bureau in Helena no later than 5:00 p.m. on the 20th calendar day after receipt, not counting the date of receipt of the contract documents:

1. The signed contract; and

2. The contract bond.

A proposal is not binding unless all the above requirements have been satisfied.

Do not begin work before:

- **a.** The contract is executed;
- **b.** Contract bond is completed; and

c. Evidence of the required insurance is provided.

The contract, bond, and insurance are subject to legal approval after execution by the Contractor and Surety.

103.08 FAILURE TO EXECUTE CONTRACT

Upon failure to execute the contract and file acceptable bonds within 20 calendar days after receipt of the contract, under Section 18-1-204 MCA, the award will be canceled and the proposal guaranty forfeited. Award may then be made to the next lowest responsive, responsible and qualified bidder, or the work may be re-advertised. If, due to circumstances entirely beyond the control of the bidder, the bidder is unable to file acceptable bonds and insurance policies within the time specified above, the commission at its sole discretion may waive cancellation of the award and forfeiture of the proposal guaranty.

103.09 BID DOCUMENTS

103.09.1 General

The following requirements apply when submission of bid documents is required by the contract. The Department agrees to safeguard the bid documents, and all information contained therein, against disclosure to the fullest extent permitted by law.

103.09.2 Bid Documentation Inventory Affidavit and Escrow Agreement

Use the most current Department Form CSB103_09A “Bid Documentation Inventory Affidavit” with the bid documentation. Follow all directions for the bid documentation listed on Form CSB103_09A.

Use the most current Department Form CSB103_09B “Escrow Agreement” when completing the bid documents escrow procedure. Follow all directions for the escrow procedure listed on Form CSB103_09B. Modified versions of the “Escrow Agreement” provided by the escrow agent may be used with written approval by the CES Engineer.

The forms must be signed by an authorized agent for the bidder. These forms are available at the following web page: http://www.mdt.mt.gov/publications/forms.shtml#contract.

103.09.3 Escrow of Bid Documents

Once identified as the apparent low bidder on a contract requiring submission of bid documents, submit all bid documents to an approved escrow agent located in Helena, Montana. Convert electronically formatted information into paper copies. Include these paper copies as part of the bid documentation. Provide written notification including copies of the Bid Documentation Inventory Affidavit and the Escrow Agreement to the Contract Plans Bureau within 7 business days, including the day of bid opening. The copy of the Escrow Agreement submitted to the Contract Plans Bureau must contain signatures from the Escrow Agent and representative of the bidder. The Department will review the documents and return a copy of the Escrow Agreement with a signature of a Department representative to the Escrow Agent.

An approved escrow agent includes any business such as a banking institution or other bonded storage facility which provides a deposit box, vault, or other secure accommodation.

Place the bid documents and completed Bid Documentation Inventory Affidavit in the container provided by the escrow agent. Clearly label the face of the container “Bid Documents” and include the bidder’s name, the date of submittal, the contract name, and the contract number.

If the apparent low bidder, for whatever reason, is not awarded the contract, the apparent second low bidder will be told they have 7 business days from the date of its verbal notification (followed immediately in writing) to comply with the above requirements.

103.09.4 Bid Responsiveness

The copies of the Bid Documentation Inventory Affidavit and Escrow Agreement submitted as part of the escrow notification will be reviewed for completeness and responsiveness. If the forms are incomplete or are not submitted, the bid will be considered non-responsive. The second low, responsive responsible bid will then be reviewed and the bidder will be required to meet the above requirements.

103.09.5 Release of Bid Documents to the Department

The bid documents in escrow are and will remain the property of the Contractor unless a Certified Claim is filed by the Contractor or litigation or arbitration is initiated under the contract. In the event that the Contractor submits a Certified Claim or litigation or arbitration is initiated under the contract; the bid documents included in the escrow become the property of the Department for its use, specifically including use in preparing for and conducting of all claims, disputes, arbitration or litigation. Failure to submit all bid documents as defined in Subsection 101.03 and the Bid Documentation Inventory Affidavit as required, or failure to include the items indicated by the Bidder on the Bid Documentation Inventory Affidavit in the documents that are placed in escrow, will be a material breach of the contract, is a failure to comply with a condition precedent to filing a claim or lawsuit, acts as a total and final waiver of all claims or disputes involving matters that would have been included (e.g. claims of delay, changed site conditions, loss of productivity, etc.), and subjects the Contractor to action under Section 18.3.101 ARM et seq.

Upon the Department's receipt of the bid documents, the Contractor will be notified and must have a representative present during the opening, unless the representation is waived. Failure to appear at the date and time designated for the opening will be considered a waiver.

103.09.6 Release of Bid Documents to the Contractor

Except as provided for in Subsection 103.09.5, the bid documents will remain in the storage location during the life of the contract. After a certificate of completion has been issued for the contract, the Department will notify the escrow agent and the Contractor that the bid documents may be released. It is the Contractor's responsibility to obtain necessary signatures and retrieve the bid documents from the Escrow Agency.

103.09.7 Method of Measurement and Basis of Payment

Escrow of Bid Documents is measured and paid as lump sum. Payment will be made on the first progress estimate. Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.

SECTION 104

SCOPE OF WORK

104.01 INTENT OF CONTRACT

Furnish all resources required to complete the work under the contract within the specified time, and for the amount bid.

104.02 DIFFERING SITE CONDITIONS, SUSPENSION OF WORK, AND SIGNIFICANT CHANGES IN THE CHARACTER OF WORK

104.02.1 Differing Site Conditions

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

Upon written notification, the Project Manager will investigate the conditions. If the Project Manager 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, an adjustment, excluding loss of anticipated profits will be made and the contract modified in writing accordingly. The Project Manager will notify the Contractor of the determination whether or not an adjustment of the contract is warranted.

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

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

104.02.2 Suspensions of Work Ordered by the Project Manager

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

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

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

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

104.02.3 Significant Changes in the Character of Work

The Project Manager reserves the right to make, in writing, at any time during 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 do 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 the contract, whether such 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 anticipated profit on unperformed work, will be made to the contract. The basis for the adjustment must be agreed upon before the work is performed. If a basis cannot be agreed upon, then an adjustment will be made either for or against the Contractor in such amount as the Project Manager may determine to be fair and equitable.

If the alterations or changes in quantities do not significantly change the character of the work to be performed under the contract, the altered work will be paid for as provided elsewhere in the contract.

The term “significant change” applies when one or more of the following circumstances is met:

A. When the character of the work as altered differs materially in kind or nature from that involved or included in the original proposed construction.

B. When a major item of work, as defined in Subsection 101.03, is increased in excess of 125% or decreased below 75% of the original contract quantity. Any allowance for an increase in quantity will apply only to that portion in excess of 125% of the original contract item quantity, or in case of a decrease below 75%, to the actual amount of work performed.

C. When an item of work, not defined as a major item in Subsection 101.03, is increased in excess of 150% or decreased below 50% of the original contract quantity. Any allowance for an increase in quantity will apply only to that portion in excess of 150% of the original contract item quantity, or in case of a decrease below 50%, to the actual amount of work performed.

104.02.4 Change Orders

Change orders will include the following information:

A. A description of the altered, increased, or decreased work or description of other change necessitating the change order;

B. An estimate of the types and quantities of work to be performed and a listing of the agreed prices and contract unit prices at which payment will be made; and

C. Contract time adjustments in accordance with Subsection 108.07.5.

Change orders must be executed by both parties to the contract and become a part of the contract.

Payment for the work will be made for the actual quantities of work performed at the prices specified in the change order.

104.03 EXTRA WORK

Perform unanticipated work, not included in the contract, if the work is related to the contract items and is ordered before the final acceptance date. Perform extra work as directed. Payment for extra work is made in accordance with Subsection 109.04.

104.04 MISCELLANEOUS WORK

This is any minor work or material that is necessary to the work.

Miscellaneous work, as provided for in the contract, is measured by the respective unit for either the material or work performed, as directed in writing by the Project Manager.

Payment for miscellaneous minor work is at agreed prices or on a force account basis.

104.05 MAINTENANCE OF WORK

104.05.1 General

Perform maintenance work on completed and uncompleted parts of the project until approval in accordance with Subsection 105.17.2.

Maintenance includes, but is not limited to the following:

1. Patching chuck holes with asphalt mix;
2. Reshaping the subgrade, side slopes, ditch sections, or aggregate courses, as necessary;
3. Cleaning debris from drainage courses, culverts, and inlets;
4. Removing rocks or earth from the roadway and ditch sections;
5. Removing debris resulting from construction activities;
6. Providing access to residences, businesses, and roads and keeping the present accesses open;
7. Repair or replace minor damaged parts of the work;
8. Repair or replace extensive damage, not by Contractor negligence, in accordance with Subsection 104.02.4;
9. Maintenance of the constructed roadway in accordance with Subsection 203.03.5;
10. Disposing of removed matter;
11. Maintenance of irrigation water in accordance with Subsection 104.05.6; and
12. Other maintenance-type work not specifically described but necessary for the maintenance and protection of traffic or of completed and uncompleted portions of the project.

Maintenance work performed before approval in accordance with Subsection 105.17.2 is incidental to other contract items.

104.05.2 Failure to Properly Maintain Roadway or Structure

The Project Manager will immediately notify the Contractor if it fails to maintain the project. Failure to begin to remedy unsatisfactory maintenance within 4 hours of notification may result in:

- The Department performing the required repair. The cost of the repair will be deducted from monies due or to become due to the Contractor, or otherwise be billed to the Contractor.
- Contract time being charged. Contract time will be charged starting on the day of the Department's initial notification and will continue until the repairs are made and the Project Manager approves the repairs.

104.05.3 Maintenance for Traffic and Detours

A. **Maintenance for Traffic.** Keep the road open to traffic during the work or provide detour roads as specified or directed.

Maintain the work under construction to accommodate traffic. Construct and maintain all accesses to parking lots, garages, businesses, residences, farms, etc. The cost of this work is incidental to other items of the contract.

Provide traffic control meeting the approved traffic control plan, Section 618, and the MUTCD.

B. **Special Detours.** When the contract has the bid item Detour - Construct, Maintain, and Remove, it includes constructing and maintaining the detour, including constructing and removing temporary bridges, pipes and associated work and obliterating the detour road.

Do not use all or any portion of an existing structure, as defined in Subsection 101.03, without the Engineer's approval. Do not modify existing structures or construct temporary

structures without Department approval before starting work. This work is incidental to the contract item.

The Department will provide the right-of-way for temporary detours or bridges specified in the contract.

104.05.4 Maintenance for Traffic During Work Suspensions

A. **Temporary Suspension.** Make passable and open to traffic all portions of the project, connections, and temporary roadways before temporary work suspensions. Maintain parts of the project, connections, temporary roadways, and detours under traffic at Contractor expense during work suspensions.

B. **Winter Suspension.** Be responsible for all traffic control and maintenance during winter weather shutdowns, including the time between November 16th and April 15th. Be responsible for all snow removal, sanding, and de-icing for all roadways not completed through the first lift of plant mix surfacing. Furnish all necessary supervision, personnel, and equipment to maintain the road in a safe condition and at the highest level of service to traffic.

The Department is not responsible for any repairs or maintenance to the project that results from snow plowing, sanding, and de-icing on any roadway not completed through top lift of plant mix surfacing.

The Contractor may request that the Department furnish all resources to perform snowplowing, and sanding, de-icing during winter suspension. This work would be detailed in a written agreement. Be responsible for all maintenance, traffic control, or other work not detailed in the agreement. Reimburse the Department, under an accounts receivable, for all Department plowing, sanding, and de-icing expenses according to the terms of the signed agreement.

Attend a meeting scheduled by the Department to review the project to develop the agreement details prior to the winter suspension.

Inspect the project at least once every 14 calendar days. Submit form CSB104_05_4 to the Project Manager within 3 calendar days of the inspection.

Failure to maintain the project under these requirements will invoke Subsection 104.05.2.

Repair or replace all work and materials lost or damaged due to temporary use of the project. Maintenance work for acts of God or acts of the public enemy, or that are outside the Contractor's control during work suspensions is paid for at contract unit prices or as extra work.

104.05.5 Reserved

104.05.6 Maintenance of Irrigation Water

Construct or move irrigation structures, boxes, channel changes, and culverts to maintain irrigation water flow at Contractor expense.

Do not shut off irrigation water in an irrigation ditch without the water-master or ditch owners written permission.

104.06 MATERIAL AND PROPERTY RIGHTS

104.06.1 Rights in and Use of Materials Found on the Project

Apply for and obtain the Project Manager's written approval prior to using excavated materials for other contract items. Designate in the request which contract item the second payment is for. Only one item will be eligible for payment when more than one field measurement by the Department would be required. Replace the removed material with acceptable material at Contractor expense.

104.06.2 Use of Department Property

Do not use Department property outside the project limits for contractor operations, such as staging, without Department approval. Submit an encroachment permit to the Department's Maintenance Division for approval. The encroachment permit request form is available from the Department's website or the Project Manager. Be responsible for all requirements within the encroachment permit and obtain associated environmental permits prior to the use of the property.

Restore the property in accordance with the contract and encroachment permit requirements no later than the encroachment permit end date. Obtain seed blend mix designs and allowed seeding time frames from the Project Manager for any re-vegetation required to the area. Repair damaged areas in a timely manner.

The Department will revoke the use of Department property if the requirements of the contract or the encroachment permit are not being met. The use of Department property outside the project limits, including any required restoration or repair work is not measured for payment. Contractor failure to fulfill the encroachment requirements is cause for the Department to perform or have corrective actions performed and deduct those costs from monies due or that may become due the Contractor.

104.07 FINAL CLEANING UP

Clean the highway, borrow pits, and all ground used in performance of the work of all rubbish, debris, excess materials, temporary structures, and equipment before final acceptance.

Meet the requirements of Subsection 106.02.5 for final cleanup of borrow and aggregate sources.

The final cleanup work of the project area and the pits, borrow areas, or quarries is not paid for directly but is incidental to other contract items.

Specify the conditions for final cleanup in all landowner agreements. Complete all cleanup conditions before final project acceptance.

104.08 VALUE ENGINEERING PROPOSALS

Cost savings generated on the contract from cost reduction proposals offered by the Contractor and approved by the Department will be shared.

The Contractor is encouraged to submit proposals for modifying the contract that reduces the total cost of construction. The cost reduction proposal must not impair the essential functions or characteristics of the project including but not limited to service life, economy of operation, ease of maintenance, reliability, desired appearance, and safety.

Submit the proposal in writing and include the following information:

1. A description of both the existing work and proposed changes for performing the work with a discussion of the comparative advantages and disadvantages;
2. An itemization of the necessary changes to the contract if the proposal is accepted;
3. A detailed cost estimate for performing the work under the existing contract and under the proposed change detailing quantities and dollar amounts for each work item;
4. An estimate of the effect the proposed changes would have on other costs to the Department;
5. A time frame within which the Department must make a decision;
6. The dates, project numbers and the action of the Department if the proposal was previously submitted; and
7. A statement of the effect implementation of the proposal would have on the contract completion time.

The Department is not required to consider a proposal or be liable to the Contractor for failure to accept or act on a proposal submitted under this specification including delays to the

work attributable to the proposal. Proposals that are similar to a change in the contract that are under consideration or have been adopted by the Department before the submittal will not be accepted. The Department reserves the right to make these changes without compensation to the Contractor.

Continue to perform the work according to the contract requirements until the Department has taken final action on the proposal. Consider the proposal rejected if the Department's final decision is not received within the time frame specified in the Contractor's submittal.

The Department will determine the acceptability and the estimated net savings in construction costs from the adoption of all or part of a proposal. The Department will disregard the contract unit prices if these prices do not represent a fair measure of the value of work to be performed or to be deleted. The Department's costs for reviewing and implementing proposals including any increased costs to the Department resulting from its application will be deducted from the total estimated cost saving to arrive at the net savings.

Costs incurred by the Department during a preliminary review will not be charged to the Contractor. If the proposal is advanced to the detailed review stage, costs incurred by the Department during the detailed review stage will be shared equally by the Department and the Contractor. The submittal of a formal proposal constitutes the Department's authority to deduct these costs from any monies due or that may become due to the Contractor under the contract. The Department costs for researching and defending claims related to an accepted VE Proposal will not be shared equally. These costs will be deducted from progress payments.

Proposals accepted by the Department in whole or in part will be by a change order. The change order will incorporate the changes in the contract necessary to implement the proposal and will include any conditions placed on the approval by the Department. The change order will establish the estimated net savings in the cost of performing the work attributable to the proposal and provide for payment of 50% of the estimated net savings to the Contractor.

Acceptance of proposals does not extend the contract time unless specifically provided for in the change order.

The payment amount specified in the change order constitutes full compensation to the Contractor for the proposal and the performance of the work.

The Department reserves the right to apply a proposal for general use on other contracts administered by the Department. When an accepted proposal is applied for general use, only the Contractor who submitted the initial proposal is eligible for compensation and this compensation applies only to those contracts awarded to the Contractor before submission of the accepted proposal. Proposals that are identical or similar to previously submitted proposals are eligible for consideration and compensation under this specification if the proposals were not previously adopted for use in other contracts administered by the Department. Subject to these provisions, the Department reserves the right to use all or any part of any submitted proposal without obligation or compensation to the Contractor.

This specification applies only to the Contractor awarded the contract.

No consideration will be given to, and no payment made for any claims for additional compensation for changed conditions that are attributable to the approved proposal.

SECTION 105

CONTROL OF WORK

105.01 AUTHORITY OF THE ENGINEER

The Engineer will decide all questions regarding the quality and acceptability of materials furnished, work performed, the rate of progress of the work, the interpretation of the contract, and the acceptable fulfillment of the contract. Contract time will continue to be charged during suspensions in accordance with Subsection 105.01(A) and Subsection 105.09(2).

A. The Engineer will suspend the work wholly or in part for failure to:
  1. Correct conditions unsafe for project personnel or the public; or
  2. Carry out provisions of the contract; or
  3. Carry out orders of the Engineer.

B. Work may also be partially or wholly suspended for:
  1. Periods necessary due to unsuitable weather; or
  2. Conditions unsuitable for the prosecution of the work; or
  3. Any condition or reason determined to be in the Department's interest.

105.02 CONTRACTOR FURNISHED DRAWINGS AND SUBMITTALS

The plans show the details of structures, lines, grades, typical roadway cross sections, location and design of structures, and a summary of items appearing in the bid package.

Furnish the Department with Contractor prepared working drawings that detail required work not included in the contract plans. Prepare all working drawings using English or Metric units as shown in the contract. Upon request, submit manufacture literature describing the materials and equipment to be incorporated into the work. This requirement to submit drawings and literature applies to all items not specifically requested elsewhere in the contract.

The Department has 20 business days to review the submittals before returning them to the Contractor. The Department has 20 business days to review drawings returned for correction and that are re-submitted for review. The Department will consider extending contract time should the Department review exceed the 20 business day review time limit and the delay can be shown to affect the Contractor's operation based on the current schedule.

The Department's approval of the fabricator's shop detail drawings is verification that the fabricator and Contractor have correctly interpreted the intent of the contract documents and the details reflect the material and connection requirements. "Approval" does not relieve the Contractor or fabricator of the responsibility for accuracy of design, dimensions, completeness or adherence to the requirements of the contract, nor does it permit deviations from the contract without the Department's documented consent.

The Department will perform an engineering review of the first submittal at no cost to the contractor. If the Department determines that the submittal fails to meet generally accepted engineering standards, it will return the submittal for correction. The Department will perform reviews of re-submittals with its own personnel when possible. If Department staff does not have time available to perform reviews, at the Department's sole option it may hire a consultant engineer from outside the Department to finish the review process.

The Department will charge for reviews of resubmittals for its staff time and at the rate charged by a hired engineering firm for its staff time, if the Department hires one. The Department will subtract the charges from contractor payments.

Working drawings and falsework plans for facilities open to public travel are to be signed by a professional engineer registered in the State of Montana before submittal to the Project Manager.

Check and approve working drawings and submittals before submittal to the Project Manager. Show the Contractor's approval on the drawings and submittals.

105.03 CONFORMITY WITH PLANS AND SPECIFICATIONS

105.03.1 General

Perform work and furnish materials to meet the contract requirements.

Provide materials and workmanship uniform in character and meeting the plan dimensions and contract specifications.

When a contract item does not meet the contract requirements but is adequate to serve the design purpose, the Contractor will be notified in writing of the deficiency. The Contractor will be given the choice to remove and replace the deficient work, correct the work at no expense to the Department, or accept a reduction in the contract unit price. If the Contractor chooses to accept a price reduction, the Project Manager will determine the amount of the reduction and will apply the reduction using a line item adjustment to the contract. The Project Manager may document the basis of the acceptance by change order.

When a contract item does not meet the contract requirements resulting in work inadequate to serve the design purpose, remove and replace or correct the work by and at Contractor expense.

105.03.2 Items Designated for Acceptance on a Lot Basis (Quality Assurance)

Contract items listed in Table 105-1 are designated for acceptance on a lot-by-lot basis. The elements in the table are evaluated and the contract items accepted under this provision. All other contract items are evaluated for acceptance under the specifications covering those items.

An element of a lot will be evaluated for conformance when results of one or more tests are outside specified tolerance limits for that element.

All the individual test results in the lot for the element to be evaluated will be averaged, and the percent of price reduction for the lot determined by the applicable formula.

1. The formula **P = (Xn + aR - Tu) x F** will be used if a maximum limit only is specified; or when the average of the test values is above the midpoint of a specified band or above a job mix target value.
2. The formula **P = (TL + aR - Xn) x F** will be used if a minimum limit only is specified; or when the average of the several test values is below the midpoint of a specified band or below a job mix target value.

TABLE 105-1
CONTRACT ITEMS - EVALUATION ELEMENTS

Elements Evaluated				
Item	**Aggregate Gradation**	**Fineness Modulus**	**Compaction**	**Fracture**
Selected Surfacing	X			
Sand Surfacing	X			
Crushed Base Course Type A	X			X
Crushed Base Course Type B	X			
Crushed Top Surfacing Type A	X			X
Crushed Top Surfacing Type B	X			
Crushed Aggregate Cover Material	X			X
Cement Treated Base	X		X	
Plant Mix Surfacing and Base	X		X	X
Portland Cement Concrete Paving	X	X		

Where:

P is the percent of reduction in contract unit price.

Xn is the average of the several test values from samples taken from the lot, with n indicating the number of values.

A is a variable factor to be used as n changes according to the following: when n is 3, a = 0.45; n is 4, a = 0.38; n is 5, a = 0.33; n is 6, a = 0.30; and n is 7, a = 0.28.

R is the difference between the highest and lowest values in the group of several test results from the lot.

Tu is the upper or maximum tolerance limit permitted by the specifications.

TL is the lower or minimum tolerance limit permitted by the specifications.

F is the price reduction factor to be applied for each element as shown in Table 105-2.

TABLE 105-2
TABLE OF PRICE REDUCTION FACTORS

Element	Factor "F"	
100% size sieve	1	
½-inch (12.5 mm) sieve and larger	1	
No. 100 to ⅜-inch (0.150 to 9.5 mm) sieve, inclusive (except 100% size sieve)	3	
No. 200 (0.075 mm) sieve	6	
Fine aggregate fineness modulus	12	
Compaction	Non-Commercial	Commercial
	12	6
Compaction - CTB	6	
Fracture	2	

If P is less than 3 or a negative quantity, the lot will be accepted as being in conformance. If one or more elements for a contract item show a positive P value, the positive values will be added and the resulting sum used to determine whether the lot is in conformance. If the total P value is between 3 and 25, the Project Manager may require correction or accept the lot at a reduced price. If P is greater than 25, the Project Manager may:

1. Require complete removal and replacement with specification material at Contractor expense;
2. Require corrective action to bring the material into conformance at Contractor expense; or
3. Where the finished product is found to be capable of initially performing the intended purpose but with a reduced service life expectancy, permit leaving the material in place with an appropriate price adjustment calculated using a P value ranging between 25 and 50.

Immediately halt production following written notification when either of the following has occurred:

1. Three consecutive lots for a contract item have an individual total P value of 5 or more.
2. Beginning with the second lot, when three tests within one lot have one or more elements outside the specification bands and the total P value for the lot is 5 or more.

Make adjustments to bring the product within the specification limits before resuming production. The Contractor does not have the option of accepting a price reduction in lieu of producing specification material. Continued production of non-specification material is prohibited. Material that is obviously defective may be isolated and rejected without regard to sampling sequence or location within a lot.

The Project Manager may allow the adjustments to be made without halting production.

105.03.3 Quality Incentive Allowance

Quality incentive allowances will be used to offset any price reductions.

All quality incentive allowance remaining after all price reductions have been deducted will be paid as a lump sum when all work on the item is complete.

A. Plant Mix Volumetric Properties. Outlier determination and payment adjustments are for properties only. If suspect test values are noted during construction, the Department will check plant production information, test equipment, processes, calculations, etc. for

errors. If a problem is noted in the plant production, sampling or other process controlled by the Contractor, the test result will be considered valid until production is complete. If a problem is found with the testing or other Department process, the test result will be corrected or the test redone on material from the same sample, if possible. If a non-correctable testing problem is found, the result will be discarded, if possible another sample will be taken and the new result used in its place. If re-sampling is not possible, the Department may discard the test results for a sub-lot considered to be an outlier and recalculate the incentives and disincentives using the remaining results in the lot. The Department may follow standard QA guidelines to adjust lot sizes.

If no identifiable problem is found, no corrections will be made until production is complete.

The following outlier evaluation only applies to projects with 10 or more QA sub-lots.

After all production of this product is completed, the Department will determine the standard deviation and mean of all the Department's test results for each property representing material produced after the initial targets were set. For each property test, the Z value is defined as the absolute value of the difference between the test value and the mean, divided by the standard deviation. If the average of the Z values of the four properties in a sub-lot is greater than 2.00, the Department may consider the sub-lot an outlier. If more than one sub-lot outlier is identified in a lot, the test results will not be considered outliers. The Department will not adjust for outliers within the last lot of production.

The Department will discard the test results for a sub-lot considered to be an outlier and recalculate the incentives and disincentives using the remaining results in the lots. The Department will follow standard QA guidelines to adjust lot sizes.

B. Density. A 1.08 pay factor will be applied to the lots of plant mix surfacing when the average density for the lot (Xn) is from 94% to 95%, inclusive, of the Maximum Specific Gravity (Rice's Method) and the range (R) is 3 or less.

C. Ride Specification. The surface smoothness will be measured using the International Roughness Index (IRI). The surface smoothness will be evaluated in each travel lane for the entire length of the project. The following project category pay factors will be applied to each lane:

TABLE 105-3
MAXIMUM ALLOWABLE VARIANCE AND DIVERGENCE

Project Category	Actual IRI (Inches/mi)	Pay Factor
Category I	< 35	1.25
	35 – 45	2.125– 25/1000 * IRI
	> 45 – < 55	1
	55 – 75	1.825 – 3/200 * IRI
	> 75 – 90	0.7
	> 90	Corrective Action (Initially assumed zero pay)
Category II	< 50	1.1
	50 – 55	2.100 – 1/50 * IRI
	> 55 – < 60	1
	60 – 95	1.343 – 1/175 * IRI
	> 95	Corrective Action (Initially assumed zero pay)
Category III	<40	1.25
	40 – 55	1.918 – 1.67/100 * IRI
	>55 - <70	1
	70 – 100	1.700 – 1/100 * IRI
	>100	Corrective Action (Initially assumed zero pay)

Notes: 1. The pay factor is the same whether the plant mix is measured in English or metric units. Final pay factors are rounded to 2 decimals and used in calculating the value of the incentive/disincentive.
2. The IRI used to calculate the Pay Factor is the average of 2 runs on each travel lane evaluated.

The incentive or disincentive for surface smoothness will be calculated based on the ride category and entire length the project in each travel lane or measured section using the following equation. The calculated value will be applied as a line item adjustment to the plant mix item on the estimate. Calculate the pay adjustment as follows:

Pay adjustment = (Pay Factor -1) x L x Unit Cost
Pay Factor = Calculate using the formulas for the appropriate project category
L = Length of the lane measured
Unit Cost = Use appropriate value from the table below

TABLE 105-4
UNIT COST

Category	Description	Unit Cost/ft.
I or III	Reconstruction or rehabilitation section with 0.3 ft. or greater plant mix surfacing	$6.425
I, II, or III	Reconstruction, rehabilitation, or overlay section with 0.2 to 0.29 ft. plant mix surfacing	$4.283
I, II, or III	0.19 ft. or less thin lift overlay	$3.213

Note: Isolation lifts are not considered to be part of the surfacing section when determining the appropriate overlay depth.

Incentives will be reduced based on the percentage of density tests that do not meet minimum plant mix pavement density requirements as determined by Table 105-5 Ride Incentive Reduction.

TABLE 105-5
RIDE INCENTIVE REDUCTION TABLE

Project Size	Percent of Density Tests not Meeting Specifications		
	No Reduction of Ride Incentive	Incentive Reduced	No Incentive Allowed
0 to 25,000 Tons	0 to 10%	(% failing tests) * 6.667-66.67	25%
> 25,000 Tons	0 to 5%	(% failing tests) * 6.667-33.34	20%

Note: Final incentive reductions are rounded to 2 decimals.

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work under the contract.

105.03.4 Table of Contractor Submittals

To assist in identifying all required submittals and clarifying the submittal process, the contract may include a Table of Contractor Submittals as a Special Provision.

The table may not be all-inclusive and does not include submittals required by other Special Provisions.

Provide all submittals required by the contract, including those not listed in the table.

If a discrepancy exists, submittals required by other Special Provisions in the contract take precedence over the Table of Contractor Submittals.

Electronic submittals to the Department will be accepted if they are in a format accessible by the Department's software and legible once opened. Verify acceptable electronic format types with the Project Manager prior to submittal.

When a specification requires submittal of a form, submit the most current Department form. Forms are available from the Project Manager or on the Department's Contractor's system Internet site at http://www.mdt.mt.gov.

105.04 COORDINATION OF CONTRACT PROVISIONS

All documents referred to in Subsection 101.03 (Contract) are essential parts of the contract, and a requirement occurring in one is binding as though occurring in all. They are complementary and describe and provide for a complete contract. If a discrepancy exists, the governing ranking is:

Dimensions

1. Plan
2. Calculated
3. Scaled

Information

1. "Question and Answer Forum" Information
2. Special Provisions
3. Table of Contractor Submittals
4. Plans
5. Supplemental Specifications
6. Standard Specifications
7. Supplemental Detailed Drawings
8. Detailed Drawings

105.05 COOPERATION BY CONTRACTOR

The Department will furnish the Contractor at least 15 sets of contract documents. Keep at least one set available on the project at all times.

Cooperate with the Engineer, Project Manager, the Inspectors, and other Contractors during the contract work.

Staff the project with a Superintendent experienced in the type of work to be performed under the contract. Provide the Superintendent's name in writing before work starts. Ensure the Superintendent, when not physically on the project, has the ability to communicate with Department representatives by phone, cell phone, radio, or other electronic means. This contact must be maintained during all work suspensions, including winter suspension.

Maintain a Contractor representative having the Superintendent's authority, when the Superintendent is not physically on the project or available for immediate communication. Notify the Project Manager in writing of the identity and contact information of that representative before that person assumes the authority.

Give the Superintendent the authority to execute orders or instructions of the Project Manager or authorized representative and the authority to obtain all resources to complete the contract, including directing all Subcontractor operations.

The Project Manager or authorized representative will issue instructions to the superintendent.

Notify the Project Manager in writing at least 24 hours in advance of changes in the Contractor's representative.

Failure to maintain a Contractor's Superintendent or authorized representative on the project is cause for the Project Manager to stop work until one is assigned. All costs associated with the delay are at Contractor expense.

Failure to maintain the ability to be contacted within 2 hours during times of work suspension will result in contract time being charged. Time will be charged for the day the Department first attempts to make contact and each additional day that the Contractor's designated representative cannot be contacted.

105.06 COOPERATION WITH UTILITIES

Underground, overhead, and non-utility facilities will be relocated or adjusted to clear conflicts with the contract. Some or all of these facilities may be relocated or adjusted during the contract work. Perform the contract work without damaging these facilities.

Conduct on-project meetings on a weekly or biweekly basis with utility company representatives having facilities within the project limits and the Project Manager. Have the first meeting on the project before grading and excavation work begins to discuss the utility locations and progress on utility relocation work. A list of utility representatives is furnished in the contract.

Cooperate with utility owners in the removal and rearrangement of utility facilities to minimize interruption to utility service and duplication of work by the utility owner.

Submission of a bid is an affirmative statement that the Contractor has considered in the bid proposal all permanent and temporary utility facilities in the present or relocated positions as specified in the contract and as revealed by its site investigation. No additional compensation is allowed for delays, inconvenience, or damage sustained due to interference from the utility facilities or their re-location work.

The contract indicates utility items to be relocated or adjusted and who is to perform the work. The contract indicates the means of adjudication, if any, if the utility owners fail to relocate or adjust the facilities.

105.07 COOPERATION BETWEEN CONTRACTORS

The Department reserves the right to contract for and perform other or additional work on or near the work for the project.

Conduct the work without interfering with or hindering the progress or completion of the work by other Contractors. Cooperate with other Contractors working within the limits of the project.

Each Contractor involved must accept all liability, financial or otherwise, in connection with the contract and protect and hold harmless the Department from damages or claims that may arise because of inconvenience, delay, or loss experienced because of the presence and operations of other Contractors working within the limits of the same project.

Coordinate and sequence with the work of other contractors. Do not store materials, tools, machinery, and other equipment in locations that interfere with the work of other Contractors.

105.08 CONSTRUCTION STAKES, LINES AND GRADES

Maintain all survey controls required to control alignment and grade using survey personnel that are trained, experienced, and skilled in construction layout and staking. Do not hire Department personnel to perform any survey work.

Staking requests must be submitted on form CSB105_08_1. Department construction staking will be performed once for a given type and location. If construction staking is required more than once, submit an additional request to the Project Manager in writing with justification.

105.08.1 Department Furnished Survey and Layout

Unless otherwise stated, the Department will furnish the following:

- All right of way and monumentation surveys
- Centerline coordinates
- Benchmarks at the beginning, end and near midpoint of the project
- Construction stakes for establishing lines, slopes and profile grade (excluding finish grade control)
- Construction stakes for culverts, structures and appurtenances
- Wetland delineation

Preserve and protect Department furnished control points and replace any that may be damaged, displaced or removed. Replace any stakes that are obliterated by the Contractor or by construction activities.

Use provided controls as the field control to perform the work. Verify accuracy of all Department furnished controls before any layout staking or grading is performed. Request all Department furnished construction staking in writing.

105.08.2 Contractor Survey and Layout

When required by the contract, furnish all surveys and calculations necessary to layout and control the work to specified lines, grades, and tolerances. Provide surveys with accuracy and control equal to or better than the requirements of the Montana Department of Transportation Survey Manual (Survey Manual).

Protect Department-furnished control points. Set or reset destroyed control points, conduct all right-of-way and monumentation and public land monumentation surveys under the responsible charge of a Registered Land Surveyor licensed in Montana per Section 70-22-115 MCA. The Department will measure quantities for payment, except items specified under pre-determined quantities.

Identify Department set control points. Verify accuracy of the Department – furnished controls before any layout staking is performed.

A. Survey Plan. At least 14 calendar days prior to beginning survey work, submit two copies of a survey plan to the Project Manager that details each proposed survey operation including:

1. Methods for initial layout to include accuracy, references, independent verification and checks.
2. Methods for control surveys to include number and type of controls for various items and measurement tolerances and accuracy.

The plan will be reviewed for compliance with the requirements of the Survey Manual. The plan will be returned for correction if it does not meet or exceed requirements of the Survey Manual.

Do not begin survey operations until the survey plan has been reviewed and approved by the Project Manager.

B. Staking. Set all stakes necessary to control all work under the contract. This includes, but is not limited to:

- Bridges
- Centerline stations
- Clearing limits
- Drainage structures
- Fencing
- Pavement
- Reference points
- Retaining structures
- Right-of-way lines and monuments
- Sewers and waterlines
- Signs, pavement markings, guardrail
- Surfacing courses
- Wetland delineation
- Any other items of work included in the contract
- Special conditions for specific layout items

Determine the slope stake catch point and provide copies of the slope staking notes to the Department. Replace any stakes that are obliterated by the Contractor or by construction activities. Do not begin grading operations until all slope stakes within a balance or at least 20% of the project have been set.

C. Culverts. Take cross sections and profiles. Adjust culvert locations to match existing field conditions. Use form MDT-CON-603-1 to submit the list of proposed culvert lengths to the Project Manager. Profiles, cross sections, adjustments and culvert lengths must be approved by the Project Manager before culverts are ordered.

D. Bridges. Include a check of the bridge location relative to railroads, streams, roads, or fixed features in the initial layout. Report discrepancies before performing any bridge construction activities. Survey controls for the following are required as a minimum:

- Foundations

- Pile layout and cutoff
- All substructure elements
- Girder seat elevations
- Girder profiles
- Deck forms and placement
- Curbs, rails, joints

E. Plan Errors. Notification must be made immediately of any apparent errors, including but not limited to grade, alignment, location, dimensions and quantities. Changes to the plans must be approved in writing by the Project Manager.

F. Inspection. The Department may conduct inspections and random checks of any portion of the layout and control work. The Project Manager may order work not performed with sufficient accuracy to be corrected. No compensation will be allowed for corrective work.

The Contractor is responsible for securing proper dimensions, lines, grades, and elevations for all parts of the work and Department inspection will not relieve the Contractor of this responsibility.

G. Survey Notes. Submit survey notes, including electronic notes, to the Project Manager every 10 business days and upon completion of each survey function.

H. Extra Work. Survey required for extra work may be performed by the Contractor or by the Department, as determined by the Project Manager.

I. Predetermined Pay Quantities. Quantity sheet amounts for items described under Sections 203 and 209 will be considered final quantities for payment. Requests for adjustment of bid schedule quantities for these items may be initiated by the Contractor or by the Project Manager if evidence indicates the total actual required in-place quantity varies from the bid schedule quantities by more than 5%.

Not taking cross section elevations during slope staking waives any adjustment to pre-determined pay quantity items, including borrow.

The party requesting the quantity adjustment must notify the other party in writing and furnish acceptable survey data and calculations to accurately establish any quantity adjustments. Load counts will not be considered acceptable for excavation and borrow items. The quantity adjustment will only apply for the amount greater than 5% of the bid schedule quantity.

Quantity adjustments due to changes ordered and approved in writing will be determined by measurement, calculation or both. These quantities will be added or deducted from bid schedule quantities without regard to the 5% limitations outlined herein.

105.08.3 Finish Grade Control

Provide all finish grade control required to establish the surfacing sections shown in the plans. Calculate the finish grades for the subgrade and each surfacing course using the plan information and the furnished staking notes. Special borrow is a surfacing course for finish grade control purposes.

Run a level circuit to check the project benchmarks on each roadway section where finish grade is being controlled.

Use a finish grade control method that provides positive horizontal and vertical alignment control for the required surfacing sections and ride quality.

105.08.4 Bridge Survey

The Department will establish control points defining median or roadway centerline, bridge centerline, and benchmarks for elevation control.

Establish and maintain all other survey controls required to control bridge alignment and grade meeting the plan dimensions and elevations using survey personnel trained, experienced, and skilled in construction layout and staking. Do not hire Department personnel to perform survey work.

Furnish horizontal and vertical control meeting the Department's Survey Manual requirements. Furnish the original survey notes upon request. Furnish the notes showing the initial layout and primary controls and references and the method of independent check before starting work on the substructure units. Submit a copy of the structure excavation cross-section notes. The Project Manager reserves the right to re-survey any pay item area.

Make calculations from the plan information to control alignment and elevation. Correct all incorrect locations, misalignments, and incorrect elevations caused by Contractor calculations, layouts, and surveys at Contractor expense. Submit the proposed method of correction for approval. Do not begin the corrective work until the proposal has been reviewed and approved.

105.08.5 Materials and Equipment

Furnish all materials and equipment required to perform this work.

Keep survey notes in a standard field notebook, written in a clear, orderly, neat manner meeting the Department's Survey Manual requirements and standard surveying practice. If survey notes are generated electronically, produce notes in a format meeting these requirements. The Project Manager will inspect the field notes for acceptance. The finished notes become the Department's property.

105.08.6 Survey Tolerances and Inspection

The Department will perform finish grade checks based on the following:

A. Subgrade. Three random stations per 1,000-foot (300 m) section will be checked. The 1,000-foot (300 m) section will be accepted if 80% or more of the points checked are within a vertical tolerance range of + 0.05 to - 0.10 foot (+ 15 to - 30 mm), and the horizontal alignment is within 0.30 foot (90 mm) of the true line. If not within required tolerances, rework the entire 1,000-foot (300 m) section. Three new random stations will be checked after rework is completed. Random checks will be performed for finish ditch grade control to ensure proper drainage.

B. Special Borrow. Three random stations per 1,000-foot (300 m) section will be checked. The 1,000-foot (300 m) section will be accepted if 80% or more of the points checked are within a vertical tolerance range of + 0.05 to - 0.10 foot (+ 15 to 30 mm), and the horizontal alignment is within 0.30 foot (90 mm) of the true line. If not within required tolerances, rework the entire 1,000-foot (300 m) section. Three new random stations will be checked.

C. Aggregate Surfacing. Six random stations per 1,000-foot (300-m) section will be checked. Each 1,000-foot (300-m) section will be accepted if 85 percent or more of the points checked meet the requirements listed in Table 301-1, and the horizontal alignment is within 0.30 foot (90 mm) of the true line. If not within required tolerances, rework the entire 1,000-foot (300 m) section. Six new random stations will be checked.

Sections that are obviously defective may or may not be checked prior to rejection.

A station check consists of centerline, shoulders, any break in cross slope, and intermediate points not to exceed intervals of 20 feet (6 m). All elevation checks are taken on the material, not on the finish grade control. The Project Manager may increase or decrease the number of stations being checked. After receiving notification of a completed section, the Project Manager will perform the finish grade check by the close of the following business day. Contract time will be extended day for day, without any other compensation, for Department caused delays beyond the allotted time to perform the finish grade check.

105.08.7 Method of Measurement

A. Finish Grade Control. Finish grade control is measured by the course foot (km) along the roadway centerline. A course foot (CR km) is one foot (1 km) for each two-lane roadway including shoulders and ditches. Each traffic lane is considered as one-half course foot (one-half CR km) including the adjacent shoulder, ditch, parking, turning, median lanes, and chain up areas.

The subgrade and each surfacing course requiring finish grade control are measured separately by the course foot (CR Km) for each roadway section, ramp, intersecting roadway, PTW connection, temporary detour, and each frontage road. Finished grade control for approaches is not measured for payment.

B. Contractor Survey and Layout. Contractor survey and layout is measured by the lump sum.

C. Bridge Survey. Bridge survey is measured by the lump sum.

105.08.8 Basis of Payment

Payment for the completed and accepted quantities is made as follows:

Pay Item	Pay Unit
Finish Grade Control	Course Foot (km)
Contractor Survey and Layout	Lump Sum
Bridge Survey	Lump Sum

Correct all deficient work due to incorrect finish grade control or bridge survey and reset reference points lost or destroyed by traffic or construction at Contractor expense.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.

105.09 AUTHORITY AND DUTIES OF PROJECT MANAGER

Each project will be staffed with a Project Manager who is the Engineer's direct representative. The Project Manager has immediate charge of the engineering details of each construction project and is responsible for the administration and satisfactory completion of the project.

The Project Manager can:

1. Reject defective material.
2. Suspend work being improperly performed.
3. Execute any authority delegated to the Project Manager by the Engineer.

The Project Manager will be identified before work begins.

105.10 AUTHORITY AND DUTIES OF INSPECTORS

Department Inspectors are authorized to:

A. Inspect all work being done and materials furnished. Inspection extends to all or any part of the work and to the preparation or manufacture of the materials to be used. Inspection does not relieve the Contractor's obligation to perform the work as specified in the contract.

B. Reject materials or suspend the work until the issue can be referred to and decided by the Project Manager.

Inspectors, Technicians, and Aides cannot:

A. Revoke, alter, enlarge, or relax any requirements of the contract.

B. Final approve or accept any portion of work.

C. Issue instructions contrary to the contract.

Only the Project Manager is authorized to make contract changes, waive or alter the contract specifications, and then only if it is made in writing. Ensure that the change, waiver, or alteration is in writing before taking action on it.

105.11 INSPECTION OF WORK

All work is subject to Department inspection. Inspectors may not be at all work activities nor available for all work shifts for each work activity. Perform the work meeting the contract requirements regardless of inspection.

Allow the Inspector access to all parts of the work and furnish information and assistance necessary to make a complete and detailed inspection. Provide a safe environment for the Inspector during the inspections.

Inspection of the work does not relieve the Contractor of its responsibility to meet the contract requirements. The Inspector cannot waive contract requirements.

Remove or uncover portions of the finished work as directed. Once examined, restore the work to the contract requirements. If the work is acceptable, the uncovering, or removing and replacing the covering or making good the parts removed is paid for as extra work. If the work is unacceptable, the uncovering, removing, and replacing the covering or making good the parts removed is at Contractor expense.

Work done or materials used without inspection by an authorized Department Inspector may be ordered removed and replaced at Contractor expense.

When a government agency, political subdivision, a utility or railroad is to accept or pay a portion of the cost of the work covered by the contract, the organization's representatives may inspect the work. The inspection does not make that entity a party to the contract nor permit it to interfere with the rights of either party to the contract.

105.12 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK

Work not meeting the contract requirements is unacceptable, unless determined acceptable under Subsection 105.03.

Remove and replace any unacceptable work before final acceptance at Contractor expense. This requirement has full effect regardless of the fact that the unacceptable work or defective materials were known or overlooked by the Inspector.

Work done contrary to instructions received, or beyond the plan limits, or extra work done without the permission of the Project Manager will not be considered for payment. Work so done may be ordered removed, restored or replaced at Contractor expense.

Neither the Contractor nor the Department incurs any liability by reason of any verbal directions or instructions received from the Project Manager. The Department will not be liable for extra materials furnished or used, or for extra work or labor done, unless required by written order from the Project Manager.

If the Contractor fails to follow any order made under this subsection, the Project Manager has the authority to remove, replace, or restore the work and deduct the costs from any monies due or to become due the Contractor.

105.13 RESERVED

105.14 RESERVED

105.15 COMPONENT INSPECTION

Upon notice of completion for a project component with a contract specific warranty (non-manufacturer), a milestone, or defined phase or unit of construction, the Project Manager will arrange to make an inspection of that work. Seal Coat warrantees will be administered in accordance with Section 409.

If the contract work is found satisfactorily completed, the inspection will constitute the component inspection. If the inspection discloses unsatisfactory work, the Project Manager will issue written instructions to the Contractor on the necessary corrections. When the deficiencies are corrected, another inspection will be made which constitutes the component inspection.

Upon completion of the component inspection, submit a completed "Contractor's Component Inspection" (form CSB105_15_1). The form is available from the Department's website or the Project Manager. The Contractor's project superintendent must sign the form. The form must state that:

1. The Department and the Contractor have completed a component inspection of the work, and the Contractor verifies that the work was completed in full accordance with the specifications and the requirements of the contract.
2. If applicable, the component has an associated incentive or disincentive, and they have been assessed.
3. If applicable, the component has an associated warranty and what the expiration date is.

Contract time assessment will not cease until all contract-specific warranties have expired, but may be suspended under Subsection 105.17.2. Within 14 calendar days of being notified of necessary warranty repairs, submit a plan detailing repair procedures, the expected date activities will begin, and expected duration of repair work. The time suspension will be rescinded and contract time charged if a repair plan is not provided within the allotted 14 calendar days.

The time suspension will be rescinded and contract time charged beginning on the date that repair activities begin or the date provided in the repair plan, whichever is earlier, and continue until repairs are complete.

Completion and approval of the Contractor's Work Component Inspection is not a statement or commitment by the Department that all work meets the contract requirements, and does not waive or alter any of the contract's terms.

105.16 CLAIMS FOR ADJUSTMENT AND DISPUTES

105.16.1 Notice of Claim

Submit a notice of claim using the Department's Notice of Claim Form CSB105_16_1A no later than the next business day of disagreements that are to be the subject of a claim for additional compensation, time extension, contract change, or other remedy. Provide full details in the written notice why additional compensation, time extension, contract change, or other remedy is warranted. Attach to the notice of claim all documentation showing the history of the disagreement.

Upon submission of the written notice, immediately begin keeping and maintaining complete and specific daily records using the Department's Claim Cost Record Form CSB105_16_1 of all details and costs directly related to the disagreement. The form is available from the Project Manager or the Department's website. Base equipment costs on internal rates for ownership, depreciation, and operating expense. Provide the Project Manager with updates of details and costs related to the disagreement as they develop.

Failure to timely provide the written notice as required waives the Contractor's right to make any claim for the disagreement. Ensure that any notice of disagreement is fully and completely explained and documented, as the Department expects and requires early notice to mitigate costs and to fully document any potential costs.

The Project Manager will attempt to resolve the disagreement after the written notice is submitted. The Project Manager will issue a written response no more than 14 calendar days after receipt of the written notice.

105.16.2 Submission of Certified Claims

If an agreeable resolution is not reached within 14 calendar days of the written notice, the Contractor may submit a Certified Claim using the Certified Claim Form CSB105_16_2 to the Project Manager no more than 7 calendar days after receipt of the Project Manager's response. The form is available from the Project Manager or the Department's website. Include all Claim Cost Records to date with the Certified Claim. Provide copies to the DCE and the CES Engineer of the Engineering Division. The Project Manager will continue to attempt to resolve the disagreement after the Certified Claim is submitted.

Detail the following in the Certified Claim:

A. Reasons for each requested remedy, referenced to the applicable contract provisions;
B. Objections to the Project Manager's response; and
C. Basis for and amount of any additional compensation, extension of time, contract change, or other remedy, including any potential solutions.

If the claim includes requests for delay compensation, follow all procedures in Subsection 108.07.6.

The Prime Contractor must verify the claim data and certify the claim. Claims from a subcontractor or supplier will not be accepted. Only the Prime Contractor may submit the Certified Claim.

Failure to timely submit the completed Certified Claim form or the Claim Cost Records as required is a material breach of contract and waives the Contractor's right to make any claim for the disagreement or be entitled to any compensation, time extension or contract change related to the disagreement.

Allow the Project Manager access to and provide copies of all records when requested by the Department. Make other project records available for technical and audit evaluation during the project and after the claim-related work has been performed. Promptly furnish written clarification and any additional information or data requested by the Department.

After the Certified Claim is submitted, continue keeping and maintaining complete and specific daily records using the Department's "Claim Cost Record" form of all details and costs directly related to the claim. Base equipment costs on internal rates for ownership, depreciation, and operating expense.

Submit claim updates every month until the claim is resolved. Include all costs incurred and any other pertinent information discovered after the Certified Claim was submitted, and include copies of all Claim Cost Records for that month.

For claims over $100,000, all claim costs must be certified by a certified public accountant (CPA) prior to the claim being resolved.

Do not change the basis of a claim after submitting the written notice. Do not supplement a faulty submission to rebut or dispute a decision made by the Project Manager. Claims that have changed in basis or that have been supplemented due to an original faulty submission will not be considered, and are waived by the Contractor.

The Contractor waives the claim and any compensation, time extension, or contract change for any of the following:

1. Not filing a timely, complete written notice;
2. Not submitting a timely and complete Certified Claim form;
3. Not submitting monthly claim updates as required; or
4. Not keeping and submitting timely and complete Claim Cost Records.

105.16.3 Decision on Claims

The Prime Contractor must verify the claim data and certify the claim. Claims from a subcontractor or supplier will not be accepted. The DCE will provide a written decision no more

than 30 calendar days after receipt of the Certified Claim for Contracts that do not require Escrow of Bid Documents. The DCE will provide a written decision no more than 45 calendar days after receipt of Bid Documents for Contracts that do require Escrow of Bid Documents. If additional time is required to research and evaluate the Claim, the DCE can extend the time period 14 calendar days by notifying the Contractor in writing.

To advance the claim, appeal the DCE's decision to the Claims Review Board (Board). Submit the "Request for Appeal" Form CSB105_16_3H to the CES Engineer no more than 30 calendar days after the date of the DCE's decision. Provide a copy of the appeal to the DCE. The DCE's decision is final unless appealed no more than 30 calendar days after the date of the decision. If appealed, the DCE will forward the original claim, supporting documents or evidence, and the District's evaluation to the CES Engineer.

The CES Engineer will submit the claim to the Board. Board meetings are scheduled on a quarterly basis, with the schedule available on request from the CES Engineer. Claim appeals received less than 60 calendar days in advance of the next scheduled Board meeting may not be presented to the Board until the following scheduled meeting.

The Board will only review those documents and evidence submitted in the original claim, its supporting documents, and the District's evaluation, but may request further information from the DCE or the Contractor.

The Board may affirm, overrule, or modify, in whole or in part, the decision of the DCE. The decision of the Board is the Department's final decision.

The Contractor or Department may request non-binding, independent third party mediation. The Contractor's request for third party mediation must be submitted to the Construction Engineer on the Request for Mediation Form CSB105_16_3E no more than 30 calendar days after the date of the Board's decision. If the Department and Contractor both agree to mediation, they must mutually agree on a mediator and a mediation date within 14 calendar days of the date of the request for mediation. All costs associated with mediation will be shared equally between the Contractor and the Department.

105.17 PROJECT FINALIZATION

105.17.1 Final Walk-through Process

When all physical work has been completed in accordance with the contract requirements, a final walk-through process will be completed to inspect the work and identify and resolve all punch-list items. If all work is complete but deferment of the final walk-through is necessary for causes outside the Contractor's control, the Project Manager will suspend contract time.

The following describes the process between the Project Manager and the Contractor:

1. The Contractor requests a final walk-through inspection using form MDT-CON-105_17_1B. Submit the preliminary MPDES/NPDES storm water permit package, if applicable, for review with this form if not previously submitted.
2. A final walk-through inspection is conducted between the Project Manager, DCE and Contractor. The final walk-through process may be postponed due to project conditions outside of Contractor control.
3. A final storm water walk-through is conducted between the Project Manager, District Environmental Engineering Specialist, Contractor, and Maintenance or local entity as appropriate.
4. Punch-list items are identified; including site work deficiencies, outstanding materials and/or Civil Rights requirements, environmental permit compliance issues, and outstanding claims. A written list of punch-list items is submitted to the Contractor within 30 calendar days of the request for the final walk-through inspection.
5. The Contractor submits the final MPDES/NPDES storm water permit package.

6. When punch-list items are completed and/or resolved, the Contractor requests a final verification using form MDT-CON-105_17_1C. The Department is exercising some operational control of the MPDES/NPDES storm water permit when the requested changes are completed.
7. The Project Manager will grant Conditional Final Acceptance within 30 calendar days of the request for the final walk-through verification. The final acceptance is granted with the condition that all contract-specific warranties have expired and all warranty issues have been resolved. If the punch-list items are fully resolved, no further action is required. If deficiencies still exist, payment will be deducted from the estimate as appropriate.

Contract time assessment will not cease until all contract-specific warranties have expired, but may be suspended under Subsection 105.17.2.

105.17.2 Final Acceptance

When the Final Walk-through Process is complete, all project-specific warranties have expired, and all warranty issues have been resolved, submit the Contractor's Certificate of Work Complete using form MDT-CON-105_17_2. Before the form will be approved by the Department, the contractor's representative must provide a sworn and notarized certification that the following items have been completed:

1. The work has been completed in accordance with the contract's specifications, and the required materials have been used, both in quality and quantity.
2. The Department and the Contractor have completed the final walk-through process, and the Contractor has corrected all deficiencies to the satisfaction of the Project Manager or payment will be deducted for outstanding deficiencies.
3. The project has been inspected for compliance with the MPDES/NPDES Storm Water Permit, all necessary corrective actions taken.
4. There are no pending investigations referencing alleged nonpayment to subcontractors or suppliers.
5. There are no pending labor compliance or nonpayment claims on the contract.
6. There are no known environmental violations. The Contractor is responsible for any violations issued for damages or non-compliance with permit requirements and conditions prior to the transfer of the MPDES/NPDES Storm Water Permit. The Contractor will defend and hold the Department harmless from any violations, claims, enforcement actions, penalties or fines issued for Contractor activities or recordkeeping that occurred prior to the transfer of the MPDES/NPDES Storm Water Permit; this does not include activities specifically directed by the Department in writing.
7. Liquidated damages have or have not been assessed, and damages that have been assessed either are or are not disputed by the Contractor.
8. The contract does or does not include any contract specific warranties (non-manufacturer). If it does, all contract specific warranties have expired and all corrective actions have been completed.

If any of the above is not completed in full before the certification form is submitted, the Project Manager will reject the form.

Contract time assessment will not cease until all warranty issues are corrected and the Contractor's Certificate of Work Complete form has been received and approved. The Project Manager may suspend contract time for punch-list items provided the roadway is in a safe and convenient condition. The date the form is approved is the Final Acceptance. Maintain the insurance specified in Subsection 107.13 until the Final Acceptance.

Completion and approval of the Contractor's Certificate of Work Complete form is not a statement or commitment by the Department that the work meets all contract requirements, and does not waive or alter any of the contract's terms.

105.17.3 Final Estimate Process

When the contract has reached the Final Acceptance under Subsection 105.17.2, the contract documents will be finalized and the final estimate processed within 90 calendar days. The final estimate will include the amount and value of each class of work performed and any extra work and materials. Errors made in previous partial payments will be corrected in the final estimate.

When the final estimate is prepared and all required documentation (such as material certifications, labor dispute resolutions, etc.) has been received, the Construction Administration Services Bureau will send a copy of the final estimate to the Contractor for review. The Contractor has 10 calendar days to notify the Project Manager in writing if the final estimate is acceptable. If no response is received within that timeframe, concurrence will be assumed.

To dispute the final estimate, submit the items disputed and justification to the Construction Administration Services Bureau. Provide a copy to the Project Manager. The Construction Administration Services Bureau will provide a written decision on the disputed items.

The Department reserves the right to withhold all or part of the final payments earned under the contract until all taxes and assessments due and owing to the State of Montana for any reason have been paid in full unless a written release is received from the Department or the state agency having a claim against the Contractor.

SECTION 106

CONTROL OF MATERIAL

106.01 SOURCE OF SUPPLY AND QUALITY REQUIREMENTS

The contract specifies the basis of acceptance for materials and assemblies.

106.01.1 Source of Supply

Use only materials that meet the contract requirements. Submit a list of the names and addresses of the suppliers, producers, manufacturers and fabricators furnishing products for the contract. Itemize the list as shown in the contract schedule of items.

Material may be inspected and tested at the source of supply before delivery to the project. All materials may be inspected, tested, and possibly rejected before incorporated into the work.

Perform sampling of any material to be tested in accordance with the contract. The Department will decide if a sample was taken correctly. Samples not properly taken may be rejected and may not be accepted for testing.

Determine the quality and quantity of materials produced at or developed from any source based on the contract documents and by conducting an independent source investigation.

If payments due the owner of a materials source become delinquent and the owner notifies the Department, a sum equal to the amount of the delinquent payments may be withheld from estimate payments due the Contractor.

106.01.2 Samples, Tests, and Cited Specifications

A. Materials accepted by Certification. Ensure all required certifications for materials are furnished to the Department and the Department has inspected and accepted the certification before incorporating the materials into the work.

The Project Manager may grant written permission to place materials before receiving certifications for materials only under the following conditions:

1. Not placing the materials poses immediate danger to traffic or the general public; or
2. Not placing the materials would cause a delay in the work resulting in damage to the project or adjacent property.

The Project Manager may require that materials be removed and replaced at Contractor expense if the certification(s) are not furnished.

B. Materials Accepted by Department Testing. Do not incorporate material into the work until it is inspected or sampled by the Department.

Reference to a specification or test designated in AASHTO, ASTM, Federal Specifications, or other recognized, nonproprietary national organization, is the specification or test method that is current on the date of advertisement for bids and as amended by the Department's Test Method Manual. Copies of individual Montana test methods (MT Methods) are available from the Department's website: www.mdt.mt.gov.

Department material tests are by and at the Department's expense. Where there is a difference in the test methods, the order of precedence for tests is:

1. The Department's Standard Material Test Methods in the Materials Manual
2. AASHTO
3. ASTM

Submit representative preliminary material samples in the specified quantities for testing upon request. The testing of preliminary samples does not constitute acceptance of the materials. Only materials delivered for incorporation into the work will be accepted or rejected based on the test results specified in the contract.

106.01.3 Unacceptable Materials

All materials not meeting the contract requirements will be accepted or rejected under Subsection 105.03.

106.02 LOCAL MATERIAL SOURCES

106.02.1 General

Local aggregate, borrow and topsoil materials sources include prospected sources, Contractor-furnished sources, and mandatory sources.

Provide the source for obtaining local materials unless mandatory sources are specified. When prospected sources are identified in the contract, use the prospected sources or locate other sources of material. Contractor-furnished sources must be approved by the Department. The Contractor must:

A. Provide an approved reclamation plan meeting Subsection 106.02.5 before using any materials source;

B. Comply with Section 106 of the National Historic Preservation Act; and

C. Adhere to state and federal requirements and obtain clearance from the State Historic Preservation Officer before using material from surfacing and borrow sources.

106.02.2 Prospected Sources

Each District/Area lab has historical information regarding potential prospected sources. This information typically includes the source location, owner, and some test results of samples taken from the source. To view or obtain this information for sources near a project, contact the Area Lab Supervisor. The phone numbers for the District area offices are in Table 106-1.

TABLE 106-1
DISTRICT/AREA LAB PHONE NUMBERS

Area	Phone Number
Missoula	(406) 523-5800
Kalispell	(406) 751-2000
Butte	(406) 494-9600
Bozeman	(406) 556-4700
Great Falls	(406) 454-5880
Havre	(406) 262-5500
Glendive	(406) 345-8200
Wolf Point	(406) 653-6700
Miles City	(406) 233-3600
Billings	(406) 252-4138
Lewistown	(406) 538-1300
Helena	(406) 444-6300

The Department is not responsible for the quantity or quality of materials indicated in the prospected source reports. Test data included in the reports are based on the samples tested from the exact locations shown using standard tests. No interpretation is made or intended by the Department. Any interpretation is the judgment of the person examining the tests. See Subsection 102.06 concerning verifying quantity and quality by an independent subsurface investigation before submitting a bid. Make arrangements with landowners for sampling and obtaining material from the prospected material sources.

Do not sell or use material from Department-owned or Department-optioned sources for anything other than the designated project without a written agreement from the landowner and Department approval. Other than those requirements specified in a written agreement between

the landowner and Department, any arrangements between the landowner and the Contractor are solely between them. Submit copies of all correspondence and agreements with the landowner to the Project Manager.

Notify the Department in writing if a prospected source is to be used and list the contract items for which that material will be used.

Pay all royalties, obtain all required permits and follow their requirements. Coordinate with the landowner to determine the access routes that are allowed for use and any additional landowner requirements. Adhere to all agreed stipulations, including contouring of pits, topsoil conservation and replacement, seeding, repair or obliteration of haul roads, cattle guards, and fencing; the cost of which is incidental to and included in the materials cost.

106.02.3 Contractor-Furnished Sources

Acquire the rights to take materials from Contractor-furnished sources and pay all related costs, including costs due to increased haul length, exploring and source development.

Furnish material that meets all statutory and regulatory requirements for being non-toxic and non-hazardous. Do not furnish material from mine tailings and waste, slag, sources within state and federal superfund sites, or sources within areas known or suspected to be contaminated with toxic substances or petroleum products unless laboratory reports from an approved laboratory indicate the material meets these requirements.

Obtain Department approval for any special borrow or aggregate source prior to use. Arrange with the Project Manager for representative samples to be taken and witnessed by the Department at least 30 calendar days before beginning production. Provide all equipment and labor necessary for the sampling. See Subsection 106.10 for the number of Department furnished tests at Department expense.

The Department's approval of the source does not release the Contractor from the responsibility to produce materials meeting all specified acceptance requirements.

A. Borrow Source Approval. The 85th percentile of the samples taken from the source(s) must meet the R-value and/or the soils classification specified in the contract.

Furnish a minimum of 8 Department-witnessed samples at the locations and depths designated within the limits of the proposed source(s).

Samples will be tested for R-value according to AASHTO T 190. The R-value at a 300 psi (2,068 kPa) exudation pressure will be used for evaluation. Samples will be tested for soils classification according to MT 214. If the source is approved, it may be limited to certain areas, layers, or soil classes within a source, during or after source approval testing. Approval of the source does not preclude the Department from sampling from the roadway.

B. Aggregate Source Approval. The Department will process and test samples to determine the suitability of the material in accordance with Subsections 701.02.1 and 701.03.1.

Passing wear and sand equivalent test results are mandatory for Department approval of bituminized material aggregate sources. Passing wear test results are mandatory for Department approval of untreated aggregate sources.

Assume all risk for producing aggregate from sources not meeting the wear test (MT 209) and sand equivalent test (AASHTO T 176). The Department will randomly test stockpiled aggregate for wear and sand equivalent.

106.02.4 Mandatory Material Sources

Use of materials from mandatory sources is a condition for preparing a bid and executing a contract. Follow the conditions in the contract for producing materials from mandatory sources.

106.02.5 Reclamation Requirements

A. General. Reclaim all land used in constructing the project as required by the approved reclamation plan. Comply with the pertinent statutes relating to open cut mining (Section 82-4 MCA); hard rock mining (Section 82-4-3 MCA); water quality (Section 75-5 MCA); stream bank preservation (Sections 82-5-5 and 75-5 MCA); the Montana County Noxious Weed Management Act Section 7-22-21 MCA; and all other applicable federal, state, and local statutes, regulations and ordinances.

The DEQ has final responsibility for administration of the Open Cut Mining Act and the Hard Rock Mining Act and must review and approve all reclamation plans and reclamation work. Follow all directives and instructions issued by the DEQ with regard to reclamation work.

B. Reclamation Plan. Submit a copy of the approved reclamation plan before removing earth, quarried rock, sand, gravel, or other substance from any materials source. Follow the DEQ "Format for Reclamation Plan" and "Mapping Guidelines" when developing reclamation plans. The format and guidelines are available from:

Department of Environmental Quality
Permitting and Compliance Division
Industrial and Energy Minerals Bureau
Open Cut Mining Section
Helena, MT 59620-0901

The time allowed for approval of reclamation plans is included in the Open Cut Mining Act, Section 82-4-434 MCA.

C. Reclamation Work. Perform reclamation immediately after removing the necessary material. Leave all slopes in a stable condition and, if topographic conditions permit, grade to no steeper than 3H:1V after final grading. Grade the excavated area to maintain the natural contour of the land and blend into the surrounding terrain. Remove or grade all outcroppings to daylight where possible.

Strip and stockpile all topsoil and overburden from the material source, stockpile site, crushing area, and equipment parking areas before excavating material. Salvage all topsoil from all new or widened haul, access, and service roads before grading or surfacing. Reclaim all roads when removal operations are complete. Store overburden or subsoil separately from topsoil and replace before topsoil is replaced on reclaimed areas. Uniformly re-distribute all topsoil to the entire reclaimed area.

Seed all re-top soiled areas during the first seeding season following grading and topsoil replacement. Contour-seed all slopes steeper than 3H:1V.

Fence newly seeded, reclaimed areas including roads where required to protect from livestock. Use Type F-3M fence.

Do not locate material sources in a flowing stream or on a stream floodway at a location likely to develop a new channel to the stream during flooding. Leave the final floor elevations of material sources high enough to not be impacted by fluctuations in the groundwater table, unless addressed in the approved reclamation plan. Provide protection and safety of persons and property adjacent to the work.

D. Method of Measurement and Basis of Payment. Reclamation of material sources is incidental to the materials cost.

106.02.6 Protection of Livestock and Property

Prevent livestock from straying into or out of any materials source.

Protect all irrigation facilities from construction operations. Promptly repair or replace damaged irrigation facilities to the landowner's satisfaction at Contractor expense.

106.02.7 Rejects (Excess Fines)

Material referred to as "rejects" are inherent in a rock pit, gravel pit, or quarry, or accumulated during crushing and screening operations. Stockpile rejects, from material sources owned or optioned by the Department and not acceptable for use on the project, at a site selected or approved by the Project Manager when requested. Stockpiled reject material is paid for at 15 cents per ton mile (10 cents per MT- km) for haul in excess of 200 feet (61 m) from the crusher site to the stockpile.

Retain title to all rejects accumulated during aggregate production from Contractor-furnished sources. Department purchased rejects are paid for at an agreed purchase price.

106.03 CERTIFICATION OF COMPLIANCE

A certification of compliance states the material meets the contract requirements. A manufacturer's authorized representative must sign the certificate. Clearly identify each lot of certified materials or assemblies delivered to the work in the certificate of compliance. Materials or assemblies used on the basis of certificates of compliance may be sampled and tested at any time. Materials not meeting contract requirements will be rejected.

106.03.1 Product Data Sheet

A product data sheet describes the mechanical, thermal, physical, chemical, and specific properties of the product. Product data sheets must contain relevant standards, test methods, and results for applicable materials and subcomponents showing products to be in compliance with contract requirements.

106.04 PLANT INSPECTION

Meet the following conditions if materials are Department inspected at the source of supply or manufacture:

A. Provide the Inspector full cooperation and assistance during inspections.
B. Provide the Inspector full entry to all parts of the plant used in the manufacture or production of the materials.
C. Furnish the facilities to determine if the material furnished meets contract requirements.
D. Provide and maintain adequate safety measures.

Materials inspected at the source may be re-inspected before incorporation into the work. Materials not meeting the contract requirements will be rejected.

106.05 FIELD LABORATORY

The Department will furnish all field offices and laboratories.

Furnish and install electrical power to field offices and laboratories as directed:

- A continuous 200-ampere, 220 to 230 volt, single phase, 60-hertz power supply using a four wire connector; or
- A 110 to 120 volt alternating current of sufficient capacity.

Have the source connected by a Montana licensed electrician.

Furnish a potable water supply to operate all testing equipment for the offices and laboratories.

Notify the Project Manager at least 2 business days prior to producing material to be tested in the field laboratory. Do not begin production until the test trailer is fully operational.

No additional payment will be made for providing power and water to the field office and laboratories. Include these costs in the other items on the project.

106.06 QUALIFIED PRODUCTS LIST

The Department's Materials Bureau maintains a QPL. Obtain further information and requirements on the QPL website, located at http://www.mdt.mt.gov contracting/consultant link.

The QPL is limited to certain types of items. Different types of products may be added to, or deleted from the QPL. Procedures for qualifying, listing, and de-listing products are available on the QPL website.

Materials listed as approved on the QPL at the time the materials are delivered to the project may be accepted as a pre-approved QPL item in lieu of the normal sampling and testing procedures.

Submit the documentation required by the QPL.

Work to qualify or list products on the QPL is not measured for payment.

106.07 HANDLING AND STORAGE OF MATERIALS

Store and handle materials to preserve their quality. Stored materials are subject to inspection and re-testing before incorporating into the work. Locate stored materials for ease of inspection.

Obtain approval to use portions of the right-of-way for storage and placing the plant and equipment.

Obtain additional required space at Contractor expense. Do not use private property for storage without the landowners or lessees written permission. Furnish copies of the written permission to the Project Manager. Restore all storage sites to original condition at Contractor expense.

Transport bulk materials in vehicles that do not cause material loss or segregation.

106.08 DEPARTMENT FURNISHED MATERIAL

Department furnished material will be delivered or made available at the locations specified.

Include the cost of handling and placing Department-furnished materials in the contract unit price for the item.

Be responsible for all Department furnished material. Deductions will be made from any monies due for shortages, deficiencies, and damage that occur after delivery. Demurrage charges, resulting from failure to accept the material at the designated time and location will be deducted from monies due the Contractor.

106.09 DOMESTIC MATERIALS

Furnish domestic steel or iron materials for applicable products as defined in MT 601. Notify the Project Manager and obtain clarification for any materials containing steel or iron components prior to their incorporation if not clearly defined in MT 601. Domestic material is material produced by manufacturing processes, including coating of steel or iron, that have occurred entirely in the United States. Pig iron, and processed, pelletized and reduced iron ore may be manufactured outside the United States. As required, furnish certification from the original steel producing mill documenting the manufacturing processes, including coatings of covered materials, as performed in the United States.

Buy America requirements apply to all manufactured products composed predominantly of steel or iron materials. A product is considered to be manufactured predominantly of steel or iron if the product consists of at least 90% steel or iron content, as determined by the Department, when it is delivered to the job site for permanent incorporation. For purposes of addressing precast or pre-stressed items, the job site encompasses locations where the precast operations occur. Buy America requirements do not apply to miscellaneous steel or iron components, subcomponents, or hardware; such as cabinets, covers, shelves, clamps, fittings, sleeves, washers, bolts (excluding high strength and anchor bolts), nuts, screws, tie wire, spacers, chairs,

lifting hooks, faucets, or door hinges that are commonly available as off-the-shelf products or minor items that are necessary to encase, assemble and construct project materials.

Do not incorporate steel or iron materials into the project until a completed Form 406 with all required documentation is submitted to the Department. Ensure that suppliers understand the Buy America and contract requirements to supply the required documentation. Submit documentation to the Department in a clear, organized, legible manner or it will be returned. Clarify which material certifications are for which items. The Department will review the submitted documentation one time at no cost to the contractor. If the Department determines that the submitted documentation is inadequate or fails to meet the contract requirements, the submitted documentation will be returned for clarification or correction. The cost for the Department's re-review of the same submittal is the contractor's responsibility, and may be deducted from contractor payments.

The Department will not pay for items installed until the submitted Form 406 and supporting documentation has been reviewed and is found to be in accordance with the contract requirements. Insufficient or unavailable documentation or documentation showing products to contain steel of foreign origin are grounds for removal and replacement at the contractor's expense.

Material inspection of pre-cast products, prefabricated steel products, or prefabrication plants will take place at the point of manufacture. The District Materials Lab, Helena Materials Bureau, or Department representative will inspect the manufacturing of these items and verify that the fabricator is maintaining supporting documentation. All precast products containing steel and prefabricated steel products delivered to the project must be accompanied by certification from the end product manufacturer or prefabrication plant which states that all steel used in the product has been melted/recycled and manufactured entirely in the United States and they have maintained supporting documentation. Submit a Form 406 with certification by the end product manufacturer or prefabrication plant that all steel incorporated has been melted/recycled and manufactured entirely in the United States. All supporting documentation must be maintained by the fabricator and made available to the Department as requested.

A minimal quantity of foreign manufactured steel and iron material may be used if the cost of the material, including delivery costs to the project, does not exceed one-tenth of 1% of the total contract amount or $2,500.00, whichever is greater. Submit a request to use a minimal quantity of foreign manufactured steel and iron a minimum of 5 business days before incorporation into the work. Include in the request the dollar amount of the steel for this request, and the cumulative dollar amount requested to date. Provide documentation, typically in the form of invoices, showing product and delivery cost. Failure to do so will require removal and replacement of all foreign steel and iron with domestic steel and iron. If the foreign steel and iron cannot be positively distinguished from any domestic material used, then all of the material must be removed and replaced with domestic steel and iron at the contractor's expense.

106.10 MIX DESIGNS AND TESTING OF MATERIAL SOURCES

The Department will furnish the number of mix design verifications or tests shown in Table 106-2, at no cost to the Contractor.

TABLE 106-2
NUMBER OF MIX DESIGNS VERIFICATIONS OR TESTS FURNISHED AT NO COST

Description	Number Furnished Per Contract
Plant Mix Surfacing Mix Design Verification	2 per grade
Portland Cement Concrete Mix Design Verification	1 per class
Cement Treated Base Mix Design Verification	2 per grade
Special Borrow Testing Package	1 per 65,000 cubic yard (50,000 m^3) of plan quantity
Surfacing Material Testing Package Indicated source(s) shown on plans Surfacing source(s) furnished by the Contractor	 2 2

Requests for additional verification or testing will be processed in the order received, with a minimum 30 calendar day turnaround. The Contractor will be charged the Department's cost for each additional mix design verification or testing package. The total cost will be deducted from the progress estimate payments.

SECTION 107

LEGAL RELATIONS AND RESPONSIBLITIES TO THE PUBLIC

107.01 LAWS, RULES AND REGULATIONS TO BE OBSERVED

Observe and comply with all of the following:

A. Federal and state laws and regulations;

B. Local laws and ordinances; and

C. Regulations, orders and decrees of bodies or Tribal ordinances having any jurisdiction or authority.

Protect and indemnify the Department and its representatives against any claim or liability arising from the violation of any of the above listed items, whether violated by the Contractor, a Subcontractor, material man, or supplier, or any of their employees or agents.

Follow all rules and regulations of federal, state, and local health officials. Do not require an employee of the Contractor or Subcontractor(s) to work in surroundings, or under conditions that are unsanitary, hazardous or dangerous to health or safety. Admit any Inspector of the OSHA or other legally responsible agency involved in safety and health administration without delay and without presentation of an inspection warrant to all areas of the work and project site upon presentation of proper credentials.

Comply with and enforce all federal, state, and local safety standards (e.g. the Montana Scaffolding Act, etc.) for Contractor's workers and its Subcontractor's workers on the project, protecting and indemnifying the Department and its representatives from all claims, suits, damages or liabilities from all accidents or safety violations, and ensuring the public's safety. The Contractor is not to enforce safety standards for Department employees.

Follow federal, state and local laws, rules and regulations regarding unlawful employment practices including race, religion, color, sex or national origin discrimination, and that define actions required for Affirmative Action and Disadvantaged Business programs.

Work within a state or national forest is under the regulations of the authority having jurisdiction governing the forest.

Immediately notify the Project Manager in writing if any discrepancy or inconsistency is discovered between the contract and any law, ordinance, regulation, order or decree.

107.02 PERMITS, LICENSES AND TAXES

Obtain all legally required permits, authorizations, and licenses, pay all charges, fees, taxes, and fuel taxes giving all notices necessary and incidental to the lawful prosecution of the work.

107.03 PATENTED DEVICES, MATERIALS AND PROCESSES

Do not use any design, device, material, or process covered by letters of patent or copyright, without a legal agreement with the patentee or owner. Indemnify and hold harmless the Department, any affected third party, or political subdivision from all claims for infringement for the use of any patented design, device, material or process, or trademark or copyright. Indemnify the Department of all costs, expenses, and damages obligated for payment by reason of an infringement during the prosecution or after the completion of the project.

107.04 RESTORING SURFACES OPENED BY PERMIT

The Department may grant permits to construct or re-construct a utility facility in the highway or street for authorities of the municipality in which the work is done. Do not allow any individual, firm, or corporation to make an opening in the street without a Department permit. Do not allow any person or persons to make an opening unless authorized by the Department. Parties bearing permits may make openings in the street. When requested by the Project Manager,

repair these openings. The work is paid for under Subsection 104.03 or as provided in the contract. Repair to the same standards as the original work.

107.05 FEDERAL AID PARTICIPATION

Federal laws, rules, or regulations in conflict with any provisions of a federally assisted contract prevail and take precedence over conflicting contract provisions.

Federally assisted work is under Department supervision and subject to inspection and approval of the United States Government. Inspections by authorized Federal representatives do not make the United States a party to the contract and do not interfere with the rights of the contract parties.

107.06 PUBLIC CONVENIENCE AND SAFETY

Conduct construction with minimum obstruction to traffic. Provide safety and convenience to the public and protect persons and property including, but not limited to, items specified in Subsection 104.05 and Section 618.

High-visibility safety apparel must be worn by all workers within the right-of-way of all projects. Use high-visibility safety apparel that meets the Performance Class 2 or 3 requirements of the ANSI/ISEA 107 publication entitled *American National Standard for High-Visibility Safety Apparel and Headwear*.

Workers include all persons on the project at the request of, employed by, or for the benefit of the Contractor. This includes suppliers and subcontractors at every tier including volunteers.

A workers failure to wear required apparel may result in the worker's immediate and permanent ejection from the project, and/or a suspension of work in that area, at the discretion of the Project Manager. No claim for compensation or delay costs may be made by or through the Contractor in such a case.

Provide complete protection at all times to the travelling public crossing under any structure. Employ positive means such as netting, tarpaulins, wood, or metal covering to prevent tools, materials, etc. from falling onto the roadway below. Positive protection may include traffic control methods, or other approved means to ensure complete protection.

Submit the proposed method and any modifications of the proposed method of traffic protection for approval to the Project Manager a minimum of 2 days prior to the start of this work. Do not begin work until the protection plan is approved and installed to the satisfaction of the Project Manager. Failure to maintain such safeguards in an effective manner may result in an immediate shutdown of work until corrected.

Do not close public roads without the Engineer's permission.

Providing protection to underlying roadways is not measured for payment.

107.07 RAILWAY-HIGHWAY PROVISIONS

Responsibilities for work involving railway property are:

A. Contractor. Perform work on railroad right-of-way without interfering with the movements of trains or traffic on railway property. Do not cross the railway right of way or tracks except at temporary or existing, open public grade crossings.

Furnish signed copies of the *Contractor Requirements and Acknowledgment for Working on Railroad Right of Way* found in the contract to the railroad and Project Manager before entering railroad property and starting work.

Provide advance notice, as agreed to between the Contractor and railway officials, before working on railway property, hauling across railway tracks, or blasting within 1000 feet (305 m) of railway property.

Comply with Section 204 and Subsection 107.18 when blasting or performing other work on or near railway property.

Furnish insurance for all work performed as required by Subsection 107.13 or the contract. Make arrangements with the railway company for railway crossings not specified in the contract at Contractor expense.

Reimburse the railroad company for all costs of railway flagging, other protective services, and installation of temporary crossings for haul roads for Contractor-furnished material sources based on billings submitted by the railway company.

B. Department. The Department will:

1. Enter into an agreement with the Contractor and the railway company when required by the railway company;
2. Arrange for railway crossings specified in the contract and pay for the crossings, railway flagging and other protective services necessary for work performed on or near railroad right of way, including haul road track crossings to Department-optioned or owned material sources; and
3. Forward billings for flagging, track crossings, and other protective service billings for Contractor-requested crossings, submitted to the Department by the railway company.

C. Railway. Railway companies must:

1. Furnish all flagging or other protective service as necessary for the safe operation of trains or traffic on railway property, and
2. Construct, maintain, protect, and remove temporary crossings and submit billings for flagging or other protective services to the Contractor or Department.

107.08 LOAD RESTRICTIONS

Do not exceed legal load restrictions when hauling material and equipment on public roadways and bridges within and beyond the project limits and on all new and existing Portland cement concrete roadways, completed and accepted gravel surfaces, treated base courses, bituminous surfacing lifts and courses, including plant mix base, plant mix surfacing, and seal and cover.

Do not place loads on a concrete pavement, treated base, or structure before the curing period has been achieved.

Repair damaged roadways and structures resulting from construction operations at Contractor expense.

Measure and analyze truck legal load limits by the bridge formula before hauling any material over existing or newly paved roadways and bridges. Furnish a drawing showing distances between axles, truck tare weight, and the overall length of each truck prior to hauling or placing operations.

Show a minimum of two applications using the bridge formula on the drawing. Include on the first application the overall length between axles. For the second application, do not consider the steering axle, and add the value obtained from the bridge formula to the anticipated load on the steering axle. Use the lesser of the two values obtained as the legal load. Retain a copy of the appropriate drawing in each truck. Do not exceed established legal load weights for single axle and tandem axles.

If raising a retractable or tag axle results in the truck being over the maximum legal weight, only raise the axles when backing to unload at a chip spreader, windrow, or plant mix paver. Back the minimum distance possible while over legal weight restrictions. Do not exceed the legal weight on the steering axle by more than 25% or tandem axles by more than 50% while backing with retractable or tag axles lifted.

The weight on a truck in excess of the maximum legal weight as determined above will be deducted from the quantity considered for payment.

Comply with this provision and all applicable laws, rules, and regulations related to operation of motor vehicles on public roads.

Trucks operated on public roads may be checked by the Department's Motor Carrier Services Division and fines levied for exceeding legal loads.

Do not use existing bridges, new bridges, or bridges to be removed but still in use by the public as work platforms, work bridges, or to support or move equipment without the Department's written approval.

Approval will be granted only where load analysis and review of traffic control, safety, and convenience show it to be in the public interest.

No additional compensation will be considered or allowed for any violation of these provisions.

107.09 RESERVED

107.10 PROTECTION AND RESTORTATION OF PROPERTY AND LANDSCAPE

107.10.1 Public and Private Property

Preserve all public and private property when performing work. Do not disturb or damage land monuments and property markers until witnessed or referenced by the Project Manager.

Be responsible for all damage to public and private property resulting from any act, omission, neglect, or misconduct in the manner or method of executing work until the project is accepted. This responsibility includes damage caused by compaction, vibratory, and impact equipment.

Replace or restore damaged property to its original condition at Contractor expense.

Conduct a review of all public roadways to be used by Contractor equipment, including haul operations, before work begins. Arrange for a local road authority representative and the Project Manager to attend the review.

The parties are to review and document the roadways existing condition and determine a dispute resolution process if an agreement on roadway restoration cannot be reached.

Once the roadway is no longer in use by the Contractor, conduct another review by the same parties. The parties are to reach an agreement on what is required to restore the roadway comparable to its original condition.

Perform all work required to restore the roadway comparable to its original condition and obtain the Project Manager's approval of the work once completed.

Roadway restoration is not measured for payment.

107.10.2 American Legion Fatality Markers

Take inventory of all American Legion Fatality Markers (fatality markers) within the project limits prior to construction activities. Identify the fatality marker's route, reference post, and side of road it is located on. Identify fatality markers in conflict with proposed construction activities and those that are not.

A. **Fatality Markers in Conflict with Construction Activities.** Prior to construction activities in vicinity of fatality markers, remove and locate fatality markers to a safe location. Upon completion of construction activities, return the fatality markers to the same route as close as practical to the original reference post and side of road, at an offset distance established by the Department.
B. **Fatality Markers not in Conflict with Construction Activities.** Do not disturb fatality markers not in Conflict with construction activities.

Be responsible for all damage to fatality markers resulting from any act, omission, neglect, or misconduct in the manner or method of executing work until the project is accepted. Replace or restore damaged fatality markers to their original condition at Contractor expense. All costs

incurred to meet the American Legion Fatality Marker requirements are incidental to other items of the contract.

107.11 ENVIRONMENTAL PROTECTION

107.11.1 General

Follow all state, local, tribal, and federal laws and regulations controlling pollution of the environment. Take precautions to prevent pollution of aquatic resources from silt, fuels, oils, bitumen, chemicals, or other harmful materials. Take precautions to prevent pollution of the atmosphere from particulate and gaseous matter.

Do not begin work in areas covered by the permits, authorizations, or notifications until all are received from the regulatory agency. Allow a minimum of 45 calendar days to receive required permits, authorizations, or notifications from the date of the submittal of a complete request, unless a different timeframe is specified by the regulatory agency. The Department is not responsible for delays caused by incomplete or inaccurate submittals by the Contractor.

Obtain and submit one copy to the Project Manager of all required environmental permits, authorizations, and notifications necessary for activities relating to construction activities, including those secured for sites outside of the project limits before construction activities start in permitted area. Submit to the Project Manager, within 7 calendar days of sending or receiving, all correspondence to or from regulatory agencies regarding potential noncompliance or violations.

107.11.2 Water Pollution Control Regulations

Refer to Section 208 for other requirements relating to water pollution control and aquatic resource protection.

A. Construction De-watering Permit. A Construction De-watering General Permit Authorization is required for any construction activity that discharges sediment-laden water from the work area, such as cofferdams, trenches, excavation pits, or other work types identified in the permit, to state waters. Obtain authorization from the Water Protection Bureau, DEQ before discharging into any state waters. If sediment-laden water is land-applied and will not reach state waters, then a discharge permit is not required.

B. Short-term Turbidity Standard (318 Authorization). Obtain authorization as required under Section 75-5-318 MCA, for any activity that will cause a short term increase in turbidity.

C. Section 404 - Nationwide Permit (NWP) and Individual Permit (IP). Follow the provisions of the Federal Clean Water Act, including the requirements of Section 404.

Temporary facilities and construction activities in and around waters of the U.S. may be covered by a COE 404 Permit. Adhere to applicable permit conditions and/or NWP Fact Sheets, Regional Conditions, and 401 Certification requirements. Obtain a 404 Permit for temporary facilities and/or construction activities that are not covered by the 404 Permit obtained by the Department for permanent structures. These construction activities may include, but are not limited to, temporary work bridges, work pads, cofferdams, diversions, temporary fills and berms, haul roads, and other work that involves the placement of fill or dredged materials into waters of the U.S.

Prepare the application and submit to the Project Manager for Department review and submittal to the COE. The contract may include additional conditions and requirements for applicable Section 404 permits.

D. Section 10 Rivers and Harbors Act Permits. Follow the requirements of the Rivers and Harbors Act, including requirements of Section 10. COE permits are required for structures or work in, over, under or affecting navigable waters of the U.S. In Montana,

navigable waters of the U.S. include, but are not limited to the: Kootenai River, Missouri River, and Yellowstone River. Section 10 permits can be issued concurrently with the Section 404 permits described above. Adhere to applicable permit conditions and/or NWP Fact Sheets, Regional Conditions, and 401 Certification requirements.

E. General Storm Water Permits. Follow the requirements of the NPDES and MPDES Storm Water Permits. Coverage under the General Permit for Storm Water Discharges Associated with Construction Activities (General Storm Water Permit) is required for any construction activity that disturbs an area of at least one acre or has the potential of discharge. DEQ administers the MPDES permit. If the project is located on one of Montana's Indian Reservations, NPDES permit authorization is issued by the EPA. Permit authorization is obtained by submitting a complete application package, including the Notice of Intent (NOI) to the appropriate regulatory entities. The EPA allows electronic submittal of the NOI. Obtain the permit authorization directly from the DEQ or EPA.

F. SPA 124 Notification. Follow the requirements of the Montana Stream Protection Act (SPA). The SPA is administered by FWP.

Obtain an SPA 124 for temporary facilities and/or construction activities that are not covered under the SPA 124 obtained by the Department. These activities may include, but are not limited to, work bridges, work pads, cofferdams, temporary detours, diversions, removal and disposal of existing structures, access, sequencing, and construction methodology.

Prepare the application and submit it to the Project Manager for Department review and submittal to FWP. The contract may include additional conditions from the SPA 124 obtained from Contractor submittal.

G. Tribal Permits. Work within reservations may require additional permits and submittals to tribal authorities. Coordinate with the Department to determine requirements and receive assistance in obtaining permits.

The Aquatic Lands Protection Ordinance (ALPO) #90-A provides regulation of all waters and aquatic lands on the Blackfeet Reservation in order to prevent or minimize their degradation. Obtain an ALPO permit for any project within or near aquatic resources.

The Shoreline Protection Office of the Confederated Salish and Kootenai Tribes (CSKT) Tribal Council administers the following Tribal Ordinances:

1. Shoreline Protection Ordinance 64A, which deals with any work along the shoreline of Flathead Lake.
2. Aquatic Lands Conservation Ordinance (ALCO) 87A, which is required for the alteration of aquatic lands, wetlands, or Flathead Reservation waters from activities such as dredging, filling, irrigation diversions and returns, drainage ditches, and maintenance repairs of these resources.

Tribal Permits are required for construction activities within the project limits and may be required for temporary facilities outside the project limits. If required, coordinate with the Department and obtain tribal permits from the tribal office for additional activities and facilities not covered by tribal permits obtained by the Department.

H. Floodplain Permit. Follow the requirements of the Montana Floodplain and Floodway Management Act. Any construction project within a designated 100-year floodplain is required to have a floodplain development permit prior to the start of construction. The DNRC administer this permit through the Floodplain Management Section or local floodplain administrators.

The Department obtains this permit for permanent facilities. Obtain the Floodplain Permit from the DNRC or the local floodplain administrator for temporary facilities if required.

107.11.3 Air Quality

Operate all equipment including, but not limited to, hot-mix paving plants, concrete batch plants, generators, aggregate crushers and screens, etc. to meet the minimum air quality standards and applicable requirements established by federal, state, tribal, and local agencies. Secure necessary air quality permits from the appropriate regulatory entity.

Use reasonable precautions to prevent or reduce dust on the project caused by construction operations or traffic, to be in compliance with all federal, state, tribal, and local laws and regulations.

Use water, liquid magnesium chloride, liquid calcium chloride, or other dust palliative approved by the Project Manager. Use only Contractor owned water sources or water that is obtained under a purchased water right according to applicable laws.

Dust control for compliance with all laws and regulations is not measured for payment. Include the cost for dust control in the item of work being performed that results in dust. Any violations or fines associated with dust control/dust control operations are the responsibility of the Contractor.

No additional payment will be made for the use or installation of dust or smoke control devices, for the disruption of work or loss of time occasioned by the installation of such control devices, or for any other related reasons.

107.11.4 Noise Pollution

Adhere to local noise ordinances, laws and regulations, and follow all requirements contained in the contract regarding noise pollution.

107.11.5 Noxious Weed Management

Follow the requirements of the County Noxious Weed Management Act, Section 7-22- 21 MCA, Section 80-7-912 MCA and all county and contract noxious weed control requirements. Determine the specific noxious weed control requirements not specified in the contract of each county where the project is located before submitting a bid.

Any product containing forage per Section 80-7-903 MCA must be certified noxious weed seed free by the Montana Department of Agriculture.

Noxious weeds include those species designated by the Montana Department of Agriculture. The most recent list of designated noxious weeds is available from the Montana Department of Agriculture, or local county Extension Service or Weed District. The Montana Department of Agriculture web site with noxious weed information is: www.agr.mt.gov/weedpest/noxiousweeds.asp.

Clean all equipment and vehicles prior to their transport into the project area. Equipment or vehicles with visible dirt or plant parts will not be allowed into the project area until they are cleaned to the satisfaction of the Project Manager.

All costs incurred to meet the county weed control requirements are incidental to other items of the contract.

107.11.6 Noxious Weed Control

When Noxious Weed Control is included as a bid item, provide noxious weed control to all lands within the right-of-way within the project limits.

Monitor the construction, borrow and staging areas at intervals necessary to prevent noxious weeds from developing viable seed. Noxious weeds may be controlled through hand-pulling or

herbicide application. Select the most effective and appropriate means of control based upon the species and size of infestation and environmental conditions.

If the control is accomplished with the application of herbicides, use only a licensed commercial pesticide applicator certified to apply general and restricted-use herbicides. Use herbicides that meet all applicable state and federal pesticide laws and that are registered with the Montana Department of Agriculture as required by the Montana Pesticide Act. Apply herbicides in a manner that provides immediate control, but does not jeopardize or cause potential harm to final reclamation objectives. Follow all applicable state and federal pesticide laws. If it is determined that herbicide application caused or contributed to the failure of reclamation, take corrective action at no additional cost to the Department.

Do not perform noxious weed control on areas that have received final seeding.

Noxious Weed Control within the project limits is measured by force account methodology. Noxious Weed Control in areas outside of the project limits is not measured for payment.

Work performed within the project limits is paid by units of Noxious Weed Control.

107.11.7 Plant and Animal Protection

A. Migratory Bird Treaty Act. Complete operations in compliance with the Migratory Bird Treaty Act. Migratory birds of any kind (including but not limited to swallows and other song birds) are protected under the Migratory Bird Treaty Act. It is unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product, manufactured or not. Direct disturbance of an occupied migratory bird nest (with birds or eggs) is prohibited under the law.

The Migratory Bird Treaty Act does not prohibit the destruction of most unoccupied (without birds or eggs) migratory bird nests, provided that no possession occurs during the destruction. The destruction of unoccupied nests of eagles and other threatened and endangered species is not allowed.

Contact the Department District Biologist if further instruction, clarification or consultation is required prior to or during construction.

Compliance with the Migratory Bird Treaty Act is incidental to performance of the work and no additional payment is made.

B. Bald and Golden Eagle Protection Act. Complete operations in compliance with the Bald and Golden Eagle Protection Act. The Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c) prohibits anyone, without a permit issued by the Secretary of the Interior, from “taking” bald eagles, including their parts, nests, or eggs. The act provides criminal penalties for persons who “take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle or golden eagle, alive or dead, or any part, nest, or egg thereof.” The act defines “take” as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb.”

For purposes of this contract, “disturb” means: “to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle; 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.”

In addition to immediate impacts, this definition also covers impacts that result from human induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle’s return, such alterations agitate or bother

an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habits, and causes injury, death, or nest abandonment.

Violation of the act can result in a fine of $100,000 ($200,000 for organizations), imprisonment for one year, or both, for a first offense. Penalties increase substantially for additional offenses, and a second violation of this act is a felony.

C. Endangered Species Act (ESA). Complete operations in compliance with the ESA (16 U.S.C 1531 et seq.). The ESA provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The ESA prohibits any taking of a threatened or endangered species. The definition of "take" includes to harass, harm, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct.

107.11.8 Protection of Aquatic Resources

Unless permitted or authorized, do not impact any aquatic resources located adjacent to the project. Avoid all equipment traffic, fill material, staging activities and other disturbances to all aquatic resources.

In areas adjacent to any water body including streams or irrigation ditches crossing the highway, and any wetland areas; or in areas immediately adjacent to the highway susceptible to sediment transport, conduct construction, staging and paving operations in a manner to avoid placement of materials in these areas.

Any impacts to these areas and associated consequences, without the proper permitting, are the responsibility of the Contractor. The Contractor must secure the appropriate permits or authorizations prior to working in these areas. If complete avoidance of these areas is not possible, contact the Project Manager who will coordinate the permitting effort with the District Biologist or the District Environmental Engineering Specialist.

107.12 FOREST PROTECTION

Observe sanitary laws and regulations regarding the performance of the work within or adjacent to state or national forests and parks. Keep all areas in a neat condition, dispose of all refuse, and obtain permits for the construction and maintenance of construction camps, stores, warehouses, residences, latrines, cesspools, septic tanks, and other structures.

Prevent, suppress, and assist in preventing and suppressing forest fires, and immediately notify a forest official of the location and extent of any fire discovered.

Maintain spark arresters to meet the forest Supervisor's requirements on all steam, gas, or diesel-driven machinery and on all flues at construction camps.

107.13 INSURANCE REQUIREMENTS

Meet the timing requirements of Subsection 103.07.

107.13.1 Insurance on All Contracts

A. Commercial General Liability Insurance. Obtain commercial general liability insurance with a general aggregate limit of $2,000,000; an occurrence limit of $1,000,000; and products and completed operations limit of $1,000,000. The policy must name the State of Montana, its agents, employees, and officers as an additional named insured.

B. Owners and Contractors Protective Liability Insurance. Obtain an Owner's and Contractor's Protective (OCP) liability insurance policy for all work to be done, on behalf of the owner (State of Montana, the Department, and its agents, employees and officers) to be submitted with the contract when executed, with a general aggregate limit of not less than $2,000,000 and an occurrence limit of not less than $1,000,000.

C. Insurance Policies. Insurance policies must:

1. Provide coverage on an occurrence basis and not on a claims-made basis;

2. Not contain exclusions for explosion, collapse, or underground damage hazards; and
3. Provide that all insurance or self-insurance maintained by the State, its agents, employees, and officers is in excess of the required insurance and does not contribute with it.

Maintain commercial general liability insurance in full force from the effective date stipulated in the Notice to Proceed until Commission acceptance of the project, unless written approval is given by the CAS Engineer to cancel the policy. Maintain Owner's and Contractor's liability insurance in full force from the effective date stipulated in the Notice to Proceed until the Final Acceptance (form MDT-CON-105_17_2) is approved by the Department.

Obtain all policies from an insurer with a Best rating of A- or better on the date the policy is written.

The insurance requirements are a condition precedent to the contract. Failure to obtain and maintain all required insurance is considered a material breach of the contract.

Reinstate the policies listed above if a return to the project is required to complete additional work. Do not begin work until the policies are reinstated and submitted to the Construction Administration Services Bureau in Helena.

107.13.2 Insurance Involving Railroads

Furnish railroad protective liability insurance on behalf of the railroad when equipment or personnel are located or work is done on any railroad right of way.

The limits of liability are specified in the contract.

Maintain railroad protective liability insurance in full force until the Final Acceptance (form MDT-CON-105_17_2) is approved by the Department.

Submit copies of the railroad insurance policies as specified in the contract for transmittal to and approval by the railroad. Do not use or enter railroad property until railroad approval is received and the policies are in effect. This applies to all work done as a part of the project.

Reinstate the railroad protective liability insurance if a return to the project is required to complete additional work. Do not begin work until the policy is reinstated and submitted to the Construction Administration Services Bureau in Helena.

107.13.3 Insurance Requirements When Utilities Are Present

When working below the ground surface, ensure a comprehensive $2,000,000 insurance policy covering underground work and resulting damage to underground utilities is in effect.

Maintain insurance in full force until the Final Acceptance (form MDT-CON_105_17_2) is approved by the Department.

107.13.4 General

Furnish insurance policies with an endorsement that prohibits canceling, altering, amending or reducing coverage without giving a minimum of 30 calendar days written notice by the insurance company to the insured and the Department. A Montana resident agent must countersign all insurance policies issued under the contract. If the State where the insurance is purchased has a reciprocal agreement with the State of Montana and the insurance company is licensed to do business in the State of Montana, a countersignature by a Montana resident agent is not required.

107.14 THIRD PARTY BENEFICIARY CLAUSE

It is specifically agreed between the parties to the contract that it is not intended to create anyone as a third party beneficiary or to authorize anyone not a party to the contract to maintain an action for damages pursuant to the terms or provisions of the contract.

107.15 RESPONSIBILITY FOR DAMAGE CLAIMS

Indemnify and hold harmless the Department and the Department's officers and employees from all actions or claims brought because of injuries or damages to persons or property caused by the actions or omissions of the Contractor's employees or agents.

107.16 OPENING SECTIONS OF PROJECT TO TRAFFIC

The Project Manager may open certain sections of the work before completion or acceptance of the contract. Opening these sections does not constitute acceptance of the work, or waive any contract requirement.

Pending completion and acceptance of the roadway, complete all repairs or removals on sections of opened roadway caused by defective materials, work or by causes other than ordinary wear and tear meeting Subsection 107.17 requirements.

If shoulders, drainage structures, or other elements of the work are not completed on schedule, the Project Manager may order all or a portion of the project open to traffic. Liability and responsibility for maintaining the work before final acceptance remains in effect. Complete the remaining work with minimum interference to traffic.

107.17 CONTRACTOR'S RESPONSIBILITY FOR WORK

Protect the work against loss, injury, or damage caused by the elements, traffic, or any other cause, including, but not limited to, fire, theft, pilferage, vandalism, or third-party negligence until final acceptance. Repair all damage to any project work, or the project site, caused by the Contractor or anyone performing any project work at no expense to the Department.

Rebuilding, repairing, and restoring damage to the work due to unforeseeable causes beyond the control of and without the fault or negligence of the Contractor (including, but not restricted to: acts of God such as earthquake, flood, tornado, or other cataclysmic phenomenon of nature or acts of the public enemy or of governmental authorities) will be paid for under Subsection 104.03. This does not excuse, or allow compensation or repayment for any act or omission by the Contractor or its subcontractors, either in violation of law, regulation, ordinance, etc., or for any act or occurrence, which could have or should have been foreseen.

Expect probable adverse weather and stream flow conditions to occur. The cost of delay, loss, injury, or damage occurring to dikes, cofferdams, caissons, work bridges, haul bridges, or any other construction item or equipment, caused by adverse weather and stream flow conditions is the Contractor's responsibility.

The above requirements do not apply if the contract has reached the Final Acceptance under Subsection 105.17.2.

Provided the damage was not caused by the Contractor or Subcontractor, repair to items that have been accepted as complete is extra work under Subsection 104.03 and will be paid for under Subsection 109.04. A building is considered complete when it is fully functional, and is open to the public.

Payment for repair of damages resulting from public traffic and use does not entitle the Contractor to:

A. The release of any part of unpaid contract funds; or
B. Relief from responsibility for defective workmanship or materials; or
C. A waiver of any contract provision.

Conduct the work to ensure maximum convenience and safety to the general public and to the property owners adjacent to the work.

Maintain access for adjacent property owners at all times.

Take precautions to prevent damage to the project during work suspensions. Provide for drainage and erect all necessary temporary structures, signs, or other facilities at Contractor expense.

107.18 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTY AND SERVICES

Protect railway, telegraph, telephone, and power company properties or other property from damage, loss or inconvenience from construction before starting work. Cooperate with the utility owners in the removal and rearrangement of underground or overhead utility lines or facilities to minimize interruption to service and duplication of work by the utility owners.

Call the Utilities Underground Location Center (1-800-424-5555) or other notification system, UDIG (1-800-551-5344) if in Flathead or Lincoln County, for the marking and locating of the utilities before excavation.

The Department will locate existing Department owned utilities. If utilities are relocated or installed as part of the contract, the location of the relocated or newly installed utilities is the responsibility of the Contractor. The Contractor remains responsible for the relocated or newly installed utilities until the utility is functioning and in use by the traveling public.

Obtain insurance covering underground work per Subsection 107.13.

Provide and maintain temporary drainage facilities if existing surface drainage, sewers, or underdrains are interrupted at Contractor expense until permanent drainage facilities are completed. Protect and preserve existing tile drains, sewers, other subsurface drains, conduits, and other underground structures affected by construction that can remain in use without any change.

Immediately stop work if a utility line, cable, pipe or other facility is exposed or damaged during the work. Notify the Project Manager and the utility company of the damage and its location. Cooperate with the utility company if utility services are interrupted due to an accidental break until service has been restored. The Project Manager will stop work in the area of the damaged utility should the Contractor not stop work voluntarily. Resume work upon notice from the Project Manager. No compensation is made for delays associated with utility damage caused by the contractors work.

The Department will withhold monies from estimates due or to become due the Contractor for all utility damage and related costs not reimbursed by the Contractor under this Subsection.

Do not begin work around fire hydrants until provisions for continued service have been made and approved by the local fire authority. Provide continuous repair until service is restored if water service is interrupted.

Repairs to damaged utility facilities or structures resulting from construction operations and negligence is at Contractor expense. Be responsible to the utility owners and operators for damage, injury, expense, loss, inconvenience, delay and for any legal suits, actions, or claims that may result from the work.

The Commission may require the Contractor to furnish protective public liability and property damage insurance to each corporation, company, partnership, or individual owning or operating the properties affected.

107.19 FURNISHING RIGHT OF WAY

The Department will obtain all right-of-way for the project.

Exceptions will be noted in the bid proposal and award of the contract may not be made until right-of-way is obtained. The submission of a bid is an affirmative statement that the bidder accepts this condition and waives any damage that could be claimed.

Claims for damage or loss of anticipated profits because of this delay will not be considered by the Department. Consideration will be given for an appropriate extension of the contract time if the award is substantially delayed.

107.20 PERSONAL LIABILITY OF PUBLIC OFFICIALS

The Department, and its authorized representatives are acting solely as agents and representatives of the State when carrying out or exercising the power or authority granted under the contract.

There is no liability on them either personally or as officials of the State.

107.21 NO WAIVER OF LEGAL RIGHTS

Final Walk through under Subsection 105.17.1 does not prevent the Department from correcting any measurement, estimate, or certificate made before or after contract completion and from recovering from the Contractor, or surety, or both overpayments sustained for failure to fulfill the obligations under the contract. A Department waiver of any breach of any part of the contract does not constitute a waiver of any other or subsequent breach.

Be liable to the Department for latent defects, fraud, or gross mistakes as may amount to fraud, or with regards to the Department's rights under any warranty or guaranty.

107.22 PROTECTION OF ARCHEOLOGICAL AND HISTORICAL FINDINGS

Submit written evidence that no historic or pre-historic sites on or eligible for listing in the National Register of Historic Places are located on property used for construction activities that are outside of the Department obtained right of way, easements, material sites, or other areas designated in the contract before construction starts. These areas include but are not limited to staging areas, Contractor furnished material sites, or other related areas to be used for the work.

Submit the legal descriptions, the area involved, a description of the work activity, a site plan, and a description of the ground surface of all sites not included in the contract plans. Within 10 business days, the Department will notify the Contractor if the presence of or potential for cultural resources exists in the areas and recommend if a professional cultural resource survey is needed or not needed. If a survey is not recommended, no further cultural resource work is required.

If a survey is recommended, hire a professional cultural resource contractor to perform a survey. A directory of cultural resource contractors is available from the Department Archeologist.

If the survey does not identify any historic or pre-historic site within the area of proposed disturbance, the Department will issue a notice to proceed with the work. If the cultural resource contractor or the Department identifies any historic or pre-historic sites within the proposed area of disturbance, the Department, in concert with SHPO will determine whether the site(s) may be eligible for listing in the National Register of Historic Places.

Choose one of the following options if a site is eligible:

A. Do not use or disturb the proposed site.

B. Request the Department to proceed with the steps to comply with 36 CFR 800. Use a professional cultural resource contractor to perform all field work, surveys, etc. required to complete the process identified by the Department. No additional compensation or delay considerations are allowed under these requirements.

Immediately stop work if archeological or historical artifacts are encountered. Immediately notify the Project Manager of the find. The Project Manager will stake the area to remain undisturbed until further notice.

107.23 DISCOVERY OF UNDERGROUND STORAGE TANKS

Take the following action if an underground storage tank or tanks are encountered, the existence or location which was previously unknown to the Department or Contractor, on the project within the project limits.

A. Immediately stop work in the vicinity and notify the Project Manager.

B. Immediately notify the local fire authority and protect people and property from fire, explosion, vapor, and other potential hazards, and prevent further release of the tank's contents. Take all action requested by the Project Manager.

C. Notify the DEQ within 24 hours if there is evidence of soil or groundwater contamination resulting from a tank leak or pipe leak, at:

Underground Storage Tank Program
Department of Environmental Quality
Environmental Remediation Division, Petroleum Technical Section
1-800-457-0568

D. Perform the tank removal and closure work as permitted by DEQ.

E. Do not resume work in the immediate vicinity of the tank or piping until approved by the Project Manager.

Costs incurred from the discovery of underground storage tanks within the project limits will be paid for as extra work in accordance with Subsection 104.03. Costs from the discovery of underground storage tanks outside the project limits are not the Department's responsibility.

107.24 DISCOVERY AND REMOVAL OF UNKNOWN HAZARDOUS MATERIALS

If hazardous material is discovered within the project limits, the existence or location of which was previously unknown to the Department or the Contractor or not identified in the contract, immediately stop work in that area and notify the Project Manager. Hazardous material includes, but is not limited to; contaminated soil, contaminated water, asbestos, PCBs, petroleum, PCPs, hazardous waste or radioactive material. If the area is determined to pose a hazard to the traveling public, close off all access to the area as directed. Work may continue in unaffected areas believed to be safe.

Once notified of the contaminated site, the Department will determine whether a separate Contractor will be used to assess and clean up the contaminated site before permitting the Contractor to resume work in the contaminated area. If the Department determines that the Contractor can perform the work, meet the requirements of Subsection 107.26. The work will be paid for under Subsection 104.03. Obtain all necessary clearances (procedures, permits, etc.) from the regulatory agencies before starting any work.

If the Contractor does not perform the work, it waives any potential claim for itself, its subcontractors, and suppliers for damages for delay from the Department's securing another Contractor to perform the clean-up work.

The Department will equitably compensate the Contractor under Subsection 109.04.3 for costs associated with the delay to work in the affected area.

107.25 ACCESS TO CONTRACTORS RECORDS

Allow access by the Department or its authorized representative, and the FHWA to all project records, and the project records of all Subcontractor's, under Section 18-1-118 MCA, by the Legislative Auditor and Legislative Fiscal Analyst to determine compliance with the contract terms.

107.26 LIABILITY FOR CERCLA/CECRA CLAIMS

The Department will indemnify, protect, and hold harmless, the Contractor for any actions which the Department specifically directs or reasonably requires the Contractor to perform only if said action is the subject of litigation or administrative action under CERCLA, 42 U.S.C. Section 9601, et seq., or CECRA (Section 75-10-701 et seq. MCA), and it does not fall within the exceptions below.

Indemnify, protect, and hold harmless the Department for any omissions or actions not specifically directed by the Department if said omissions or actions are the subject of litigation or

administrative action pursuant to CERCLA or CECRA. Actions or omissions which are chosen either in type, scope, location, amount or method by the Contractor are not “specifically directed or reasonably required” by the Department.

Further indemnify, protect, and hold harmless, the Department for any negligent actions by the Contractor, its subcontractors, their employees or agents, including any actions that may be the subject of litigation or administrative action pursuant to CERCLA or CECRA.

When the Contractor is directed by the contract to obtain hazardous material liability insurance coverage for a project; that contract requirement controls and has priority over this specification.

107.27 DIESEL FUEL USED ON THE PROJECT

Use taxed clear fuel as required by state law to construct the project.

Violation of state law may result in a six-month suspension of the violating firm from participation in Department contracts not already awarded on the date of suspension. Prime Contractors are responsible for compliance of their own equipment, and the equipment of all Subcontractors and their Subcontractors.

SECTION 108

PROSECUTION AND PROGRESS

108.01 SUBCONTRATING OR ASSIGNMENT OF CONTRACT

108.01.1 Subcontracting

Do not subcontract, assign, or otherwise dispose of more than 60% of the original contract cost without the written consent of the surety and the Department.

Table 108-1 illustrates when an executed subcontract is required. The table is not all-inclusive, but shows examples. When required, a final determination will be made by the CAS Engineer.

TABLE 108-1
SUBCONTRACT REQUIREMENTS

Activity	Subcontract Required	Payroll Required
Physical work within the project limits	Yes	Yes
Material application (dust palliative, water, oil products, etc.)	Yes	Yes
Commercially supplied materials	No	No
Owner/Operator of heavy haul trucks	No	*
Crushing operations at a site dedicated to the project	Yes	*
Concrete pump truck (no labor by operator)	No	No
Equipment rentals (w/operator)	No	Yes
Work performed by a Contractor on the prime's payroll	No	Yes
Survey work	Yes	*
Consultant services within project limits	Yes	*
Consultant services not within project limits	No	No

*Contact the Department's Civil Rights Bureau for a determination.

The same criteria apply to work added by a change order. A subcontract is required for work performed by a Subcontractor at any level (second-tier, third-tier, etc) of the contract.

Include in the written subcontract or assignment or in a separate written document with the subcontract or assignment the following language:

> "In consideration of being awarded this subcontract, and in consideration of having this subcontract approved by the State of Montana, the Subcontractor hereby assigns to the State of Montana any and all claims or causes of action for any antitrust law violations, or damages arising there from, as to goods, materials, and services purchased under the terms of this subcontract or any change order that may result from this subcontract."

Do not hire or use in any manner a person or organization that performed any part of the design work for the Department unless first approved by the Department in writing.

108.01.2 Contract Performance

Perform at least 40% of the original contract cost with the Contractor's organization. The price of items designated in the contract as "Specialty Items" will be subtracted from the original contract price before the amount required to be performed by the Contractor is calculated.

Where an entire item is subcontracted, the percentage of the work subcontracted is based on the original contract item unit price. When a portion of an item is subcontracted, the percentage of the work subcontracted will be based on either the subcontract item unit price or on an

estimated percentage of the contract item unit price, determined by the CAS Engineer. An item will not be considered partially subcontracted unless the prime contractor performs a portion of the work (equipment, materials or labor). If the same item is subcontracted at multiple levels, the cost is only accounted for at the first level. When an item added by change order is subcontracted, the cost of the item does not count towards the required contract performance in Subsection 108.01.1.

Do not allow a Subcontractor at any contract tier to start work until its subcontract is consented to by the CAS Engineer. Include one executed and certified copy of the subcontract, a letter from the surety consenting to the subcontract, and the Subcontractor's Checklist.

Inform the Subcontractor of all the contract provisions, and that the Subcontractor is bound by all terms of the prime's contract with the Department. Provide the Subcontractor a copy of all the contract provisions including the applicable prevailing wage rates and FHWA 1273. Include in the subcontract the following language:

> "The Subcontractor agrees to comply with all of the labor provisions contained in the attached Special Required Contract Provisions and Davis Bacon Wage Decision."

All subcontractors are agents of the Contractor. The Contractor is responsible for all work, material furnished, project documentation provided by, and indebtedness incurred by its subcontractors.

Written consent to subcontract, assign or transfer the contract does not release the Contractor from liability under the contract and bond.

108.01.3 Subcontractor Payments

Submit payment information for all Subcontractors to the Civil Rights Bureau within 30 calendar days of the payment. This information can be submitted electronically on the Department's website.

108.02 NOTICE TO PROCEED

Work is to begin and time charges start on the date stipulated in the Notice to Proceed. Do not begin actual work nor permit subcontractors to begin work until all Subsection 103.07 requirements are met.

If work cannot begin on the date in the Notice to Proceed due to reasons beyond the Contractor's control, these conditions, dates, and reasons will be recorded in the weekly Assessment of Contract Time report and no time will be charged. Begin work when the Project Manager determines and issues a notice to resume work and that assessment of contract time will start.

108.03 PROSECUTION OF WORK

108.03.1 General

Begin obtaining all air quality, water quality and storm water runoff permits, approval of reclamation plans, and archaeological and historical clearances immediately upon receipt of the notice of contract award letter from the Department. Furnish the completed applications to secure permits, approvals or clearances as they are submitted to the respective agency. Furnish approved permits, reclamation plans and clearances necessary to complete the work in conformance with all federal, state and contract requirements.

The Department will reimburse all reasonable costs incurred in securing the permits, approvals and clearances if the Department does not execute the contract for reasons outside its control.

A pre-construction conference will be held on a mutually agreed date between the Contractor, Department and other parties interested in the work before work within the project limits begins no later than 20 calendar days after the Notice to Proceed date. The Contractor's superintendent in charge of the project must attend the conference. Encourage subcontractors to attend. Submit a schedule meeting all requirements of Subsection 108.03.2 or 108.03.3 at or before the pre-construction conference. No other work, except obtaining permits, may begin until the schedule requirements have been met. No payments will be made on the contract until the pre-construction conference has been held and the submitted schedule reviewed.

Obtain written approval before starting night work. Provide work area flood lighting for night work and do not rely solely on equipment lights. Night work approval may be rescinded at any time.

Suspending and resuming work on all or a part of the contract will be by Subsection 105.01.

Work may be suspended on working day contracts for unsuitable weather or for other conditions that are detrimental to the work accuracy and quality. Prevent damage and repair damaged work that was not protected during the suspension at Contractor expense. No time extensions will be approved for work to correct non-protected work.

Store materials to protect against damage and without obstructing, endangering or impeding traffic.

Do not allow water to pond on the roadway or within the construction limits, excluding environmental protective devices. Open ditches and shoulder drains, and take other actions to protect the public and the work.

The Department does not authorize project suspension by the Contractor and time will be charged during unauthorized project suspensions. If the Contractor suspends the project, provide written notification of the suspension to the Project Manager 7 calendar days before the suspension. The Contractor is responsible for all maintenance required during unauthorized suspensions and for all work and materials required due to the suspension.

108.03.2 Project Schedules

For projects not subject to Subsection 108.03.3 requirements, submit 2 copies of an ASC, and 2 copies of a WN that details the work and time (working days, calendar days or completion date) to complete the contract. The initial schedule must show that the work will be completed in the time frame specified in the contract.

The Contractor may use a CPM schedule as the ASC if it meets the requirements described in Subsection 108.03.2 herein and results in no additional cost to the Department.

A. Include in the ASC:
- **1.** A bar chart chronologically sequenced and to time scale showing the following:
  - **a.** All work activities with a completion duration of 5 or more working days. (For this requirement, working days does not exclude the period from November 16th through April 15th.)
  - **b.** Any work activity that has an impact on completion of the project.
- **2.** The relationship of each work activity listed in Subsection 108.03.2(A)(1) to other work activities, permits, plans, submittals and approvals required to complete the project.
- **3.** Work activity durations by working days or calendar days as appropriate. Indicate non-working periods exceeding 3 days on each activity bar.

B. Include in the WN:
- **1.** The proposed work process sequence describing the relationship of the work activities listed in Subsection 108.03.2(A) required to complete the contract, including

shop drawing submittals, permits (including estimated maximum waiting periods for all required permits), fabrication and delivery activities.

2. A detailed description and the progress time of each work activity listed in Subsection 108.03.2(A) measured by working day or calendar day, as appropriate.
3. A detailed description of the ASC, including holidays, planned workdays per week, number of shifts per day, hours per shift, size of work crews and resources used.
4. The Contractor's anticipated number of days during each month that weather will affect operations.

Submit an updated ASC and WN every month in which work is performed, one week before the end of the project's monthly estimate cycle. The ASC and WN should show current progress and all revisions or modifications that reflect changes in the method or manner of the work, specification changes, extra work, changes in duration, changes in shifts, work crews or resources. If the work is not proceeding consistently with the Contractor's most recently reviewed ASC and WN, the Project Manager may require that the Contractor submit 2 copies of an updated ASC and WN that accurately reflect the Contractor's progress, resource allocation for the project, and revised schedule. Submit the updated ASC and WN within 1 working day of the Project Manager's request. Ensure that the WN and ASC submitted meet the above requirements and accurately reflect the work progress. The Project Manager may suspend work under Subsection 105.01(A) if the WN and ASC do not accurately reflect the actual progress of the work; the suspension may continue until accurate WN and ASC are submitted.

Any delay in beginning or prosecuting work that is caused by the Contractor's failure to provide an ASC or WN when and as required is solely the responsibility of the Contractor, and is not an excusable delay.

Prosecute the work with the resources required to complete the contract within the time shown in the Contractor's updated ASC and WN.

The Department may withhold 10% of each monthly progress estimate for failure to submit an original or updated ASC or WN 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 ASC and WN. The Project Manager's review does not attest to the validity of the ASC or WN.

108.03.3 CPM Scheduling

Develop, maintain and provide a detailed time-scaled computer generated progress schedule using the critical path method that is compatible with Primavera P6 or other Primavera product which generates a .xer file type.

Schedule all contract work including that of subcontractors, vendors and suppliers. The initial schedule must show that the work will be completed in the time frame specified in the contract.

Prepare the initial CPM schedule as an Activity On Node (AON) or Precedence Diagramming Method (PDM).

The Project Manager may withhold 10% of each monthly progress estimate for failure to submit an original or updated CPM 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 CPM schedule. The Project Manager's approval of the CPM schedule does not attest to the validity of the Contractor's assumptions, logic constraints, dependency relationships, resource allocations, labor and equipment or other schedule aspects.

A. **Preparation and Submission of Schedule.** Prepare an initial schedule and submit an electronic file compatible with Primavera P6 or other Primavera product which generates

a .xer file type. Once an accepted baseline schedule is submitted, furnish one ANSI D (24-inch by 36-inch) paper copy. Submit all items listed in Subsection 108.03.3(C).

Attend a meeting scheduled by the Project Manager within 10 calendar days of the Project Manager's receipt of the CPM schedule to review, correct or adjust the CPM schedule if required.

Make all schedule adjustments and corrections discussed at the meeting and re-submit a disk with the revised schedule within 15 calendar days after the meeting. Plan and execute the work to meet project milestones and completion dates.

B. Initial Schedule Requirements. Include the requirements listed in Subsection 108.03.3(C) and the following:

1. Total float sort; responsibility/early start sort; area/early start sort;
2. 60-day look ahead bar charts by early start; and
3. Logic diagram having a maximum 100 activities for each ANSI D (24-inch by 36-inch) size sheet. Ensure each sheet includes project number, page number, title, match data or diagram correlation and key to identify all components used in the diagram.

C. Schedule Requirements. Submit schedules that include:

1. Activity identification numbers;
2. Project milestones;
3. Activity descriptions;
4. Appropriate relationships;
5. Activity durations appropriate for the work. Submit activity manpower, equipment, unit quantities and production rates to the Project Manager for review;
6. Procurement of permits;
7. Material procurement separated into at least two activities, fabrication and delivery. Include time for delivering all submittals and Department review of working drawing submittals as separate items in the schedule logic for all items requiring submittal, review and approval;
8. Activities coded to reflect the party performing each activity (only one party performs each activity) including subcontractors and suppliers and the area/location of each activity;
9. Work days per week, holidays, number of shifts per day, hours per shift and major equipment to be used;
10. Phasing (staging) details, if the work has phasing or is to be performed in phases;
11. Written narrative describing the anticipated work in an orderly sequence of the construction phasing, anticipated problems, and anticipated project completion dates, in a detailed description. Narratives that are a listing of the work will not be acceptable. Include written narratives with each submission;
12. Calendars, including weekends, holidays, or other Contractor non-work periods. All activities must be identified by entry of their appropriate calendar; and
13. The Contractor's anticipated number of days during each month that weather will affect operations.

Use only contractual constraints in the schedule logic. Do not use any other schedule constraints such as activity mandatory start and finish dates or mandatory zero float constraints.

Float is defined as the amount of time between when an activity "can start" and when it "must start". Total float is float shared with all other activities and is defined as the amount of time an activity can be delayed without affecting the overall time of project completion. Float is a shared commodity, not for the exclusive use or financial benefit of either party. Either party has the full use of float until it is depleted.

The critical path is defined as the longest continuous sequence of activities through the network schedule that establishes the minimum overall project duration. The submitted activity sequence and durations must generate a CPM schedule having a critical path. Keep multiple critical paths and near-critical paths to a minimum. Describe multiple critical paths and near-critical paths with thorough and reasonable justification in the written narrative.

Show the sequence and interdependence of all activities required for the complete performance of all items of work under this contract, including acquiring all the environmental permits. Show all network "dummies" on the diagram.

The Department reserves the right to limit the number of activities on the schedule to between 50 and 1000 activities.

Describe the activities so that the work is identifiable and the progress on each activity is measurable.

D. Schedule Updates and Progress Payments. Schedule and attend monthly project progress meetings to compare the schedule to the actual finish dates of completed activities, the remaining duration of uncompleted activities and the proposed logic and/or time estimate revisions. Provide the status of activities at these meetings, and the schedule updates based on this information, once it has been verified.

Each month of the project, one week before the end of the project's monthly estimate cycle, submit an electronic file using Primavera P6 or other Primavera product which generates a .xer file type containing:

1. Total float sort;

2. A narrative report describing the critical path, logic revisions or modifications to the schedule, including, but not limited to: changes in the method or manner of the work, changes in specifications, extra work, changes in duration, etc.; and

3. Any revised activity on node diagrams for the following:

- **a.** Delay in the completion of any critical activity;
- **b.** Actual prosecution of the work that is different than that represented on the CPM schedule; and
- **c.** The addition, deletion, or revision of activities required by contract modification or logic revisions.

The contract time will be adjusted only as specified in the contract. Furnish documentation to support requests for time extensions for milestone dates or the contract completion date.

108.03.4 Method of Measurement

CPM schedule is measured by the lump sum. Other scheduling requirements are not measured for payment.

108.03.5 Basis of Payment

Payment for all costs associated with CPM scheduling is included in the lump sum contract unit price for CPM scheduling. Payment for all costs associated with other scheduling requirements is included in the payment for other items of work.

Failure to submit a CPM schedule update to the Project Manager within 2 calendar days of its due date will result in a 10% deduct of the CPM schedule bid item for each update that is late.

Failure to submit a revised CPM schedule as specified may also result in withholding 10% of each monthly progress estimate. Payment withheld for violation of the schedule requirements will be included in the next progress estimate following the Contractor's submission of the required schedule.

Partial payments for CPM scheduling will be made based on the lump sum contract unit price as follows:

1. 50% when the initial schedule is finalized.
2. 75% when the overall project is 50% complete.
3. 100% when all updates have been submitted.

108.04 LIMITATION OF OPERATIONS

Conduct the work to minimize interfering with traffic and work already started. Finish a section of roadway before starting work on any additional sections if it is essential to public convenience.

108.05 CHARACTER OF WORKERS

Provide workers with the skill and experience to perform the work.

Remove any person employed who does not perform work in a proper and skillful manner or who is intemperate, disorderly, or verbally abusive. Employees may not return to the project or communicate with Department personnel without the written approval of the Project Manager.

Failure to remove the employee(s) or failure to furnish suitable and sufficient personnel to perform the work may result in a written notice to suspend the work.

108.06 METHODS AND EQUIPMENT

Use equipment of the size and mechanical condition to perform and produce the specified quality of work. Do not use equipment that damages the roadway, adjacent property, or other highways.

Operate all equipment with adequate lighting at night.

Do not use methods or equipment other than as specified unless requested in writing and authorized by the Project Manager. Include in the request a full description of the proposed methods and equipment to be used and the reasons for the change. Produce work meeting the contract requirements.

Discontinue use of alternate methods or equipment if the Project Manager determines that the work does not meet contract requirements. Remove and replace or repair deficient work with work of specified quality at Contractor expense. No change will be made regarding payment for authorizing a change in methods or equipment.

108.07 DETERMINATION OF COMPENSATION AND EXTENSION OF CONTRACT TIME FOR EXCUSABLE, NONCOMPENSABLE, AND COMPENSABLE DELAYS

Time allowed for completion of the contract is determined by the Completion Date, Calendar Day or Working Day provision in the contract.

108.07.1 Completion Date Contracts

Complete all work by the completion date specified in the contract. Begin work on the effective date stated in the Notice to Proceed.

The completion date will be extended for the following:

A. Extensions according to the calendar days added under Subsection 108.07.5; or
B. Suspensions of work authorized after the contract is awarded; or
C. Delays in the award of the contract.

The new completion date is determined by adding the calendar days added under Subsection 108.07.5; the number of calendar days during authorized suspensions; or the number of calendar days the award was delayed past the posted award date to the specified completion date.

The actual completion date is the date the Project Manager approves the Contractor's Certificate of Work Complete form under Subsection 105.17.2.

Contract time overruns for assessment of liquidated damages will be computed as the number of calendar days elapsing between the contract completion date and the actual completion date.

108.07.2 Calendar Day Contracts

Complete all work within the number of calendar days specified in the contract.

A calendar day is defined in Subsection 101.03. Begin work on the effective date stated in the Notice to Proceed.

Calendar days will be added for extensions added under Subsection 108.07.5.

Work on no work days will be considered a chargeable day and assessed against the contract time unless the work is an exempt work item defined in Subsection 101.03.

Contract time assessment will cease when the Project Manager approves the Contractor's Certificate of Work Complete form under Subsection 105.17.2.

Contract time overruns for assessment of liquidated damages will be computed as the number of calendar days the contract is not complete beyond the contract time specified.

108.07.3 Working Day Contracts

Complete all work within the number of working days specified in the contract.

A working day is defined in Subsection 101.03. Begin work on the effective date stated in the Notice to Proceed.

Working days will be assessed against the contract time except for days when work cannot be performed due to inclement weather. Days will not be assessed if inclement weather or the aftermath of inclement weather prevents the contractor from working at least six hours in a day. Inclement weather will not be considered when assessing time if the contractor is not actively performing work or is not scheduled to work.

Work on no work days will considered a chargeable day and assessed against the contract time unless the work is an exempt work item defined in Subsection 101.03.

A working day will not be assessed against the contract for work performed up until 12:00 noon on Friday prior to Memorial Day, Labor Day or Independence Day (July 4th).

Chargeable or non-chargeable working days will be determined daily by the Project Manager. Except during the winter shutdown, the Project Manager will furnish a weekly report every Monday showing the number of working days:

A. Charged for the preceding week;
B. Previously charged;
C. Specified for contract completion;
D. Approved time extensions; and
E. Remaining to complete the contract.

During winter shutdown, the Project Manager will furnish a report showing the information listed above for any week that the Contractor has chargeable days.

Submit a written protest to the Project Manager within the timeframe shown on the weekly report for any alleged discrepancies in the time assessed. Failure to file a protest is conclusive evidence that the time assessed is accepted as correct.

Contract time assessment will cease when the Project Manager approves the Contractor's Certificate of Work Complete form under Subsection 105.17.2.

Contract time overruns for assessment of liquidated damages will be computed as the number of working days assessed beyond the contract time specified.

108.07.4 Delays

The following delays will be considered for extensions of contract time:

A. Excusable or Non-compensable Delay. Contract time allowed for the performance of the work may be extended for delays caused by acts of God, acts of the public enemy, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, unusually severe weather, or delays not caused by the Contractor's fault or negligence. Provide project and site specific documentation to support the delay cause.

B. Compensable Delay. Contract time may be extended for delays caused by the Department under Subsection 108.07.6.

108.07.5 Extensions

Provide a written request detailing the reasons for requesting a time extension. A plea that insufficient contract time was specified is not a valid reason for a time extension. If the Department finds that the work was delayed because of conditions beyond the control of and not the fault of the Contractor, the contract time will be extended in the amount justified. The extended time for completion is in full force and effect as though it were the original time for completion.

Time extension requests must be made within 10 business days of the alleged delay. The time extension request must be accompanied with a written narrative and an updated schedule.

The contract time as awarded is based on the estimated quantities as defined in Subsection 102.05. No decrease in contract time will be made for any decrease in a contract item. The contract time will be increased based on the quantity and difficulty of added work and how it impacts the critical activities of the Contractor's operation as shown on the most current work schedule as required under Subsection 108.03.

The time extension will be to the nearest whole day.

No additional contract time will be allowed for:

A. Increases in percentages of asphalt in plant mix materials.

B. The addition of anti-stripping additives to bituminous materials.

C. The addition of or for increases in hydrated lime or mineral fillers to plant mix materials.

D. Increases in traffic control devices.

E. Delays for slow delivery of materials from the supplier or fabricator.

F. Material deliveries delayed for reasons of late ordering, financial considerations, or other foreseeable and preventable causes within the Contractor's control.

Delays in material deliveries for unusual market condition caused by an industry-wide strike, national disaster, or an area-wide shortage beyond the Contractor's control will be considered as a basis for granting additional time.

Submit written documentation substantiating the reasons for the late delivery or non-availability of materials. The documentation must be from the original supplier and document the dates the material was ordered by the Contractor and the reason for late delivery or non-availability of the material. Include a statement elaborating on the efforts to obtain materials from alternate suppliers.

108.07.6 Delay Compensation

Notify the Project Manager of the request for delay consideration. Keep daily records of all non-salaried labor, material costs, and equipment expenses for all operations affected by the delay.

Maintain a daily record of each operation affected by the delay. Identify the location, by stations, of the affected operations. Each Monday, prepare and submit written reports to the Project Manager containing the following information:

1. Number of days behind schedule;

2. A summation of all operations that have been delayed, or will be delayed;

3. An explanation for compensable delays and how the Department's act or omission delayed each operation;
4. An estimate of the time required to complete the project; and
5. An itemization of all extra costs incurred, including:
   a) Relating the extra costs to the delay and document how they are calculated and measured;
   b) Identifying all non-salaried project employees for whom costs are being compiled; and
   c) Summarizing the time charges for equipment, identified by manufacturer's number for which costs are compiled.

The Project Manager will maintain daily records of the operations by stations. At the end of each week, request a copy of the Project Manager's daily records, in writing. Compare the two records and provide a written summation of the comparison of the detailed reports to the Project Manager within 10 calendar days of receipt of the Project Manager's daily records. Identify all disagreements between specific records.

Failure to review the Project Manager's records or to report disagreements between the records is considered the Contractor's acceptance of the Project Manager's records as accurate.

Submit a written report to the Project Manager within 30 calendar days of completion of work allegedly delayed. All costs shown in the report submitted must be certified by a certified public accountant (CPA) and include the following:

1. A description of the delayed operations and the documentation and explanation of the reason for the delay, including all reports prepared for the Contractor by consultants, if used; and
2. An item-by-item measurement and explanation of extra costs requested for reimbursement due to the delay.

The Project Manager will provide a written decision to the Contractor within 14 calendar days of receiving the submittal.

In the case of compensable delays, if it is determined that the Department is responsible for delays to the Contractor's operations, the Project Manager's written decision will reflect the nature and extent of any equitable adjustment to the contract as specified in Subsection 109.04.3.

108.08 FAILURE TO COMPLETE ON TIME

If the contract time is exceeded, including approved adjustments, a daily charge will be made against the contract until final acceptance under Subsection 105.17.2. This daily charge, determined from Table 108-2, will be deducted from any money due the Contractor. This deduction is for liquidated damages for added Department contract administration costs, etc. for failure to complete the work on time.

TABLE 108-2
SCHEDULE OF LIQUIDATED DAMAGES

Original Contract Amount		Daily Charge
From More Than	**To and Including**	**Working Day or Calendar Day**
$ 0	$ 100,000	$ 827
$100,000	$ 500,000	$ 1,251
$ 500,000	$ 1,000,000	$ 1,532
$ 1,000,000	$ 2,000,000	$ 1,993
$ 2,000,000	$ 5,000,000	$ 2,756
$ 5,000,000	$ 10,000,000	$ 4,242
$ 10,000,000	—	$ 5,428

Permitting the Contractor to continue and complete the work after the specified contract completion time or approved extensions granted, does not waive the Department's rights under the contract.

If the Contractor disputes the liquidated damages on the approved "Contractor's Certificate of Work Complete" form, the CAS Bureau will send a final notification in writing to the Contractor of the number of days to be assessed and the dollar amount of proposed liquidated damages. Submit any objections of the assessment to the CAS Bureau in writing within 30 calendar days of receipt of the Department's notification. Include with the objection the justification and all information to support an adjustment to the assessment. The Department will review the Contractor's information and perform a final analysis.

The Commission will review all liquidated damages and any disputes. The CAS Bureau will submit the Contractor's information and the Department's recommendation to the Commission. A copy of the Department's recommendation will be sent to the Contractor within 45 calendar days of receipt of the objections. The Contractor must state in writing within 14 calendar days of receipt of the Department's recommendation if an appearance before the Commission is requested. If an appearance is requested, the Department will notify the Contractor in writing of the date the Commission will review the liquidated damages recommendation. The Commission will not receive or hear new information at the meeting not already furnished in the Contractor's original response.

108.09 DEFAULT OF CONTRACTOR

The Contractor will be in default if it:

A. Fails to begin the work under the contract within the time specified in the Notice to Proceed.
B. Fails to perform the work with sufficient resources to promptly complete the work.
C. Fails to perform the work in accordance with the contract requirements or refuses to remove and replace rejected materials or unacceptable work.
D. Discontinues the prosecution of the work.
E. Fails to resume work that has been discontinued within a reasonable time after notice to resume has been given.
F. Becomes insolvent or is declared bankrupt or commits an act of bankruptcy or insolvency.
G. Allows a final judgment to remain unsatisfied for a period of 10 calendar days.
H. Makes an assignment for the benefit of creditors.
I. Fails to comply with contract requirements regarding minimum wage payments, EEO requirements, or any state or federally mandated affirmative action requirements.

J. For any other cause, fails to carry on the work in an acceptable manner.

The Engineer will give written notice to the Contractor and surety of such delay, neglect, or default. Failure to correct the delay, neglect, or default within 10 calendar days after the Engineer's written notice gives the Department full authority without violating the contract to take over prosecution of the work from the Contractor. The Department may appropriate or use any or all materials and equipment at the project site that is suitable and acceptable and enter into an agreement for completing the contract. The Department may use any methods determined necessary to complete the contract.

All costs and charges incurred by the Department, including the cost of completing the work under the contract, will be deducted from any monies due or that may become due the Contractor. If the expense exceeds the sum that would have been payable under the contract, then the Contractor and the surety are liable and must pay to the Department the amount of such excess.

108.10 TERMINATION FOR PUBLIC CONVENIENCE

108.10.1 General

The Department may terminate the contract in whole or part, whenever:

A. Work cannot proceed because of an Executive Order of the President with respect to the prosecution of war or in the interest of national defense; or an Executive Order of the President or Governor of the State with respect to the preservation of energy resources.

B. Work cannot proceed because of a preliminary, special, or permanent restraining order of a court of competent jurisdiction where the issuance of such restraining order is primarily caused by acts or omissions of persons or agencies other than the Contractor.

C. It is determined that termination is in the best interests of the Department.

108.10.2 Payment

Payment will be made for the actual work performed at the contract unit prices for completed items of work when the contract is terminated under Subsection 108.10.1.

Payment will be made for materials delivered or stockpiled, or work performed, that comply with the contract's specifications or that have been inspected, tested, and accepted for use. Payment will only be made for materials that have been properly stored and maintained until they are delivered to the Department. An equitable adjustment will be made under Subsection 109.05 for partially completed items of work and disposal of materials.

Submit the termination costs to the Project Manager within 60 calendar days of the date of the notice of Termination for Public Convenience, under Subsection 108.10.1. Provide sufficient detail and make all project records available so the Engineer can determine the basis and amount of the termination costs. If a basis cannot be agreed upon, then an adjustment will be made in such amount as the Engineer may determine to be fair and equitable. Follow the requirements of Subsection 105.16 if the Engineer's equitable adjustment is disputed.

108.10.3 Responsibility of the Contractor and Surety

Termination of a contract does not relieve the Contractor of any contractual responsibilities for the work nor the Surety or Sureties of the obligations under the contract bond for the work performed.

SECTION 109

MEASUREMENT AND PAYMENT

109.01 MEASUREMENT OF QUANTITIES

Work completed under the contract will be measured using the United States standard measure or the metric system when specified.

Where the standard measure is given in the English system, approximate metric equivalents are shown in parentheses. No guarantee is provided, explicit or implicit, that the units are exact conversions. Work will be accepted on the basis of measures in the contract. Specified metric tolerances apply to metric contracts.

The method of measurement and computations used in determining quantities of material furnished and work performed are those methods recognized as conforming to sound engineering practice.

A station, when used as a term of measurement, is 100 feet or 100 meters.

Longitudinal and transverse measurements for surface area computations will be made horizontally using the neat plan dimensions. No deductions will be made for individual fixtures having an area of 9 square feet (0.8 m^2) or less.

Structures are measured using neat lines shown on the plans or as altered to fit field conditions.

Items that are measured by the foot (m, mm), such as pipe culverts, guardrail, underdrains, and the like, are measured parallel to the structure base or foundation.

Computing excavation volumes will be by the average end area method or by alternate methods involving three-dimensional measurements (delta surface).

The term “gauge”, when used for measuring plates, is the U.S. Standard Gauge. Galvanized sheets used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing are specified and measured as sheet thickness in inches (mm).

When the term “gauge” refers to measuring wire, it is the U.S. Steel Wire Gauge.

The term “ton” is the short ton consisting of 2,000 pounds (908 kg).

Measure or proportion weighed materials on certified scales at the designated locations.

Material shipped by rail may be accepted using the car weight provided that only the actual weight of material is paid for. Car weights are not acceptable for material that will be processed in mixing plants.

Obtain tare weights daily on haul vehicles, or as directed. Clearly mark each individual vehicle with a legible identification mark.

Haul materials measured by volume in approved hauling vehicles and measure materials at the point of delivery.

If approved, material specified to be measured by the ton may be weighed and converted to cubic yards (m^3). The Project Manager will determine the conversion factors from weight to volume subject to Contractor concurrence before using this method of measurement.

Net certified scale weights, based on certified volumes in the case of rail shipments, will be the basis of measurement, corrected for loss of bituminous material from the car or distributor, wasted, or otherwise not incorporated in the work.

When bituminous materials are shipped by truck or transport, net certified weights or volume, subject to correction for loss or foaming, may be used for computing quantities.

Lump sum payment is complete payment for the work item described in the contract.

When a complete structure or structural unit (i.e. lump sum work) is specified as the unit of measurement, the unit includes all necessary fittings and accessories.

Rented equipment is measured in hours of actual working time and necessary equipment travel time within the project limits. Travel time and transportation to the project is measured for special equipment, ordered by the Project Manager for force account work.

When standard manufactured items are specified, such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gauge, unit weight, section dimensions, etc., this identification is the nominal weight or dimension. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

Other quantities are computed in the contract units using established engineering principles, without consideration of local rules or customs.

109.01.1 Weighing Equipment

Furnish accurate weigh equipment for material specified to be proportioned or measured for payment by weight. The weigh equipment must indicate the weight to within the smaller of:

1. Tolerances from correct weight adopted by the Montana Bureau of Weights and Measures; or
2. One-half percent of the correct weight.

Use weigh systems tested and certified by the Bureau of Weights and Measures before each use and after each scale set-up or when directed. The Project Manager will accept reports from a Montana certified scale service stating compliance with the applicable tolerances in lieu of State certification. Seal the weigh system after adjustment and testing. Evidence of tampering or scale adjustment is cause to suspend use of the scale until it is re-tested and certified.

All materials received after the last test and certification will be reduced by the percent of error in excess of the specified tolerances if the weigh system is found to overweigh (indicate more than the correct weight).

No adjustment is made for systems found to under-weigh (indicate less than the correct weight).

Repair and re-certify weigh systems under-weighing or over-weighing outside the specified accuracy limits before use.

Follow the weigh equipment manufacturer's procedures or the National Bureau of Standards Handbook No. 44 procedures for weigh system testing, witnessed by the Project Manager. Provide all equipment, tools, and labor necessary to perform the test. Test permanent scales at least annually.

The cost of furnishing, testing, operating and maintaining weigh equipment is incidental to and included in the payment for the work.

109.02 SCOPE OF PAYMENT

Receive and accept the specified compensation as full payment for furnishing all materials, performing all work under the contract in a complete and acceptable manner and for all risk, loss, damage, or expense arising from the work, subject to Subsection 107.21.

If the Basis of Payment clause for unit price in the contract requires that the unit price be full compensation for work or material essential to the item, this same work or material is not measured or paid for under any other pay item in the contract.

The payment of any current or final estimate or of any unpaid contract funds does not prejudice or affect the Contractor's obligation to submit for final acceptance a completed improvement meeting the contract specifications.

In accordance with the requirements of Section 15-50-101 MCA, for contracts exceeding $5,000, including approved modifications, the Department will withhold 1% of the dollar amount of all Contractor payments. All payments by a Prime Contractor to a Subcontractor are also

subject to this 1% gross receipts fee. The Prime Contractor must withhold 1% of all payments made to subcontractors.

109.02.1 Pay Unit Rounding

The Project Manager will determine the quantities of work performed for each pay estimate as outlined in Subsection 109.01. All quantity calculations will be rounded for payment as outlined in Table 109-1.

TABLE 109-1
ROUNDING CRITERIA

Pay Unit	Rounding
Foot (m)	1 (0.1)
Station	0.01
Mile (km)	0.01 (0.01)
Course Foot (km)	10 (0.01)
Square Foot (m^2)	1 (0.1)
Square Yard (m^2)	0.1 (0.1)
Acre (ha)	0.01 (0.001)
Cubic Yard (m^3)	0.01 (0.01)
Gallon (L)	1 (1)
Pound (kg)	1 (1)
Ton (MT)	0.001 (0.001)
Hour	0.1
Lump Sum	0.001
Each	1
Unit	1

All dollars will be rounded on progress and final estimates to $0.01.

109.03 COMPENSATION FOR ALTERED QUANTITIES

Accept payment for work quantities that vary from the contract quantities at the original contract unit prices. No allowance, except under Subsections 104.02 and 108.10, will be made for any increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed resulting either directly from such alterations or indirectly from unbalanced allocation among the contract items of overhead expense and subsequent loss of expected reimbursements or from any other cause.

Only those quantities of materials actually incorporated into the final work and accepted will be paid for.

109.04 PAYMENT FOR EXTRA WORK

109.04.1 Unit Price or Agreed Price

Extra work performed under Subsections 104.02 and 104.03 is paid for at the unit price or price agreed upon and specified in the change order.

Force account basis under Subsection 109.04.2 will be used if a change order with an agreed price is not signed by the Contractor.

109.04.2 Force Account Basis

Approved extra work paid for on a force account basis will be accounted for daily. The daily report sheets are the true record of extra work. The payments below are full compensation and include profit and overhead. No additional profit will be added. Extra work on a force account basis ordered by the Project Manager in writing, under Section 104, is paid for as follows:

A. Labor. The Contractor is paid the wage rates for all labor and foremen assigned exclusively to performing the extra work for the total hours worked plus at least 80% of the total. The 80% surcharge may be increased if certified documentation is submitted showing that a higher percentage surcharge is needed to cover labor costs. The wage rates used for the above computation include travel pay, if applicable, but must not include fringe benefits, whether or not paid directly to the employees. Payment as described above is full compensation for all labor related expenses incurred including but not limited to premiums for worker's compensation insurance, public liability and property damage insurance, social security, unemployment compensation, health and welfare expenses, and other expenses imposed by federal or state laws or both.

Submit evidence of the actual wage rates paid. Only labor on certified payrolls is eligible. The rate paid will be that which is listed on the certified payroll.

B. Materials. The Contractor will receive the actual delivered cost of all materials used based on invoices, plus 15%. The quantity of material used must be documented.

C. Equipment. The Contractor will receive the rental rate or invoice price, where applicable, for machinery or special equipment (other than small tools) used to perform the work plus 10%. Rental rates are calculated using the current issue of the Departments Equipment Rental Rate Guidelines. Rates and allowances for standby time, outside rented equipment, owner-operated equipment, and moving of equipment is determined under the Equipment Rate Guidelines.

D. Bond. The actual cost chargeable to force account work of premiums for the performance bond are paid. No surcharge is allowed for the performance bond. No payment will be made for additional performance bond premiums if the evidence is not submitted within 30 calendar days of completion of the force account work. Furnish evidence of the rate paid for the bond.

E. Miscellaneous. Accept the compensation provided for under Subsection 109.09.2 as full payment for extra work done.

F. Statements. Submit all statements for the extra work done on a force account basis on Department forms. Attach the original extra work order, material invoices and freight bills.

The Inspector will compile and forward to the Project Manager, at the end of each day, a daily record of extra work done on a force account basis. The Project Manager will forward the information to the Contractor.

G. Subcontracting. Extra work performed on a force account basis by a Subcontractor under an extra work order will include the percentage allowed in Table 109-2 for administrative expenses. This administrative allowance only applies to charges for labor and materials. The allowance is applied to all charges and added percentages specified in Subsections 109.04.2(A), (B), and (D). Bid items in the original contract are not eligible for this administrative allowance.

TABLE 109-2
SUBCONTRACTING - ADMINISTRATIVE ALLOWANCES

Extra Work - Subcontractor	Administrative Allowance
$0 to $1,000	10%
$1,000.01 to $10,000	$100 plus 5% of excess over $1,000
Over $10,000.01	$550 plus 3% of excess over $10,000

Approval of this additional percentage is made after the Contractor furnishes receipted invoices.

Administrative expenses are not paid for on a force account basis above the amount allowed the Prime Contractor and Subcontractor if the work is done by a sub Subcontractor.

109.04.3 Equitable Adjustment

The equitable adjustment provided for in Subsection 105.16 is determined as follows:

A. If the parties agree, the price is determined using unit prices or other agreed upon prices.

B. If the parties cannot agree, the price is determined by the Project Manager using unit prices or other means to establish cost.

The following limitations apply:

A. The rental rates must be actual cost not to exceed the rates established in Subsection 109.04.2 and in effect at the time the work is performed.

B. No claim for loss of anticipated profits on deleted or uncompleted work or consequential damages of any kind is allowed.

109.05 DELETED OR TERMINATED WORK

The Engineer may delete work by change order under Subsection 104.02.4 or may terminate the contract in whole or part, under Subsection 108.10. When the contract is terminated in part, the partial termination is treated as a deletion change order for payment under this section. Payment for completed items is at the contract unit prices.

When any item is deleted, in whole or in part, by change order or when the contract is terminated, in whole or in part, payment for deleted or terminated work is made as follows:

1. Payment will be made for the actual number of units of work completed and meeting all contract requirements at the contract unit prices unless the Project Manager determines the contract unit prices are inappropriate for the work actually performed. When that determination is made, payment for work performed will be as mutually agreed. If the parties cannot agree, the Project Manager will determine the amount or the equitable adjustment under Subsection 109.04.3.

2. Payment for partially completed lump sum items that meet contract requirements will be as mutually agreed. If the parties cannot agree, the Project Manager will determine the amount of the equitable adjustment under Subsection 109.04.3.

3. The Department will pay as part of the equitable adjustment those direct costs necessarily and actually incurred in anticipation of performing the work that has been deleted or terminated. Costs previously paid for by the contract unit prices for completed units of work are excluded.

4. The total payment for any one item in the case of a deletion or partial termination cannot exceed the contract unit price as modified by approved change orders less the estimated cost (including overhead and profit) to complete the work and less any amount paid to the Contractor for the item.

5. The total payment where the contract is terminated will not exceed the total contract price, as modified by approved change orders less those amounts paid before the effective date of termination.

No claim for damages of any kind or for loss of anticipated profits on deleted or terminated work is allowed because of the termination or change order.

Contract time will be adjusted as the parties agree. If the parties cannot agree, the Project Manager will determine the equitable adjustment for contract time.

Materials to be permanently incorporated into the work and ordered before the date the work was terminated under Subsection 108.10 or as deleted under Subsection 104.02, will either be purchased by the Department at the actual cost and become Department property, or the Contractor will be reimbursed for the actual cost of returning the materials to the suppliers.

109.06 PARTIAL PAYMENTS

Partial payments will be made once each month following the effective date on the Notice to Proceed, based on estimates of the value of the work performed and materials complete in place under the contract, including materials delivered under Subsection 109.07. No payments will be made for work performed or materials produced without the required permits and authorizations in place as required under Subsection 107.02.

The Department reserves the right to withhold all or part of any partial payments earned under the contract until all special fuel users tax payments due or owing to the State of Montana under Section 15-70-302 MCA or other statutory taxes are paid in full.

If the Contractor becomes delinquent in any monetary contractual obligations (e.g. prompt payment upon satisfactory completion of work, payment to owners of materials sources, etc.), the Department may withhold unpaid contract funds from each monthly estimate thereafter until the delinquency is resolved or the amount of the delinquency has been withheld. The amount of the withholding will not exceed the amount of known delinquency but, depending on the amount of the delinquency and the amount of the monthly estimate, may be in the full amount of that monthly estimate. In the event the delinquency involves nonpayment to a Subcontractor or supplier, the Department also may order forfeiture of the contract bond, or take action under Subsection 108.09.

The Department will release the withheld amounts to the Contractor upon the Engineer's receipt of a notarized statement from the entity to whom the delinquency was owed stating that the delinquency has been satisfied in full or, in the event the entity has received partial payment of the delinquency, that portion of the withheld amount may be released.

If the contract extends beyond the contract completion time, the sum specified in Table 108-2 will be deducted from any money due the Contractor.

109.06.1 Billing Cycle

In accordance with Section 28-2-2115 MCA, this contract provides that the Department will submit payment estimates in billing cycles other than once a month, when deemed necessary. Do not submit a request for routine payment and requests for payment of any item does not initiate any period for payment. Requests may be submitted for stockpiled material payments in accordance with Subsection 109.07.

In accordance with federal regulations, the Project Manager will issue estimates, usually monthly, for progress payments greater than $500 based on the documentation of approved work and the Project Manager's opinion of the percentage of completion, in accordance with specifications, of each of the project's Schedule of Items. The Department will review work performed for completeness, specification compliance, and quality assurance before it is given conditional approval for progress payment. Should work that was previously paid for any reason, such as stockpiled material under Subsection 109.07, be later found not to comply with quality

assurance or specification, such as compliance testing or any required material certification, that part of the work will be deleted from payment approval. In such case, future monthly estimates will be lessened by the reduced amount, or the Contractor will be required to repay the previously-paid amounts until the work is performed in full compliance with specification and quality assurance.

Notice of extended payment provision: this contract allows the Department to make payment within 30 calendar days after submission of estimates by the Project Manager.

The contract's final payment will not be made until:

- The Contractor has fully completed all work under the contract;
- All required documentation has been submitted to the Department's satisfaction; and
- The materials supplied and work performed has passed the Department's quality assurance testing.

Pay all subcontractors within seven days after receipt of a periodic or final payment from the Department, for the full amount due the subcontractor under the subcontract for work performed or materials provided that were included in the periodic or final payment according to the provisions of Section 28-2-2103(2)(a) MCA. A subcontract may not provide for a time longer than the law's mandated 7 days.

109.07 STOCKPILED MATERIALS

Materials delivered and stockpiled at the project site or other location approved by the Project Manager may be considered for partial payment, if the following requirements are met:

1. The requirements of Subsection 108.03 have been satisfied.
2. The material meets the contract requirements.
3. The material is a manufactured end product or a fully fabricated product. Aggregate must be produced and stockpiled to the final stage for incorporation into the specified mixture or the roadway. Riprap meeting the gradations specified in Table 701-19 for the class specified in the plans is considered a manufactured end product for this Subsection.
4. Material is stored to prevent damage and theft, without obstructing or impeding the traveling public. Department Inspectors must have access to the inventory sheets and the stockpiles at all times.
5. A written request is accompanied with an invoice(s) for all items received at least one week before the end of the monthly estimate cycle. Include the quantity for which payment is requested, the length of time the material is to be stored, the location for material stored off the project site, and sufficient detail to justify the costs. If the material is manufactured by the Contractor, include the manufacturing costs in the request.

   Submit a new request and invoice(s) to the Project Manager whenever items are added to the stockpile. Clearly identify the project number, location, designation and the entire inventory on these sheets. Keep each project's stockpiled material separated from stockpiles belonging to other projects. Only use stockpiled material for the designated project.

Steel or iron items meeting Subsection 106.09 may be stored at property owned or leased by the Contractor or approved Subcontractor if approved by the Project Manager. The property must be located in Montana and accessible to Department personnel at all times.

Payment made for material on hand does not constitute acceptance of the material.

If stored material is lost, stolen, or damaged, the material's value will be deducted from the subsequent estimate or estimates.

Payment of partial estimates for stored material, acceptance of the materials to be stored, or approval of the storage method does not relieve the Contractor's responsibility for all materials and work upon which payments have been made or the restoration of any damaged work. The

payments are not a waiver by the Department of any other contract provisions or of its rights to require fulfillment of all contract terms.

Partial payment will be made for the invoice price, or for the manufacturing costs incurred by the Contractor. Payment for stockpiled materials will not exceed the contract unit price or the amount justified to the Project Manager. When stockpiled material has been produced by crushing operations, payment will not exceed 40% of the contract unit price. Maximum payment for materials in storage will be based on quantities that will be measured for payment.

Obtain the Project Manager's written approval of off-project site storage locations for bridge prestressed beams, bridge structural steel members, concrete box structures, and other large structural items.

No payment is made for bridge deck re-surfacing materials having a manufacturer's expiration date passing before its scheduled incorporation into the work.

109.08 RESERVED

109.09 MOBILIZATION

109.09.1 General

Mobilization is the preparatory work and operations performed including, but not limited to, those necessary for:

1. The movement of personnel, equipment, supplies, and incidentals to the project site;
2. The establishment of all offices, buildings, and other facilities necessary for work on the project;
3. Premium on contract bonds;
4. Insurance for the contract;
5. Other work and operations that must be performed or costs incurred before beginning contract work;
6. Mobilization costs for subcontracted work; and
7. Submission of all forms, certifications, and documentation required by the Department to prepare the final estimate and issue a certificate of completion.

Mobilization is only to be used for these reasonably-anticipated expenses, and is not to be used either to front-load a bid in order to receive payment earlier, or to unbalance a bid.

109.09.2 Payment

The original contract amount is the total price of the contract as bid. The contract amount paid is the cumulative amount paid on progress estimates, excluding all price adjustments. Partial payments for mobilization will be made based on the lump sum contract unit price under Table 109-3. No payments will be made for mobilization until the requirements of Subsection 108.03 have been satisfied.

TABLE 109-3
MOBILIZATION PAYMENTS

Percent of Contract Amount Paid	Amount Paid (whichever is less)	
	Percent of Mobilization Bid Amount [1]	Percent of Original Contract Amount
First estimate after Notice to Proceed	99	1
5	25	3
10	50	6
25	60	8
50	90	10
70 or Conditional Final Acceptance, whichever occurs first	99	
Final Estimate	100	

Note: 1. This percentage is the cumulative amount paid to that point, not the amount paid on the progress estimate.

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work under the contract.

109.09.3 Payment (SMP Contracts)

An exception to Subsection 109.09.2 is state maintenance stockpile contracts (SMP contracts). Mobilization will be paid for based on the percentage each stockpile site quantity bears in relation to the entire contract quantity, determined by the Department. The amount established as payment for mobilization for each site will be paid for in its entirety with the first estimate for each site.

109.10 OVERPAYMENTS

Overpayments on progress estimates will be deducted from subsequent progress estimate payments. If there are no subsequent progress estimate payments to be made, or the amounts to be paid are less than the overpayment, the Department may:

1. Notify the Contractor of the overpayment. The Contractor has 30 calendar days from the date of receipt of notification of overpayment to repay the money owed. If the money owed is not received by the Department before the 30-day period expires, interest will be charged on the overpayment beginning with the date of receipt of notification of overpayment. The interest rate charged will be the average Short Term Investment Pool (STIP) rate, determined by the Montana State Board of Investments, for the period in which the overpayment is not repaid.

   The Contractor may be barred from bidding on Department projects until the money that is owed has been received.
2. The Department may deduct the amount of overpayment and accrued interest from the progress estimate payment of any contract with the Department.

109.11 FUEL PRICE ADJUSTMENT

Notify the Project Manager in writing by the Notice to Proceed date or at the pre-construction conference, whichever comes first, of intent to participate in fuel price adjustment. Once the provision is invoked, it will not be reversed. Submit a list of contract items, according to Table 109-4, that are requested to be subject to fuel price adjustment. Submit the list to the Project Manager for approval by the Pre-construction Conference, using form CSB109_11.

TABLE 109-4
ITEMS SUBJECT TO FUEL PRICE ADJUSTMENT

Original Contract Amount	Maximum Number of Items
$0 to $8,000,000	10
$8,000,001 to $15,000,000	15
Greater than $15,000,000	20

When required by the Project Manager, provide actual diesel fuel, propane fuel and gasoline fuel costs along with the calculations used to determine the costs for the respective contract items. The accumulated diesel fuel, propane fuel and gasoline fuel costs may not exceed 20% of the contract unit price without additional justification acceptable to the Project Manager. Items measured on a lump sum basis will not be eligible for fuel price adjustment. No fuel price adjustment will be made for stockpiled materials.

Adjustments will be calculated using the increase or decrease between the base price and the monthly average price at the time the contract items are added to the progress estimate. The base price for the contract will be the average of the high and low price for the 5 business days before the bid opening. The base price for propane fuel will be the base price for diesel fuel divided by the difference in BTU/hr. for each fuel, or 1.5455 BTU/hr. The monthly average price will be the average of the high and low prices on Wednesday of each week in the adjustment period taken from Platt's Oilgram Price Report, or other fuel price report determined by the Department for unleaded gasoline and ultra-low sulfur diesel fuel. The average price for propane fuel will be the average monthly price for diesel fuel divided by 1.5455. The adjustment period for fuel price is from the Wednesday of the full week before the beginning of the estimate cycle to the Wednesday of the full week prior to the next estimate cycle. If the estimate cycle extends beyond the monthly estimate period, only the fuel prices from the month in which the item is added to the estimate will be used to generate the average price.

Adjustments will be made only when the monthly average price exceeds $0.25 per gallon more or less than the base price. The adjustments will be for the amount exceeding $0.25 per gallon.

The price adjustment for each type of fuel will be the change in cost from the base price (BP) to the monthly average price (AP) that exceeds $0.25, multiplied by the quantity (Q) of the item added to the progress estimate, multiplied by the fuel cost (FC).

Adjustments will be according to the following formulas:

$$Increase = \left(\frac{AP - BP - 0.25}{BP} \right) * FC * Q$$

$$Decrease = -\left(\frac{BP - AP - 0.25}{BP} \right) * FC * Q$$

Where:

AP= Monthly Average Price BP= Base Price
FC= Fuel Cost Q= Quantity

Include only the cost of fuel associated with the approved items in FC. Do not include additional costs related to items such as servicing of equipment, lubricants, tire and ground engaging component wear, depreciation, insurance, storage, licenses, inspection, etc.

Adjustments will be calculated for each type as described without regard to the grade or amount of fuel actually used. The total of the fuel price adjustments will be added to, or subtracted from, the monthly progress estimate.

SECTION 201

CLEARING AND GRUBBING

201.01 DESCRIPTION

This work is the clearing, grubbing, removing, burning, burying, and disposing of vegetation and debris within the R/W limits and easement areas without damaging vegetation, adjacent property and other objects designated to remain in place.

Immediately stop work and notify the Project Manager if evidence of aboriginal activity or occupation is encountered.

201.01.1 Clearing

Clearing is felling trees, disposing of stumps, brush, windfalls, logs, limbs, sticks, piles of sawdust, rubbish, debris, vegetation, and other matter within the clearing limits or other areas that interfere with the excavation and embankment limits.

201.01.2 Grubbing

Grubbing is removing and disposing of roots, stumps, stubs, duff, matted roots, and debris from the grubbing limits.

201.01.3 Clearing and Grubbing

Perform clearing and grubbing in accordance with Subsections 201.01.1 and 201.01.2.

201.01.4 Disposal

Disposal is removing, burning, and burying material generated from clearing, grubbing, or clearing and grubbing operations meeting all local, state and federal laws and regulations.

201.02 RESERVED

201.03 CONSTRUCTION REQUIREMENTS

201.03.1 General

Limit dragging, piling, disposing of debris, and other work to areas to be excavated or covered by embankment. Do not damage or destroy vegetation not designated to be removed.

Do not injure or damage vegetation adjacent to streams, ponds, or lakes unless designated for removal in the contract. Replace damaged or destroyed vegetation not to be disturbed at Contractor expense.

Coat cut or scarred surfaces of trees or shrubs to be preserved with an asphaltum base paint formulated for tree surgery.

Locate pioneer roads or work trails a minimum 20 feet (6 m) inside of the clearing limits. Protect live root systems adjacent to, but outside of, the clearing limits.

Close-cut and remove potential hazards, such as leaning trees (alive or dead), and snags within the R/W as directed by the Project Manager.

Coordinate clearing, grubbing, or clearing and grubbing with the grading work to meet the approved erosion control plan in Subsection 208.03.2. Backfill or grade depressions caused by grubbing to drain. Construct temporary settling basins where scour may occur.

Stake construction limits for cuts, fills, channel changes, ditches, fence lines, utility relocation, roadside development areas, selective thinning for sight distance, grubbing, and similar areas to establish clearing and grubbing limits in accordance with 105.08.

201.03.2 Clearing

Clear only within the staked construction limits.

Cut off trees, stumps, brush, shrubs, and other vegetation to within 6 inches (150 mm) of the ground. Fell trees without endangering traffic and injuring trees or objects not designated for removal.

Remove dead vegetation, logs, stumps, limbs, sticks, sawdust piles, rubbish, debris, and other undesirable matter from areas where live shrubbery, brush, or trees are to remain in place.

Merchantable timber is the property of the Contractor.

201.03.3 Grubbing

Grub only within the staked construction limits.

Remove all stumps, roots, logs, timber exceeding 3 inches (75 mm) in diameter, and all brush, matted roots, and other debris within the grubbing limits to at least 12 inches (305 mm) below the original ground surface.

Grubbing items that do not extend more than 6 inches (150 mm) above the ground line that are to be covered with at least 4 feet (1.2 m) of subgrade or slope embankment may remain.

201.03.4 Clearing and Grubbing

Clear and grub in accordance with Subsections 201.03.2 and 201.03.3 requirements.

201.03.5 Disposal

Dispose of all brush, stumps, windfalls, slash, timber having no commercial value, and all other debris from clearing, grubbing, clearing and grubbing, or other operations to meet all local, state and federal requirements at Contractor expense.

Furnish the Project Manager a written statement detailing the disposal location of non-salvageable treated timber.

A. Burning. Burn materials meeting the State of Montana Open Burning Regulations administered by the Air Quality Bureau of the Montana Department of Health and Environmental Sciences, and all other applicable local, state and federal rules and regulations. The general requirements of the Montana Open Burning Regulations regarding burning season and permits are described below.

1. **Permits.** Obtain an open burning permit from the Air Quality Bureau during the open burning season when burning more than 100 acres (40.5 ha) of forest residue per year.

   When burning near public lands during the fire season (May 1st through September 30th, or as extended), obtain a burning permit from the local, state or federal fire protection agency having jurisdiction.

2. **Open Burning Season.** The open burning season for forestry slash is from March 1st through November 30th. Open burning is not allowed during December, January, or February. Burning from September 1st through November 30th, on a day-to-day basis is subject to ventilation conditions available from the Air Quality Bureau, at 1-800-225-6779. Obtain the ventilation conditions daily before burning.

3. **Burning Methods and Instructions.** Burning by the air curtain destructor or forced air methods are encouraged.

   Obtain the Project Manager's approval for burning pits located within the R/W limits. Dispose of all pits, ashes, and debris meeting Subsection 201.03.5(B). Locate burning pits at least 100 feet (30.5 m) from free-flowing water or areas where ditches are to be constructed. Locate pits and incinerators to prevent fire damage or hazard to surrounding vegetation or structures. Contact local fire protection agencies before the start of any burning.

   Provide 24 hour monitoring of all burning.

B. Disposal of Other Material. Obtain the Project Manager's approval to incorporate non-hazardous solid material into the work for constructive use.

Dispose of material not incorporated into the work at Contractor expense.

201.04 METHOD OF MEASUREMENT

Measurement for clearing, grubbing, or clearing and grubbing is by either of the following methods.

201.04.1 Lump Sum Basis

Clearing, grubbing, and clearing and grubbing are measured by the lump sum. Disposal of the material is not measured for payment.

201.04.2 Area Basis

Measurement is by the acre (ha) for the area actually cleared to the limits in the contract or as staked. Disposal is not measured for payment.

201.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Clearing	Lump Sum or Acre (ha)
Clearing and Grubbing	Lump Sum or Acre (ha)
Grubbing	Lump Sum or Acre (ha)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

201.05.1 Lump Sum Basis

Payments will be prorated for the percentage of completed work for each item listed as a lump sum item in the contract.

201.05.2 Area Basis

No payment is made or allowed for any areas not actually cleared (PTW, paved surfaces, etc.).

201.05.3 Reserved

201.05.4 Exclusion

When the contract does not contain a pay item for clearing, grubbing, or clearing and grubbing, the work is incidental to and included in payment for other items of work.

SECTION 202

REMOVAL OF STRUCTURES AND OBSTRUCTIONS

202.01 DESCRIPTION

Remove and dispose of all structures and obstructions not designated to remain or to be removed and disposed of under other items of the contract.

202.02 RESERVED

202.03 CONSTRUCTION REQUIREMENTS

A. General. Retain a Blasting Consultant as required in Subsection 204.03.1 when using explosives to remove structures or obstructions.

Raze, remove, and dispose of all buildings, foundations, structures, fences, debris, and other obstructions on the R/W, excluding utilities. Remove and transport specified salvage material designated to remain property of the Department, without damage, to the specified locations. Obtain the Project Manager's written permission to use any salvaged materials.

Dispose of unusable combustible material in accordance with Subsection 201.03.5(A). Dispose of unusable noncombustible material in accordance with Subsection 201.03.5(B). Backfill cavities caused by removing structures and obstructions level with the surrounding ground and compact the backfill in accordance with Subsection 203.03.3.

Install the necessary traffic control devices when removing and transporting structures to maintain traffic in the work area.

B. Structure Removal. Submit to the Project Manager, 5 copies of a written proposal that describes the proposed plan for removal and/or salvage of bridges. Do not begin removal or salvage operations prior to receiving approval. Include in the proposal a narrative of all operations, including all cutting and welding procedures, done in conjunction with the removal of the existing bridge. Include welder's certifications and descriptions of welding processes. Approval of the plan is contingent on the plan meeting the requirements of the contract and all permits.

202.03.1 Removal of Bridges and Major Drainage Structures

A. Removal of Superstructures. Repair or replace all damaged or destroyed members, pins, nuts, and plates from steel or timber structures designated to be salvaged at Contractor expense.

Match-mark all members to be salvaged with paint before dismantling. Similarly mark all pins, nuts, and plates to indicate their location in the structure. Paint all pins, pin holes, and machined surfaces with a zinc-rich paint, and wire all loose parts to adjacent members or pack in clearly marked boxes showing the contents and index-numbered for identification.

B. Removal of Substructures. Remove or cut off piles and substructures to 3 feet (915 mm) below the finished grade or existing ground surface elevation, whichever is lower. Shape and contour the removal areas to blend with the surrounding terrain.

Do not damage new work while removing existing structures.

C. Disposal of Materials Removed.

1. **Structural Steel.** Store salvaged structure members and all steel beams above the ground on skids at the designated sites.
2. **Concrete and Masonry.** Use concrete and masonry removed from old structures in backfills or approach embankments in accordance with Subsection 202.03.3. Dispose

of concrete or masonry not placed in backfills or embankments at Contractor expense. Remove all contract related concrete rubble from streams.

3. **Timber and Other Materials.** Store all salvageable timber or other salvaged materials above ground on skids at the designated sites.

D. **Disposal of Temporary Structures.** Remove and dispose of all temporary structures in accordance with Subsection 202.03.1(C).

E. **Removal and Salvage of Structure.** Do not weld or use a cutting torch on any portion of existing bridge without an approved welding or cutting plan. Follow the requirements of Section 624 and perform no welding without the presence of the CWI. Notify the Project Manager at least 5 working days prior to welding/cutting operations for scheduling of the CWI.

Assume all costs for repairs of contractor caused damage to the structure, including inspection and testing. Inspection/testing costs include salaries, travel expenses and fees for professional services by whomever the State assigns or hires to perform those services.

Notify each party (as listed in contract as owner) at least 30 days prior to the anticipated date of structure removal. Keep each party informed about any changes to the removal dates. If the new owners have a transport available on site at the time of removal, set the truss and floor materials on the transport provided by the new owners. If the new owners do not provide a transport at the time of removal, set the truss and floor materials aside on site at a location as directed. If the new owners have not transported the structure off the project within 60 calendar days of removal, dispose of it unless otherwise directed by the Project Manager.

Any loss or damage, suffered by the new owner of a removed bridge or by a firm or entity that is to remove the bridge on behalf of the new owner, caused by the contractor's failure to fully comply with the provisions of this contract, will be solely the responsibility of the contractor and will be paid by the contactor, or will subject the contractor to action under its bond or insurance policy, at no expense to the State.

Dispose of all non-salvageable materials in accordance with approved methods and applicable rules, laws and regulations for disposal of solid waste. At the conclusion of the project, clean up all affected areas to the satisfaction of the Project Manager.

202.03.2 Removal of Minor Drainage Structures

Remove minor drainage structures as specified in the contract. Replace lost or damaged salvaged material at Contractor expense.

202.03.3 Removal of Pavement, Concrete, and Masonry

Remove and dispose of all existing bituminous or concrete materials to be removed unless otherwise specified. If used for new roadway construction, process, handle and transport these materials for embankments; or crush, screen, mix and process for use as base, surfacing or traffic gravel as approved. Otherwise, dispose of them as solid waste in conformance with applicable laws, rules, regulations and the Montana Solid Waste Management Act.

Existing materials used for base gravel or surfacing must meet the specifications for the particular item. Process bituminous material to be used as embankment to a maximum 6-inch (150 mm) size in its largest dimension. Process concrete material, to be used in the embankment, to a maximum 12-inch (305 mm) size in its largest dimension. Do not place the removed bituminous or concrete material in ephemeral drainages or within 100 feet (30 m) of standing water and groundwater wells. Bituminous materials used for embankment of the new roadway must be covered with plant mix surfacing or 12 inches (305 mm) of soil capable of supporting plant growth.

Include all costs of this work in the unit price for the applicable contract item.

202.04 METHOD OF MEASUREMENT

202.04.1 Remove Structures and Obstructions

Remove structures and obstructions is measured by the lump sum and includes the removal and disposal of all structures and obstructions encountered within the right-of-way.

202.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Remove Structures and Obstructions	Lump Sum

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

When the contract does not contain estimated quantities or lump sum items for removal and disposal of structures and obstructions, the work is incidental to and included in payment for other items of work.

SECTION 203

EXCAVATION AND EMBANKMENT

203.01 DESCRIPTION

This work is the excavation, placing, compacting and disposal of material encountered within the construction limits necessary to construct the project. This is also referred to as grading.

203.01.1 Excavation

A. **Unclassified Excavation.** Unclassified excavation is excavating and disposing, when required, of material from the R/W or construction easement areas except borrow excavation and muck excavation.

B. **Borrow Excavation.** Borrow for embankment construction is Contractor furnished excavation from outside the R/W or construction easement areas.

   1. **Unclassified Borrow.** Use Department approved sources meeting current environmental and cultural resource preservation regulations. Material from a Department-optioned or Department-owned borrow source may be available at no cost. The applicable provisions of Subsections 102.06 and 106.02 apply to unclassified borrow.
   2. **Special Borrow.** Special borrow-excavation and special borrow-neat line is the providing and placing of the specified quality of borrow material from designated sources or from other approved sources. The applicable provisions of Subsections 106.02 and 203.01.1(B)(1) apply to special borrow-excavation and special borrow-neat line.

C. **Unclassified Channel Excavation.** Unclassified channel excavation is excavating and disposing of all materials from new watercourses or channels and the widening, deepening, or relocation of existing channels.

D. **Street Excavation.** Street excavation is excavating and disposal of all material to the street template.

E. **Muck Excavation.** Muck excavation is removing and disposing of unsuitable material in cut sections or below the natural ground line in embankment sections. Material defined as muck must be deemed unsuitable and is unable to be excavated using the same equipment and methods as for unclassified excavation.

   Material is considered unsuitable if:

   1. It contains soil or organic matter unsuitable for foundation material, regardless of moisture content; or
   2. It is too wet to be properly compacted and cannot be dried within a demonstrated reasonable timeframe prior to incorporating into work. Excessive moisture alone is not sufficient cause for determining unsuitable material.

   Topsoil removed below the natural ground line in embankment sections unsuitable material.

   Excavated unsuitable material areas will be measured before they are backfilled.

   Do not place fill over unsuitable or unstable foundation soils without the Project Manager's approval. Materials placed before approval may be ordered removed and replaced at Contractor expense.

F. **Sub-excavation.** Sub-excavation is removing unstable material from below the plan subgrade elevation as shown or directed.

G. **Digout Excavation.** Digout excavation is removing and replacing sections of material at neat lines as shown in the contract or directed by the Project Manager.

203.01.2 Embankment

Place and compact excavation in roadway embankments, dikes, areas where unsuitable material is removed, holes, pits, and other roadway depressions. Prepare embankment foundations prior to placing embankment material.

203.02 RESERVED

203.03 CONSTRUCTION REQUIREMENTS

203.03.1 Excavation

A. General. Do not begin grading operations before the area is cleared of vegetation and obstructions in accordance with Sections 201 and 202. Ensure erosion controls are placed as specified in the contract.

Excavate without disturbing material and vegetation outside of the slope limits.

Use all suitable material removed from the excavation in embankments, subgrade, shoulders, top soiling, and other designated locations. Excavated material not used as specified or directed is not paid for.

Sequence excavation of backfill or road finishing material so it is placed into final position as soon as possible. Stockpile suitable material that is not immediately used.

Construct temporary fencing to restrict livestock and vehicular traffic from the work in accordance with Subsection 607.03.5.

Replace temporarily removed fence and repair damaged fence to a condition equal to the existing fence at Contractor expense. Confine livestock when fencing is disturbed.

If excavated material from the roadbed is used outside the embankments, furnish and place at Contractor expense, an equal quantity of borrow to replace the material.

Do not dispose of excess or unusable material within the right-of-way limits unless approved by the Project Manager.

Compact the top 8 inches (200 mm) of the subgrade in cut sections in accordance with Subsection 203.03.3.

B. Rock Blasting. Perform all blasting in accordance with Section 204.

C. Rock Excavated Below Grade. Excavate all un-yielding materials that require blasting or the use of rippers to at least 6 inches (150 mm) below subgrade within the roadbed limits. Backfill the excavation with specified or approved material. Remove or drain surface rock pockets that trap or pond water.

Rock, removed to a maximum depth of 6 inches (150 mm) below subgrade is measured and paid for as unclassified excavation. Rock removed or backfilling due to over excavating in excess of the 6 inches (150 mm) with approved backfill material is at Contractor expense.

D. Removing Excess Moisture. Rework materials from excavation or borrow areas exceeding 2% of optimum moisture to the specified optimum moisture before use in embankments or as backfill. Costs to remove excess moisture from the material are incidental to the embankment.

Remove excess moisture in the finished roadbed soil, introduced or caused by construction operations, for re-use in the work at Contractor expense. Excessively wet material, caused by the construction operations that cannot be properly compacted must be removed and replaced with suitable material at Contractor expense.

E. Borrow Material. Excluding special borrow, borrow material may be used only after the roadway excavation has been placed in the embankment. If excess borrow is placed creating a waste of excavation, the waste quantity will be deducted from the measured volume in the borrow area.

Notify the Project Manager 5 calendar days before excavating material from the borrow area so that the area may be surveyed. Do not excavate beyond the dimensions and elevations established for the borrow areas. Finish and shape all borrow areas to permit accurate measurements. Reclaim borrow areas meeting Subsection 106.02.5 requirements

F. Roughen Slopes. Roughen slopes as directed.

G. Digout. In areas of digout, excavate the full road width to a depth as shown in the contract or as directed by the Project Manager. Excavate parallel to the finish grade, daylighting to the left and right slopes. Slope the ends of the digout no steeper than 4H:1V. Dispose of the excavated material to the satisfaction of the Project Manager.

Provide special borrow for digout replacement material consisting of a well-graded sand and gravel, free of organic and other deleterious material, meeting the AASHTO M 145 requirements for A-1-a group classification, with 100% passing the 2-inch (50 mm) sieve and a maximum of 8% passing the No. 200 (0.075 mm) sieve. The material may consist of up to 50% millings, uniformly blended. Crusher fines and reject material may be used if the requirements in Table 701-22 are met.

Provide stabilization geotextile that meets the requirements of Subsection 716.03 for Stabilization geotextile.

Place stabilization geotextile over the bottom and sides of the excavated digout area in conformance with Subsection 622.03. Extend the geotextile up the side walls of the excavation for the full height of the exposed subgrade soils.

Place the initial lift of special borrow over the geotextile in accordance with Subsection 622.03.2.

Repair any geotextile damaged during construction in accordance with the Manufacturer's recommendations or as directed by the Project Manager at Contractor expense.

H. Sub Excavation. In areas of sub excavation, excavate the full road width to a depth as shown in the contract or as directed by the Project Manager. Excavate parallel to the finish grade, day lighting to the left and right slopes. Slope the ends of the excavation no steeper than a 10H:1V. Dispose of the excavated material to the satisfaction of the Project Manager.

Provide special borrow for sub-excavation replacement material consisting of a well-graded sand and gravel, free of organic and other deleterious material, meeting the AASHTO M 145 requirements for A-1-a group classification, with 100% passing the 6-inch (152 mm) sieve and a maximum of 8% passing the No. 200 (0.075 mm) sieve. The material may consist of up to 50% millings, uniformly blended. Crusher fines and crusher reject material may be used if the requirements in Table 701-22 are met.

Provide stabilization geotextile that meets the requirements of Subsection 716.03.

Place stabilization geotextile over the bottom and sides of the sub excavated area in conformance with Subsection 622.03. Extend the geotextile up the side walls of the excavation for the full height of the exposed subgrade soils.

Place the initial lift of special borrow over the geotextile in accordance with Subsection 622.03.2.

Repair any geotextile damaged during construction in accordance with Subsection 622.03.2.

203.03.2 Embankment

A. General. Do not place stumps, trees, logs, rubbish, vegetation, muck, frozen material, pockets of rock, volcanic ash or other deleterious materials in embankments.

Sod mixed with surface soil and soil containing excessive humus or other organic materials may be spread over the top of embankment slopes. Compact embankment, backfill, and embankment foundation areas in accordance with Subsection 203.03.3.

Leave the surface of completed embankments in a roughened condition.

Rework or remove and replace unstable or pumping material prior to placing additional lifts or materials. Reworking or replacing materials within constructed embankment is at Contractor expense.

B. Embankment at Structures. Do not place rocks, broken concrete, or other solid material in areas where piling is to be driven.

Do not place embankment against any backwall or abutment until the concrete has cured for 10 calendar days or has reached 70% of the required strength. Furnish a certified laboratory test report showing the field-cured cylinders meet the required strengths.

The Project Manager may approve early embankment work at backwalls or abutments with beams or girders in place, or that are cantilevered from a fixed footing or cap if the strength requirement is met.

Do not place embankment against un-supported backwalls or U-shaped abutments rigidly connected to the deck until the deck is placed and cured meeting the applicable requirements of Section 552.

The Contractor may submit a method of supporting the structure to permit early placement of embankment against the structure. If approved, all costs of the alternate method are at Contractor expense.

Place embankment in 8-inch (200 mm) maximum layers loose thickness and compact adjacent to structures, around columns and similar structural supports, and on both sides of concrete walls, box type structures, and similar structures. Extend embankment material placed above the excavation limits or ground line a minimum 10 feet (3 m) from the structure or structural support.

Restore, repair, or replace structures or structural members moved or distorted by placing and compacting embankment at Contractor expense.

Compact embankment inaccessible to rollers by mechanical tampers to the density specified in Subsection 203.03.3.

Before placing and compacting backfill, compact at least the top 8 inches (200 mm) of the existing ground in accordance with Subsection 203.03.3.

C. Preparation of Embankment Foundations. Bench all embankments placed and compacted on hillsides, against existing embankments, built one-half width at a time, or on slopes 6H:1V or steeper when measured at right angles to the roadway centerline. Construct benches in minimum 4-foot (1.2 m) widths. Maintain the horizontal inclination within 5% of horizontal. Backfill and compact each bench in maximum 8-inch (200 mm) layers.

Excavate each bench as close to each other as the slope permits. Use approved material excavated from benches in the embankment.

In excavation to embankment transitions where the natural ground slope exceeds 6H:1V, construct the excavated benches so the natural ground surface is a minimum 12 inches (305 mm) from the top of the subgrade.

Remove frozen earth, snow and ice from the cut or embankment surface and place it outside the slope stakes. Provide the replacement borrow material at no cost to the Department.

Clear the full width of the subgrade of sod and vegetative matter. Scarify the top 8 inches (200 mm) of the embankment foundation and compact in accordance with

Subsection 203.03.3 before constructing embankments 4 feet (1.2 m) high or less, or embankments placed on soils having less than 95% maximum density, determined by MT 210.

If original lightly compacted soils are encountered that exceed 8 inches (200 mm) in depth, remove it to the depth directed. Compact the upper 8 inches (200 mm) of the ground in accordance with Subsection 203.03.3. Place the removed material in the embankment or use it for topsoil as directed. Material useable as topsoil may be placed alongside the roadway after compaction is completed.

D. Earth Embankment. Place earth roadway embankment in uniform horizontal layers not exceeding 8 inches (200 mm) loose measurement and compact in accordance with Subsection 203.03.3. Continuously level, work, and maintain moisture to compact to the specified density. Uniformly work the entire surface of each layer.

Work each layer of earth embankment that is not rock, gravel or sand using a tandem type construction disk with a maximum disk spacing of 14 inches (355 mm) and a minimum worn disk diameter of 25 inches (635 mm). With the disk, work moisture into the soil, break clods of soil, disorient the soil particles, and penetrate the full depth of the layer being placed. Larger disks may be used if the ratio of disk spacing to disk size is comparable to the above dimensions. Leave the embankment slopes in a roughened condition.

E. Rock Embankment. When the excavated material contains more than 25% rock by volume, 6 inches (150 mm) or larger in its greatest dimension, place the embankment in layers 2 inches (50 mm) thicker than the maximum size rock in the material not to exceed 24 inches (610 mm) loose thickness.

Individual rocks and boulders larger than 24 inches (610 mm) in diameter may be placed in the embankment if the rocks do not exceed 48 inches (1.2 m) vertical height after placement, are evenly distributed, and are spaced to allow placing and compacting of the soil in between the rocks.

Place and compact the upper 2 feet (610 mm) of the embankment in maximum 8-inch (200 mm) layers loose thickness as specified in Subsection 203.03.2(D).

Dump and work rock from excavations to the stream face when the embankments are adjacent to streams or channels. Prevent the rock from entering the stream. This work is incidental to unclassified excavation.

F. Embankment Over Swampy Areas. On low, swampy ground incapable of supporting haul equipment, construct the lower part of the embankment by dumping successive loads of uniformly distributed material in layers thick enough to support the equipment. Place subsequent layers in accordance with Subsections 203.03.2(D) or (E) as directed.

G. Disposal of Unsuitable or Excess Material. If disposal of excess or unusable excavation within the R/W limits is approved by the Project Manager, slope and shape all disposal areas to blend into the surrounding terrain and meet the requirements of Subsections 106.02.5 and 107.11.

203.03.3 Moisture and Density Requirements

Compact each layer of material to the in-place density requirements of Table 203-1 for the method of moisture and density control used. The moisture and density control is the Proctor method or the Zero Air Voids method, determined by the Project Manager.

If proctors are used for density control, the Contractor may make a written request to the Project Manager to compact the soils at lower moisture content. Identify the soil class in the request. The Project Manager may approve the request provided a Department investigation

determines the lower moisture content is not detrimental to the soil for the given application. For A-1 material in embankments, MT 218 and MT 230 tests will be used.

Compact rock embankments that cannot be tested by Montana Test Methods MT 212 and MT 218 (Proctor Method) or MT 229 (Zero Air Voids Method) with compaction equipment and hauling and spreading equipment. Use grid rollers, pneumatic-tired rollers, vibrating rollers, vibrating compactors, or self-propelled tamping rollers. Do not use sheepsfoot rollers unless approved by the Project Manager. Use water as required.

TABLE 203-1
COMPACTION REQUIREMENTS

Compaction Control Method		
Material Compacted	**Proctor**	**Zero Air Voids**
	Test Methods: MT 210, MT 230, MT 212, MT 218	Test Method: MT 229
Earth embankment including all backfills	Minimum 95% of maximum density at optimum moisture ± 2%	Less than 10% air-filled voids
Top 8 inches (200 mm) of subgrade in cut sections		
Culvert foundations		
Top 8 inches (200 mm) of embankment foundations		
Backfill foundations		

203.03.4 Sloping and Finishing

A. Sloping. Finish and shape all cut slopes, ditches, embankments, and structure berms to a uniform, rough textured surface. Scarify smooth slopes.

Conduct slope roughening in accordance with the contract and Detailed Drawings. Slope roughening is a part of slope construction and is not measured for payment.

Where roadway slopes are not completed to the planned or directed lines and the material from the backslope erodes, sloughs, or slides due to incomplete erosion control measures or the Contractor's operations, the removal of the material and restoration of the slope is at Contractor expense.

Where roadway slopes are completed to the plan or directed lines, all required erosion control devices are in place as specified, and the material from the completed slopes erode, slough, or slide onto the roadbed before acceptance of the work, through no fault of the Contractor, the removing of the slide material, potential slide material, and the drainage excavation is paid for in accordance with Subsection 109.04.

When directed, widen cuts and flatten slopes to obtain additional excavation for embankments or to increase slope stability. The Project Manager may steepen stable rock slopes. This work is measured and paid for under the grading item unless it requires non-contract construction methods increasing costs that are considered extra work in accordance with Subsection 104.03.

B. Finishing. Finish the entire roadbed to the final elevations specified.

203.03.5 Maintenance of Constructed Roadway

Maintain the roadway during construction so it is continuously well drained.

Keep all drainage ditches and structures open and free from debris until the final inspection is approved.

If grading work is suspended, blade smooth and grade the entire roadway area to prevent water from collecting or ponding on the roadway. Maintain the roadway during suspension periods to the specified grade and cross section at Contractor expense.

Maintain erosion and siltation control devices meeting the contract requirements.

203.03.6 Topsoil - Salvaging and Placing

Remove sufficient amounts of topsoil from the excavation and embankment foundations to ensure replacement quantities are available to cover all disturbed areas with 4 inches (100 mm) of topsoil.

Place topsoil on the completed graded roadway to the lines, grades, and elevations specified.

Unless directed by the Project Manager, place topsoil on all slopes, excluding slopes 2H:1V or steeper. Place topsoil to an average 4-inch (100 mm) loose depth on the base course surfacing inslope. Uniformly spread the remaining topsoil over the rest of the disturbed areas. Finish the disturbed areas in accordance with Subsection 610.03.2.

Stockpile topsoil at acceptable selected locations within the R/W. When construction operations do not permit stockpiling within the R/W, make arrangements for stockpile sites outside the R/W at no additional cost to the Department.

Construct stockpiles so drainage is maintained and topsoil is easily reclaimed. Provide erosion controls following best management practice.

In the event that construction sequencing prevents replacement of topsoil over all disturbed areas prior to final paving, reserve adequate quantities to cover the exposed base course surfacing inslope as shown in the Detailed Drawings.

203.03.7 Limitation on Grading Operations

The maximum length allowed to be disturbed at one time within the project limits is 2.0 miles (3,200 m) of clearing and grubbing and 2.0 miles (3,200 m) of borrow, excavation and embankment.

The Project Manager may modify the restriction when soil characteristics, Contractor operations or both, indicate that a smaller or larger area is acceptable. For long or complex projects, the Contractor may have several separate grading operations working, where the Project Manager may apply the limit to each individual operation, provided finishing, mulching, and seeding closely follow the rough grading operations at each location. Use the specified pollution controls at each individual location.

203.04 METHOD OF MEASUREMENT

203.04.1 Excavation

The quantities of unclassified excavation, unclassified borrow excavation, special borrow-excavation, unclassified channel excavation, street excavation, sub-excavation, digout excavation, and muck excavation are measured for payment in cubic yards (m^3) as surveyed or calculated in accordance with Subsection 109.01.

The Department will provide the initial measurement at no charge for the following specific work areas:

1. In slide areas determined by the Department not to be the fault of the Contractor;
2. In excavated areas authorized by the Project Manager, outside the staked lines and grades; and
3. In un-staked areas such as borrow areas, muck excavations, sub-excavations, and un-staked excavations authorized by the Project Manager.

These areas of excavation and borrow are measured in their original position in accordance with Subsection 109.01. Disposal of excess or unusable excavation is not measured for payment.

The quantities of special borrow-neat line for payment are calculated in its final position in accordance with Subsection 109.01 with no allowance for shrink or swell.

Either the Department or the Contractor may request re-measurement of specific work areas, or the entire project, if there is disagreement over the accuracy of quantities computed from the staked lines and grades. The party requesting the re-measurement is responsible for all costs associated with the re-measurement. Department staff may perform the re-measurement, in which case, the cost for the Department's re-measurement is the Contractor's responsibility. An independent third party acceptable to the DCE, and under the direction of a professional land surveyor registered in Montana, may also be used to perform the re-measurement, at Contractor expense.

Excavation is eligible for a second payment under the following conditions:

1. A second handling is required;
2. The excavated material meets all the contract requirements for the second usage;
3. The second payment item quantity is calculated in-place in its final disposition, or computed from plan dimensions. Items that require a second field measurement, such as special borrow-excavation, are not eligible for a second payment;
4. The contractor makes up any shortfall in excavation, at no cost to the Department, caused by the second use. The material making up the shortfall is subject to approval by the Project Manager; and
5. The contractor is responsible for the haul, balance lengths, balance points or other foreseen or unforeseen project constraints. No payment will be made for any additional costs.

Authorized excavation of rock, shale, muck, or unstable material below grade necessary to provide the designed thickness of backfill is measured for payment. If the designated bottom plane of the excavation falls within a layer of rock, the below-grade excavation to the bottom of the layer, not exceeding 6 inches (150 mm) below grade, is considered authorized and is measured for payment.

Rock excavation exceeding 6 inches (150 mm) below grade is not measured for payment. If the nature of the material, the thickness of the layers or strata, and method of operations make it practical to excavate only to the plan depth, any material removed below plan depth is not measured.

Measurements are made for unusable materials excavated and removed.

Useable material temporarily removed and replaced for Contractor convenience is not measured for payment.

Removal and disposal of unusable materials from borrow areas is not measured for payment. Special borrow removed from areas before surveying is not measured for payment.

The actual quantities of plan and approved sub-excavation are measured and added to the quantities of unclassified excavation for payment.

Unstable material reworked in accordance with Subsection 203.03.1(D) is measured and paid for as unclassified excavation for the second handling.

When the contract does not contain a bid item for muck excavation and an area is determined to be muck in accordance with Subsection 203.01.1(E), the muck excavation quantity is measured and paid for in accordance with Subsection 109.04. Measurement and payment for muck excavation at the agreed price includes all excavating and hauling, disposing of all stumps, logs, and other debris encountered in the excavation, all pumping and de-watering required, and finishing of the planned disposal areas.

Unclassified excavation allowed for pre-split drill equipment clearance is calculated from the area bounded by the plan slope and lines parallel to plan slope, offset 2 feet (610 mm) for each 50-foot (15.2 m) increment in vertical cut height. The quantity for drill equipment clearance where the cut slope height is less than 50 feet (15.2 m) is not measured for payment.

Excavation used as select or stockpiled select material is measured by the cubic yard (m^3) in its original position.

Removed and placed stockpile material is measured using the volume in its original excavated position.

Channel excavation is measured and paid for as unclassified channel excavation.

Street excavation is measured and paid for as unclassified excavation unless the contract has street excavation as a bid item. Disposal of material or other items within the limits of the street excavation are not measured for payment.

Geotextile is measured in accordance with Subsection 622.04. Accepted quantities of geotextile are paid for in accordance with Subsection 622.05.

203.04.2 Reserved

203.04.3 Embankment in Place

The embankment quantities measured in cubic yards (m^3) for payment as Embankment In Place include the following:

1. The actual quantities of roadway embankment measured, above the original ground line in accordance with Subsection 109.01, with no volume adjustments made for shrinkage, compaction, or subsidence.
2. The topsoil replacement quantity, measured in the topsoil stockpiles.
3. Excavation of unusable material and sub-excavation in the contract or directed by the Project Manager in its original position.

203.04.4 Compaction

Work and materials to compact embankment material and backfill to the specified density is not measured for payment.

203.04.5 Topsoil

Excavation of topsoil material from its original position, loading, hauling, stockpiling, and removal from the stockpile and spreading on the designated areas is measured for payment by the cubic yard (m^3) in the stockpile before final placement.

Before measurement, shape and smooth each stockpile into the smallest practical area. Haul is not measured for payment.

Topsoil removed from cut areas is not deducted from the grading quantities.

Measurement is made as if the topsoil had not been removed.

Topsoil removed from embankment areas and from borrow areas, excluding Contractor-optioned in accordance with Section 106, is measured under the bid item Topsoil - Salvaging and Placing.

203.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Digout Excavation	Cubic Yard (m^3)
Embankment in Place	Cubic Yard (m^3)
Muck Excavation	Cubic Yard (m^3)
Special Borrow	Cubic Yard (m^3)
Street Excavation	Cubic Yard (m^3)
Topsoil - Salvaging and Placement	Cubic Yard (m^3)
Unclassified Borrow Excavation	Cubic Yard (m^3)
Unclassified Channel Excavation	Cubic Yard (m^3)
Unclassified Excavation	Cubic Yard (m^3)

Payment at the contract unit prices is full compensation for all resources necessary to complete these items of work in accordance with the contract.

SECTION 204

BLASTING

204.01 DESCRIPTION

This work is using blasting techniques to form cut slopes, remove rock obstructions and other objects to construct highway roads, bridges and facilities.

204.02 MATERIAL

Furnish non-plastic crushed granular material for stemming, meeting the following gradation requirements:

Sieve Size	Percent Passing
⅝" (16 mm)	100
No. 4 (4.75 mm)	0 – 10

Provide a minimum of 35% of the material retained on the No. 4 (4.75 mm) sieve with at least one mechanically fractured face.

204.03 PRODUCTION BLASTING

Production blasting refers to the main fragmentation blasting resulting from more widely spaced production holes drilled throughout the main excavation area adjacent to the controlled blast line.

204.03.1 Blasting Professional

A. **Blasting Consultant.** Retain a recognized Blasting Consultant to assist in the blast design. Ensure the Blasting Consultant is an expert in the field of drilling and blasting and is not an employee of the Contractor, an explosives manufacturer, or explosives distributor. Review the Blasting Consultant's resume to ensure adequate experience in drilling and blasting. Submit a copy of the resume to the Project Manager at the Pre Construction Conference. The Blasting Consultant is professionally responsible when advising the Contractor on issues relating to blast safety, blast design, and public safety and convenience. The Contractor is responsible for all damage.

   The Blasting Consultant is in responsible charge of the blast monitoring, pre-blast and post-blast surveys, ground vibration monitoring, and air overpressure monitoring. Have the Blasting Consultant review all blasting plans and submit comments regarding the adequacy of the blast plans to ensure conformance to these specifications and all other applicable Federal, State, and local regulations. The Blasting Consultant and the Blaster-in-Charge must coordinate their efforts to ensure these requirements are met. Forward the Blasting Consultant's comments, Master Blasting Plan, and all other ancillary plans required by the contract, to the Project Manager for review.

   The Blasting Consultant has the authority to require modification of any of the proposed blasting plans to meet project requirements, environmental requirements, or satisfy safety concerns. Submit these modifications to the Project Manager for review as required.

   The Blasting Consultant must attend all blasting related meetings including the preconstruction meeting.

B. **Prequalified Blasting Contractors.** Use prequalified blasting contractors to complete the work required in the contract. A list of prequalified contractors is located at the following website: http://www.mdt.mt.gov/business/contracting/prequalified.shtml.

   Contractors not currently prequalified by the Department to perform blasting work can obtain pre-qualification information from the CES Bureau, 2701 Prospect Ave., Helena,

Montana. A complete Statement of Qualifications (SOQ) must be received a minimum of 14 calendar days prior to the bid opening as specified in the Invitation for Bids.

204.03.2 Use of Explosives

Explosives refer to any commercial explosive products, materials, blasting agents, primers, delays, initiators, etc., used in blasting operations.

Transport, store, handle, and load explosives and blasting agents following all laws and ordinances as well as the applicable requirements of Title 29, Title 30, and Title 49 of the Code of Federal Regulations and specifically the current Office of Surface Mining Reclamation and Enforcement (OSMRE) Blasting Guidance Manual when using, handling, loading, transporting, and storing explosives and blasting agents.

Use only explosives permitted by the State, local laws and ordinances, and all respective agencies having jurisdiction over them.

Use explosives without endangering life or property and be responsible for all resulting property damages, injury, or death.

Only use persons experienced in the handling of explosives and do not fire explosives until sounding a warning and removing all persons from the radius of danger.

Notify each property owner, Railway Company, and public utility Company having facilities near the blasting area of the intent to use explosives to enable them to take precautions to protect their property from injury. Be responsible for damages to property or injury to persons attributable to the use of explosives.

Do not use explosives and explosive products containing the chemical compound perchlorate (ClO_4).

204.03.3 Master Blasting and Safety Plan

Submit a Master Blasting Plan, along with any comments from the Blasting Consultant, to the Project Manager for review at least 10 business days before the start of test or production drilling operations or at any time the drilling and blasting methods, or explosive type or product are changed. Include full details of the drilling and blasting patterns and controls to be used for production blasting in the blasting plan.

A. Blasting Plan. Include the following information, at a minimum, in all blast plans:

1. Shot Number.
2. Date and proposed time of shot.
3. Top and bottom elevations of the blast.
4. Seismograph locations, elevations, and distances between the blast and vibration monitoring points.
5. The station limits of the proposed blast(s) and the number of holes to be drilled and shot per blast.
6. The hole diameter, hole depths, and explosive load for each hole (number of cartridges of each type, stemming depth, decks, and primers, etc.).
7. Explosive type; diameter; length; weight; and brand name.
8. Proposed quantities of production and presplit/cushion blasting for each blast and the entire project.
9. Appropriately scaled plan diagram(s) showing: blast hole locations, blast hole diameter, blast hole pattern, blast hole angle(s), free face, burden, spacing, lift height, sub drill depth(s), delay periods, delay pattern, and relative location of nearby structures and appurtenances. Base all plan diagrams on the project plan sheets, including topography.

10. Appropriately scaled cross section diagram(s) showing: blast hole depths, blast hole angle(s), loading, stemming, sub drill (as applicable), etc. Base all cross section views on the project plan sheets, including topography.
11. Total pounds of explosives and number of cartridges to be used.
12. Total volume of blasted material.
13. Powder Factor and maximum pounds of explosives per delay.
14. Detailed calculations for predicted peak particle velocities, and predicted vibration frequencies for ground and pertinent adjacent structures to ensure compliance with required peak particle velocity and vibration limits.
15. The signatures of the Blaster-in-Charge and the Blasting Consultant.
16. A storage plan for explosives, including the type of magazine or explosive facility, (if applicable) or a declaration indicating the use of daily explosive deliveries for the duration of the project. Provide a copy of the notification letter sent to the Federal Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF), signed by the magazine owner, if daily delivery will not be utilized at any time during the contract.
17. A detailed plan with the methods describing fly rock or blast debris prevention.
18. Manufacturer's product data sheets or technical bulletins and MSDS information for all explosives to be employed.
19. Copies of the Blaster-in-Charge's current State of Montana Blasters License. The State of Montana requires blasters to have a current Montana Blasters License.

The Master Blasting Plan and required submittals will be reviewed and revised based on the results of the test blasts. After satisfactorily completing the test blast section(s), and incorporating all test blast results and Blasting Consultant's comments, submit the reviewed and revised blasting plan as the Master Blasting Plan.

Submit an individual production blast plan for all subsequent blasts at least 4 business days prior to the planned blast day. Include the items discussed above, in Subsection 204.03.3(A), items (1) through (15), in each blast plan. Submit the production blasting plans on form CSN-55.

Do not begin full scale production blasting until the master blast plan has been submitted and reviewed for conformance to the Contract. Review of the blast plan(s) does not relieve the Contractor of responsibility for the accuracy, adequacy, and safety of the plan when implemented in the field.

B. Safety Plan. Submit a Safety Plan, in addition to the Master Blasting Plan and including any comments from the Blasting Consultant, to the Project Manager for review at least 10 business days before the start of test or production drilling operations. Include the following information, in the Safety Plan:

1. The name and telephone number of the Blaster-in-Charge. The Blaster-in-Charge is responsible for directing the day to day drilling and blasting operations, for clearing the blast site before excavation of the blasted material may proceed, for clearing local traffic through the blast zone, and for all required report preparation including daily blast logs, daily explosives consumption reports, and loss reports. Submit sample copies of daily blast logs, daily explosives consumption reports, and loss reports.
2. A detailed access control plan with the methods proposed to clear the blast area and to control access to the blast site and other closure locations required by the contract by unauthorized personnel during drilling, loading, blasting, and scaling operations. This plan will be followed exclusively by all parties concerned.
3. A detailed plan with the methods proposed to notify local residences, and all project personnel involved with field operations within the blast area, of an impending blast. Include the method(s) of notification and the proposed timeline(s) in the plan.

4. A detailed plan with methods to document, assess, and control ground vibration and air overpressure as well as calculated scale distances to each structure or appurtenance within a minimum of 1,320 feet (400 m) from the blast. Structures and appurtenances include, but are not limited to: culverts, bridges, other drainage facilities, wells, gabion walls, bin walls, other retaining structures, utilities, buildings, residences, railroads, etc.
5. A detailed vibration and blast monitoring plan, including a current calibration certification of any seismographs to be used.
6. A detailed fire prevention and protection plan.
7. A detailed plan to identify all potential blast site electrical hazards including, but not limited to, a lightning detection and protection plan.
8. A detailed emergency plan outlining the procedures to be followed in the event of an injury, accident, or unanticipated road closure in excess of one hour. Details of this plan must contain provisions for emergency vehicle traffic and personnel including potential detour routes, length of emergency detour, and estimated time to traverse the emergency detour.
9. A detailed blasting day protocol to be followed by all parties concerned. Information in the blasting day protocol must include, but is not limited to:
   - **(a)** Notifications made to impacted local residents, all project personnel, local emergency response organizations, utilities, or other entities that may be impacted by the blast.
   - **(b)** A contact list and appropriate phone numbers of all parties impacted by or involved in the blasting. Post copies of the contact list in the field office and submit a copy of the contact list to the Project Manager.
10. A copy of a sign-up sheet for documenting attendance of mandatory safety meetings by all project personnel involved with field operations within the blasting area.
11. A detailed scaling plan including the methods proposed and the entity responsible for conducting scaling operations on the project.
12. The signature of the Blaster-in-Charge and the Blasting Consultant.

Blasting and Safety Plan submittals must be complete. They may be submitted as 2 separate submittals, but each plan must be a complete document. The review time does not start until the complete package is received. Electronic documents (.pdf) are encouraged, but may also be in the form of portable storage devices.

204.03.4 Blasting Test Section(s)

Prior to conducting full-scale blasting operations, demonstrate the adequacy of the proposed Master Blasting Plan by drilling, blasting, and excavating test sections 100 feet (30 m) in length. Use the test sections to demonstrate which combination of methods, burden, spacing, other blast design parameters, and charge perform the best based on in-situ field conditions. When warranted by field conditions, test sections shorter than 100 feet (30 m) may be required, as determined by the Project Manager.

Requirements for production blasting operations covered elsewhere in this specification also apply to the blasting operations carried out in conjunction with the test blasts.

Do not drill ahead of the test blast area until the test section has been excavated and the results are evaluated by the Project Manager. If the results of the test blast(s) are unsatisfactory, adopt revised methods as necessary to achieve the required results at no additional cost to the Department.

If methods of drilling and blasting do not produce a uniform slope and shear face or adequate fragmentation within the tolerances specified in the contract, drill, blast, and excavate in short

sections, not exceeding 100 feet (30 m) in length, until a technique is arrived at producing the desired results, with no additional cost to the Department.

Unsatisfactory blast results include, but are not limited to: fragmentation beyond the indicated lines and grade (over break), excessive oversize material, poor fragmentation, fly rock, excessive ground vibration, excessive air overpressure, or violation of other requirements within these specifications. All costs incurred in adopting revised blasting methods necessary to produce an acceptable test blast are the sole responsibility of the Contractor.

204.03.5 Safety

Comply with all State and Federal requirements for blasting safety, including the OSMRE *Blasting Guidance Manual*, which provides guidance on the use of explosives and certification of blasters.

A. General. Prior to the each blast, conduct a safety meeting to discuss the safety requirements for blasting operations and the blast day protocol. Attendance for this meeting is mandatory for all project personnel that may be involved in field operations within the blasting and closure areas. Document attendance with a sign-up sheet and provide a copy of this sheet to the Project Manager. If there any changes to the safety requirements or blast day protocol, conduct another mandatory meeting and document attendance as required above.

1. Post required blasting signage prior to the start of the shift on the day of the blast. Signage must meet requirements of Section 618 and the traffic control plan.
2. Do not blast during hours of darkness (one-half hour before sunset to one-half hour after the following sunrise).
3. Do not load holes during hours of darkness (as defined above).
4. Do not load explosives prior to Department review of applicable blast plans.
5. Keep all personnel and equipment not involved in loading or blasting operations a minimum of 100 feet (30 m) from the blast site during loading operations.
6. Keep all equipment and personnel a minimum of 1,000 feet (305 m) from the blast site during blasting operations.
7. Remove and properly dispose of all explosives packaging material prior to each blast.

B. General. The blasting day protocol is to be followed exclusively by all parties concerned. Information in the blasting day protocol includes, but is not limited to, the information listed in Subsection 204.03.3(B)(9).

1. Convene the following personnel one hour prior to blasting to coordinate traffic control, required closures, and blast procedures: Blasting Consultant, Blaster-in-Charge, Traffic Control Contractor, Project Manager (or Representative), Contractors or Subcontractors Foreman, and other pertinent personnel.
2. Road closures due to blasting operations and clean-up may not exceed the requirements of the contract. Clean-up activities include, but are not limited to, scaling or clean-up of loose rock or blasting related debris for safety purposes.
3. If road closures due to blasting operations exceed the required time limit, the Project Manager will suspend all work not directly related to blasting activities in accordance with the following:
   - **(a)** Closures up to 15 minutes beyond the allowed closure will result in a 2-day suspension of all work as defined above and time charged to the contract.
   - **(b)** Closures of 15 to 30 minutes beyond the allowed closure will result in a 3-day suspension of all work as defined above and time charged to the contract.
   - **(c)** Closures of greater than 30 minutes beyond the allowed closure will result in a 4-day suspension of all work as defined above and time charged to the contract.

(d) The Project Manager will rescind the suspension of work after receipt of a written plan from the Contractor detailing the measures to be taken ensuring compliance with the required road closure times. No adjustment to contract time will be made for work suspensions resulting in excessive road closures.

C. Warnings and Signals. Provide a detailed explanation and description for the signals that will be used. The warning signals must be clearly audible for ½-mile (800 m) from the blast site. The Blaster-in-Charge must demonstrate to the Project Manager that the method of warning meets this requirement.

1. Sound an initial warning signal 5 minutes prior to blast initiation to notify all in the area of the start of blasting within a 5 minute period. Sound a second warning signal one minute prior to blast initiation.

2. After the blast is over, the Blaster-in-Charge and the Blasting Consultant are required to observe the entire blast area for a minimum of 5 minutes to determine if all explosives have detonated and to guard against rock fall before commencing cleanup work and excavation.

3. The Blaster-in-Charge is responsible for clearing the site. If any holes have not detonated, the Blaster-in-Charge, with the assistance and advice of the Blasting Consultant, is required to address the misfire(s) and eliminate the hazard before other personnel enter the worksite. The blast site is off limits to unauthorized personnel during this time. The Contractor is responsible for all costs resulting from misfires. If a misfire occurs on a blast, notify the Project Manager. Submit a written report of existing conditions and remedial action taken to the Project Manager within 24 hours.

4. Once the Blaster-in-Charge and the Blasting Consultant indicate the area is free from misfires, blast damage, overhangs, or other hazards, sound an all clear signal to indicate to all personnel in the area that blasting operations are finished. Do not allow traffic to proceed until the all clear signal is given.

204.03.6 Pre-Splitting Rock Slopes

A. General. Pre-split rock cuts to a smooth plane using loaded, timed, and spaced drill holes.

Produce a continuous or semi-continuous fracture between drill holes and a stable rock cut by eliminating over break in the back slope during primary blasting.

B. Drilling. Use drills equipped with mechanical devices that accurately determine the angle the drill steel enters the rock. Do not drill if the devices are missing or inoperative.

Perform grading, as necessary, to remove overburden soil and loose or decomposed rock along the top of the excavation to establish a uniform and stable platform for drilling activities.

Use pre-split hole diameters that are between 2½ and 3 inches (65 to 75 mm). Drill pre-split holes within 3 inches (75 mm) of the staked collar location. Holes drilled outside the 3-inch (75 mm) tolerance will be rejected and not measured for payment. Drill hole intervals may vary between 24 and 36 inches (610 to 915 mm). A 30-inch (765 mm) interval is used to estimate the quantity of pre-split drilling in the contract.

When the cut height exceeds 30 feet (10 m), and after completion of the top excavation lift, an offset from the staked slope line, not to exceed 2 feet (610 mm) is allowed at the top of each lift after the top lift. The actual slope cannot deviate from the plan slope by more than 1-foot (305 mm).

Control the drilling operations to ensure that no hole deviates from the slope plane by more than 9 inches (230 mm). This tolerance applies to deviations left or right of an apparent vertical projection of the hole when viewed from a right angle to the slope face or deviations into or out of

the planned slope plane when viewed parallel to the slope face. Pre-split holes exceeding these limits will not be paid for.

Drilling 2 feet (610 mm) below ditch bottom to aid in removing the toe berm is permitted.

Extend pre-split holes a minimum of 30 feet (9.1 m) beyond the limits of the production holes or to the end of the cut.

Maintain the length of pre-split holes for any individual lift at no more than 30 feet (9.1 m). The Project Manager may approve a written request to increase the hole length to a maximum of 60 feet (18.2 m) if it is demonstrated that the above pre-split hole tolerances and a uniform slope can be maintained. If over 5% of the pre-split holes are misaligned in any one lift, reduce the lift heights until the 9-inch (230 mm) tolerance is met.

204.03.7 Blasting Operations

A. General. All blasting operations, including the transport, storage, handling, and loading of explosives, are the direct responsibility of the Blaster-in-Charge. Conduct all blasting operations in accordance with the contract and all applicable Federal, State, and local regulations.

Store all explosives in accordance with the submitted storage plan and all applicable Federal, State, and local regulations.

Provide each cap period from one lot number. Mixing of lot numbers for any one cap period is prohibited. Any blasting materials in excess of one year of age are prohibited.

If any explosives are determined to be of either excessive age or in a deteriorated condition, cease all blasting work until the explosives age or quality can be verified. Do not use explosives that do not meet the manufacturer's specifications. Remove and properly dispose of explosives, not meeting the manufacturer's specifications, at no cost to the Department.

Explosives missing date codes are prohibited and cannot be brought to the site. The Blasting Consultant is responsible for verifying that the above requirements are met.

The Project Manager has the authority to:

- Require the explosives to be tested by an independent organization to determine its performance compared to the manufacturer's product data sheet.
- Approve the independent testing organization prior to performing the tests.
- Reject any lot number if the explosives performance and/or composition deviates more than 10% in any manner from the manufacturer's product data sheet.

All costs for testing and replacement of the explosives are the Contractor's responsibility if the explosives performance or composition deviates by more than 10%. The Department will pay the testing costs if the explosives meet the manufacturer's product data sheet.

B. Procedure. Drill production blast holes in accordance with the patterns shown on the submitted blasting plan(s). Drill the production blast holes within two blast-hole diameters of the staked collar location. Do not drill the production hole bottoms lower than the presplit hole bottoms. The maximum allowable diameter for production holes is 6 inches (150 mm).

Locate and stake the blast holes. If more than 5% of the holes are drilled outside of this tolerance, fill the holes with crushed stone or approved material and re-drill the blast holes at the proper location.

Detonate production holes on a delay sequence toward a free face. Stem production holes a minimum of 3 feet (915 mm) or 0.7 times the burden distance, whichever is greater, with stemming meeting the requirements of this specification. Take all precautions necessary in the blasting operations to prevent blast damage to the final rock

slope. Production blasting is incidental to and included in the measurement and payment for unclassified excavation.

Do not use bulk ammonium nitrate and fuel oil in the pre-split holes. Use only standard explosives manufactured specifically for pre-splitting.

Fit blast holes with a temporary plug to prevent overburden, drill cuttings, or other foreign material from falling into the hole after drilling. Verify that the drill holes are free of obstructions for their entire depth before placing charges. Take precautions to prevent material from entering the drill holes during loading operations.

Stem all presplit holes a minimum of 3 feet (915 mm) with stemming meeting the requirements of this specification. The Contractor may pre-split the slope face before production drilling or pre-split the slope face and production blast at the same time, if the pre-split drill holes are fired simultaneously at least 100 milliseconds before the production blast. Do not delay pre-split holes more than 25 milliseconds, hole to hole, to reduce noise and ground vibration.

Prior to loading any blast holes, check and measure holes for conformance to the submitted blast plan. The Blasting Consultant is responsible for verifying the location and depth of these holes. If the blast holes are not drilled to the correct depth, are plugged, or are unable to be fully loaded, clean out or re-drill those holes not meeting the contract requirements or the submitted blast plan. The Blasting Consultant is responsible for verifying that all explosives and stemming are installed in accordance with the submitted blast plan. Notify the Project Manager of any variations or deviations from the submitted blast plan. Submit a detailed written report on the discrepancies observed and recommended remedial action to the Project Manager as soon as possible.

204.03.8 Scaling

Scale slopes throughout the duration of the contract, and at such frequency as required, removing all loose rocks, overhangs, or other hazards. Scale during or upon completion of excavation in each lift. Do not allow drilling of the next lift until this work has been completed. Scaling must be performed to industry standards and contract requirements.

Perform additional stabilization or scaling, required as a result of the blasting, at no additional cost to the Department.

The Project Manager has the authority to prohibit or halt blasting operations if:

- The required slopes are not being obtained in a stable condition;
- The safety and convenience of the traveling public is being jeopardized; or
- Unsatisfactory blast results are being obtained as defined in Subsection 204.03.4.

All costs incurred in adopting revised blasting methods necessary to produce acceptable blasting results are the sole responsibility of the Contractor.

204.03.9 Records

A. Drilling Logs. On a daily basis, and prior to loading any explosives, provide copies of the daily drilling logs to the Blasting Consultant, the Blaster-in-Charge, and the Project Manager. Include all of the following information, at a minimum, for each hole drilled:

1. Drill hole location within the blast pattern (i.e. row number and hole number).
2. Drill hole diameter.
3. Total depth of drill hole.
4. Drill hole angle.
5. Depth of overburden.
6. Depth to any changes in material hardness (e.g. clay seams, sand seams, soft rock, coal seams, etc.).
7. Depth and length of any voids encountered.

8. Depth to water if encountered.
9. Date drilled.
10. Driller's name.

B. **Blasting Logs.** On a weekly basis, provide copies of the daily logs of blasting operations to the Project Manager. Include the numbers, times, dates, blasting locations, and patterns of all blasts in the logs for that week. Additionally, include all of the following information:
   1. Any variations from the reviewed blasting plan.
   2. Trade names and sizes of all explosives.
   3. Explosives consumption and loss reports.
   4. All ground vibration and air overpressure records.
   5. Signature of Blaster-in-Charge.

204.03.10 Survey

A. **Pre-Blast Condition Survey.** Have the blast consultant arrange for a pre-blast survey of any nearby buildings, structures, utilities, or other appurtenances that may potentially be at risk from blasting damage. Use a survey method acceptable to the Contractor's insurance company. Submit copies of all pre-blast survey records to the Project Manager for review before blasting operations begin. Notify occupants/owners of local buildings, structures, utilities, or other appurtenances a minimum of 48 hours prior to the start of blasting operations.

B. **Post-Blast Condition Survey.** If complaints of damage or annoyance are made, have the blast consultant arrange for a post-blast survey of any nearby buildings, structures, utilities, or other appurtenances affected by blasting. Use a survey method acceptable to the Contractor's insurance company. Be responsible for any damage as described in Subsections 107.15 and 204.03.2. Submit copies of all post-blast survey records to the Project Manager for review within 48 hours of completing the survey. Notify the Project Manager of any damage or annoyance claims from occupants/owners of local buildings, structures, utilities, or other appurtenances a within 24 hours of the complaint.

C. **Vibration Control and Monitoring.** Have the blast consultant establish a vibration control and monitoring program. Submit the vibration control and monitoring program to the Project Manager for review at least 10 business days before the start of test or production drilling operations or at any time the drilling and blasting methods are changed.

When blasting near buildings, structures, or utilities, or other appurtenances that may be subject to damage from blast induced ground vibrations; control the ground vibrations by using properly designed delay sequences and allowable charge weights per delay. Establish allowable charge weights per delay by carrying out test blasts and measuring vibration levels. Confirm that the test blasts, in accordance with Subsection 204.03.4 and modified as required, limit ground vibrations to below damage thresholds.

Monitor each blast using an approved seismograph(s) located, in accordance with the submitted Master Blasting Plan, between the blast area and the closest structure(s) subject to blast damage whenever vibration damage to adjacent structures is possible. Use a seismograph(s) capable of recording peak particle velocity for three mutually perpendicular components of vibration in the ranges typical for blasting operations. All seismographs employed for monitoring are required to be calibrated within the preceding 12 months. Furnish current calibration certifications to the Project Manager.

Do not allow peak particle velocity or frequency of each component to exceed the safe limits of the nearest structure subject to vibration damage. Have the Blasting Consultant

interpret the seismograph records to ensure that the seismograph data is effectively utilized in the control of the blasting operations with respect to the existing structures.

Provide the data recorded for each blast to the Project Manager prior to the next blast and include the following:

1. Identification of instrument used.
2. Name of qualified observer and interpreter.
3. Distance and direction of recording station from blast area.
4. Type of ground at recording station and material on which the instrument is sitting/placed.
5. Maximum peak particle velocity and frequency in each component.
6. A dated and signed copy of photographic records of seismograph readings.

Table 204-1 lists suggested conservative limits for maximum peak particle velocity and minimum frequency.

TABLE 204-1
SEISMOGRAPH TOLERANCES

Structure Type	Maximum Peak Particle Velocity, inches per second	Minimum Vibration Frequency, Hertz
Green concrete (less than 7 days)	1.00	18
All other structures; utilities; wells; springs; and aquifers	2.00	30

The Blasting Consultant has the authority to modify the above parameters to safely meet contract and environmental requirements.

Older deteriorated structures, utilities, or structures housing computers or other sensitive equipment, may require lower peak particle velocity and different frequency limits than given in Table 204-1. Additionally, buried pipelines, fiber optic cables, or other appurtenances owned by private utility companies or structures owned by other entities may be subject to lower limiting values imposed by the owner. On critical projects where vibration and frequency control is important, have an experienced vibration specialist establish safe vibration limits.

In special cases, the Blasting Consultant may use the Blasting Level Chart, (Figure 1, page 24, OSMRE Guidelines) to determine maximum allowable ground vibration. This figure provides alternative blasting level criteria based on blast vibration frequency and maximum allowable peak particle velocity.

The Blasting Consultant is responsible for; all necessary materials and equipment utilized in the performance of this work, for providing a high-speed film or video record of each blast, to be available to perform evaluation, monitoring, and record keeping as described above and as directed by the Project Manager.

204.03.11 Noise and Debris Control

A. **Air Overpressure and Noise Control.** Have the Blasting Consultant install an air overpressure monitoring system, if appropriate, between the main blasting area and the nearest structure subject to blast damage or other detrimental effects. Ensure the equipment used to make the air overpressure measurements is the type specifically manufactured for that purpose. Hold peak overpressure below 0.05 psi (0.34 kPa) at the nearest structure or other designated location. Use appropriate blast hole patterns, stemming, and detonation systems to prevent venting of blasts and to minimize air overpressure and noise levels produced by the blasting operations. Lower the overpressure limit if it proves too high based on damage or complaints. Immediately after

each blast, furnish a permanent signed and dated record of the peak overpressure measurements to the Project Manager.

B. Fly Rock Control. Where necessary, use approved blasting mats, soil, or other equally serviceable materials or containment methods to prevent fly rock and/or debris.

Permit violations, resulting from blasting operations, are the sole responsibility of the Contractor.

204.03.12 Controlled Blasting

Controlled blasting refers to the controlled use of explosives and blasting accessories in carefully spaced and aligned drill holes to produce a free surface or shear plane in the rock along the specified excavation back slope.

Controlled blasting techniques include presplitting and cushion (trim) blasting. All final slopes identified in the contract as pre-split slopes must be excavated with controlled blasting methods. Ripping is not allowed within 10 feet (3 m) of the final slope face.

A. General. Meet all requirements of Subsection 204.03, as well as the following:

1. When presplitting, detonate the presplit line before detonating any production holes.
2. Cushion blasting is similar to presplitting, except detonation along the cut face is after the detonation of the production holes.
3. Unless otherwise approved by the Project Manager, begin tests using controlled blast holes spaced 2½ feet (760 mm), adjusting if necessary, to a maximum spacing of 3.0 feet (915 mm), until the Project Manager approves the spacing to be used for a full-scale controlled blasting operations.

B. Controlled Blasting Methods

1. **Presplitting.** Perform all presplitting, including the blasting test sections, in accordance with Subsection 204.03.4.
2. **Cushion (Trim) Blasting.** Cushion blast, in lieu of presplitting, where the horizontal distance from the cut face to the existing rock face is less than 15 feet (5 m). The difference in delay time between the trim line and the nearest production row cannot be more than 75 milliseconds or less than 25 milliseconds.

204.04 METHOD OF MEASUREMENT

204.04.1 Drill Pre-Splitting Holes

A. Production Blasting. Production blasting is incidental to and included in the measurement for Unclassified Excavation in accordance with Section 203.

B. Controlled Blasting. Drill pre-splitting holes are measured by the linear foot (m) of controlled blast hole. The measurement is made from hole collar to a depth of 2 feet (610 mm) below finished ditch grade. Holes with alignments not meeting the requirements of Subsection 204.03.3 are not measured for payment. Quantities shown in the contract are based on 2½-foot (760 mm) hole spacing. Actual quantities will depend on field conditions and results from test sections. The quantity of drill pre-splitting holes shown in the contract is not guaranteed, and the Department reserves the right to increase or decrease this item with no adjustment in the contract unit price.

204.04.2 Blasting Consultant

Blasting Consultant is measured by the lump sum.

204.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Blasting Consultant	Lump Sum
Drill Pre-Splitting Holes	Linear Foot (m)

Equipment to perform vibration and air overpressure monitoring, pre-blast and post-blast surveying, film, videotape, and other expendable materials are incidental to Blasting Consultant work and are not paid separately. Payment for all costs associated with Blasting Consultant work is included in the lump sum bid price for Blasting Consultant.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

204.05.1 Production Blasting

Payment for all costs associated with production blasting including materials, explosives, labor, tools, and equipment is included in the contract unit price per cubic yard (m^3) of Unclassified Excavation.

204.05.2 Controlled Blasting

Payment for all costs associated with controlled blasting including materials, explosives, labor, tools, and equipment is included in the contract unit price per linear foot (m) of drill pre-splitting holes.

SECTION 206

DETOURS

206.01 DESCRIPTION

This work consists of constructing, maintaining and removing a detour within the prescribed corridor and as specified in the contract.

206.02 RESERVED

206.03 CONSTRUCTION

206.03.1 General

Construct the detour to the lines and grades shown in the contract and cross sections. Provide surfacing materials and thicknesses as specified in the contract.

Remove and stockpile topsoil within areas of the detour that require excavation prior to detour grading operations. Complete detour grading operations in accordance with Section 203.

In wetland or riparian areas as shown in the contract, cut shrubs impacted by temporary detour construction flush with the ground, do not grub. Use geotextile, or other approved separation, between the natural ground and temporary detour fill to provide minimal disturbance to the existing ground.

206.03.2 Design

Construct the temporary detour within the R/W or permit area and to the lines and grades shown in the contract and cross sections or as approved by the Project Manager. Surface the detour as indicated in the contract.

The method required for conveyance of a waterway is not included in the Preconstruction authorizations and permits issued by resource and regulatory agencies. Prior to commencing any work on the detour, determine a preferred method of conveyance and submit this with the Contractor's temporary facilities joint application to the Project Manager. The submittal will be forwarded to the appropriate resource and regulatory agencies for review and approval.

A. Culverts. If used, furnish culverts of the size and length shown in the contract. Provide adequate bulkheads at the approach fills to prevent fill materials from entering the waterway. Place culverts in accordance with Section 603.

B. Structures. If a bridge is chosen as means for conveyance of the waterway, provide a waterway opening of sufficient size to accommodate the 2-year flood event, spanning the active channels with 1-foot (305 mm) minimum freeboard. Construct all temporary bents in a manner that the current remains un-deflected. Provide adequate bulkheads at the approach fills to prevent fill materials from entering the waterway.

Provide the detour bridge with a width greater than or equal to that of the existing bridge, with a design load capacity of AASHTO HS-20 (MS-18). Provide a rail system with blunt end protection at all bridge ends. Ensure the rail system either meets NCHRP 350 TL-1 or MASH crash test requirements or can resist railing design forces as specified in AASHTO LRFD TL-1 (Table A13.2-1).

206.03.3 Submittals

A. Bridge. Submit a copy of the design and calculations plus 5 copies of the working drawings for the proposed detour bridge stamped and signed by a professional engineer licensed to practice in the State of Montana. Show the following in the drawings:

1. Bridge length and width.
2. Location of all bents.
3. Clear water opening.
4. Bulkheads and method of construction.

5. Details of the bridge rail.

B. **Culverts.** When culverts are not shown in the contract, submit a copy of the design for the proposed pipe which must show the following:
   1. Pipe size and length.
   2. Location.
   3. Minimum fill cover.

The Department has 20 business days to review the submittals. Approval of the detour is contingent upon meeting the requirements of this provision and those of the resource and regulatory agencies with jurisdictional authority.

206.03.4 Maintenance

Maintain the detour in accordance with Subsection 104.05 to provide the traveling public with a safe and smooth riding surface. Provide a satisfactory surface similar or better to that which existed on the PTW prior to beginning construction. Repair all damage to the detour and the PTW connections immediately and at no additional cost to the Department. This includes, but is not limited to, damage from washouts, chuckholes, soft spots, guardrail damage, or debris on the roadway. Failure to maintain the detour in a manner that provides the traveling public with a safe and smooth riding surface is cause for the Project Manager to stop work until corrective actions take place. All costs associated with the delay are the Contractor's responsibility.

206.03.5 Removal

Remove the detour only after the mainline work has been completed and approved by the Project Manager. Fill areas excavated for detour construction and incorporate the material removed from the detour into the mainline embankment. Grade the location impacted by the detour to approximately match its original contours. Place salvaged topsoil over the disturbed area and seed as specified in the contract.

206.04 METHOD OF MEASUREMENT

Detour - Construct, Maintain, and Remove will be measured as a lump sum quantity in accordance with Section 109. Materials, labor, and equipment needed to construct, maintain, and remove the detour are considered incidental to this item of work and will not be measured for payment. No additional measurements will be made for finish grade control or traffic control devices associated with detour construction. Traffic control devices used to maintain traffic after detour construction is complete will be measured under the traffic control bid item specified in the contract.

206.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Detour - Construct, Maintain, and Remove	Lump Sum

Include all materials, labor, and equipment needed to construct, maintain, and remove the detour in the lump sum bid for Detour - Construct, Maintain, and Remove. Traffic control devices required to construct the detour are considered incidental and will not be paid separately. Traffic control devices required for operation of the detour will be paid under the traffic control item specified in the contract.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 207

CULVERT EXCAVATION AND TRENCH EXCAVATION

207.01 DESCRIPTION

This work is the excavation for placing or removing drainage and other appurtenant structures. It includes foundation preparation, backfilling, disposal of excavation material, bailing, drainage, sheeting, shoring, cribbing and installation of safety measures needed to satisfy the requirements of Subsection 107.17. Excavation classes are described below.

207.01.1. Culvert Excavation

Culvert excavation is all work under Subsection 207.01, where vertical walls are not required and the excavation width is not specified.

207.01.2. Trench Excavation

Trench excavation is the excavation for placing or removing storm drains, sanitary sewers, water lines, and other installations in the contract. Vertical trench walls, when required, must be shored or supported to meet the U.S. Department of Labor, OSHA, Safety and Health Regulations for Construction. Trench widths are specified in Subsection 207.03.3.

207.02 RESERVED

207.03 CONSTRUCTION REQUIREMENTS

207.03.1 General

Excavate to permit removal, jointing, and backfilling of pipe.

Construct and maintain the excavations to prevent personal injuries, damage to foundations, structures, pole lines, or other facilities.

Pile and maintain all excavated material to meet OSHA requirements and with a minimum of inconvenience to the public. Do not obstruct fire hydrants, water valves, meters, and the free flow of storm water in gutters, other conduits, and natural water courses.

Do not excavate below the specified depth, except as permitted in Subsection 207.03.6.

Remove all obstructions in the excavation at Contractor expense.

Backfill excavated areas in accordance with Subsection 603.03.4. Do not place backfill against newly constructed masonry or concrete structures for at least 14 calendar days. Remove all sheeting and bracing before backfilling.

207.03.2 Culvert Excavation

When special foundation stabilization is specified, excavate the bedding trench walls vertically and excavate the trench width to provide room for the bedding material.

207.03.3 Trench Excavation

Keep trench lengths to a minimum in paved roadways, sidewalks, or other improved areas, in advance of the pipe laying and not to exceed 200 feet (61 m). Keep trench backfilling and compaction to within 300 feet (91.5 m) of the installed pipe.

Cut the pavement full depth vertically along regular neat lines in paved roadways that require patching. Excavate the minimum trench width possible.

When vertical trench walls are specified, the maximum trench width is the external width of the pipe barrel plus 3 feet (915 mm). When a special foundation is specified, excavate the bedding trench walls vertically and the trench width as specified.

Do not exceed the specified trench width without the Project Manager’s approval when vertical trench walls are specified.

Furnish any additional select backfill material and additional surface and subsurface improvements if the maximum trench width is exceeded at Contractor expense.

207.03.4 Excavation for Appurtenant Structures

Excavate for riprap, rubble masonry, retaining walls, cutoff walls, headwalls, manholes, drop inlets, catch basins, headgates, division boxes, and other structures appurtenant to culverts, sewers, drains, pipes, or tubing to meet the applicable requirements of Subsection 207.03.1.

207.03.5 Shoring

Provide and remove shoring or supports for excavation walls that protect the work, existing property, utilities, pavement, and other existing facilities. Provide safe working conditions meeting OSHA, local and state safety codes.

Repair damage caused from excavation support failure or from failure to provide support at Contractor expense.

207.03.6 Foundation Preparation

Compact foundations for culverts, sewers, drains, pipes, tubing, and appurtenant structures to the moisture and density requirements of Subsection 203.03.3.

Remove unstable or unsuitable material encountered below the excavation floor elevation and replace with material meeting Subsection 701.04.2. Cover with bedding material meeting Subsection 701.04.1 as directed. If approved by the Project Manager excavatable CLSM may be substituted as bedding material for concrete and steel pipes. A request to use excavatable CLSM for any other pipes or application must be submitted at least 5 business days prior to use. The Project Manager will investigate unstable pipe installations requiring 4 feet (1.2 m) or more of foundation material.

Remove unyielding material below the staked elevation to at least 12 inches (305 mm) and replace with bedding material meeting Subsection 701.04.

Bed culverts larger than 12 inches (305 mm) as shown in the Detailed Drawings. Place bedding for 12-inch (305 mm) diameter and smaller culverts to uniformly support the culvert throughout its length. The bedding does not need to conform to the outside of the culvert.

Do not lay pipe until the foundations are approved by the Project Manager. Remove and relay pipe laid on unapproved foundations at Contractor expense.

207.04 METHOD OF MEASUREMENT

Culvert excavation, trench excavation and excavation for bedding and foundation material are not measured for payment.

207.05 BASIS OF PAYMENT

Payment for all costs associated with culvert and trench excavation, furnishing and installing culverts is included in the contract unit price per foot (m) of pipe (type and size).

When bedding or foundation material is specified in the contract, payment for all costs associated with excavation required to place bedding and foundation material is included in the contract unit price per cubic yard (m^3) of bedding or foundation material.

Payment for safety measures required to protect open trenches is included in the contract unit price per foot (m) of pipe (type and size).

SECTION 208

WATER POLLUTION CONTROL AND AQUATIC RESOURCE PRESERVATION

208.01 DESCRIPTION

Water pollution control is the planning, scheduling, installing, maintaining, and removing of measures and devices to prevent or minimize pollution and control sediment transport and soil erosion. Aquatic resource preservation is the avoidance and minimization of impacts to aquatic resources.

208.02 MATERIALS

Use materials meeting contract requirements or approved by the Project Manager if permanent and temporary materials are not specified.

208.03 CONSTRUCTION REQUIREMENTS

208.03.1 General

Comply with all local, state, tribal, and federal laws and regulations as well as applicable permits, authorizations, and notifications for prevention or abatement of erosion, water pollution, and siltation. Obtain and submit copies of any required permits, authorizations, and notifications to the Project Manager before beginning construction activities covered under the applicable permit. The Department is not responsible for delays caused by incomplete or inaccurate submittals by the Contractor. Defend, indemnify, and hold harmless the Department from legal actions or fines resulting from violations of the rules, regulations, permits, authorizations, and notifications due to any act, omission, neglect, or Contractor misconduct.

Plan, install, inspect, and maintain temporary and permanent water pollution controls (i.e. BMPs) to provide economical, effective, continuous erosion and sediment control, prevent pollution during and after completion of construction activities, and preserve existing aquatic resources. Erosion and sediment control is required on all projects as necessary to minimize damage to the highway and adjacent properties and abate pollution of surface and ground water resources.

208.03.2 Water Pollution Control

Contractor failure to provide erosion, sediment, and water pollution controls may cause the Department to provide the work and deduct those costs from monies due or to become due the Contractor, or otherwise billed to the Contractor. The Department may also stop the work or withhold any payments due until acceptable corrective action is taken.

A. **Spill Prevention and Waste Disposal.** Prevent chemicals, fuels, lubricants, bitumen, raw sewage, and other wastes from entering regulated aquatic resources. Dispose of all wastes, refuse, and discarded materials in accordance with Subsection 107.11.

B. **Erosion and Sediment Control Measures.** Control erosion, sediment, and water pollution during all work and work suspensions. Design, install, and maintain erosion and sediment controls to control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.

   1. **Temporary Control Measures.** Install BMPs prior to, or concurrently with, soil disturbance activities. When BMP installation is concurrent with the soil disturbance activity, limit the work to an area that can be protected by BMPs no later than the same day the work is performed. Failure to install BMPs within the same day will result in suspension of all work relating to those BMPs.

      Maintain all temporary erosion control, sediment control, and other pollution control measures until it is no longer needed or conflicts with the work. If devices that

conflict with the work are removed, replace these devices no later than the end of each shift.

Re-grade work sites to match the surrounding terrain after the devices are removed.

Repair or replace damaged, inadequate, non-functioning, or non-conforming devices. Initiate work to fix the problem immediately after discovering the problem. Unless specified differently in permits or authorizations, complete this work as soon as practicable, but no later than 7 calendar days after discovering any deficiencies.

Temporary pollution control measures required due to the Contractor's negligence, carelessness, failure to maintain, or failure to install designed permanent controls in place of temporary controls are at Contractor expense.

2. **Permanent Control Measures.** Install permanent pollution controls concurrently or immediately following work that disturbs natural ground.

C. **Inspections.** Conduct inspections as specified in the permit. When no permit is required, conduct inspections to evaluate performance and maintenance needs of water pollution controls in accordance with the following schedule unless specified differently in permits or authorizations:

- At least once per month; and
- Within 24 hours of a storm event of 0.25 inches (6.5 mm) or greater.

Use the Department's most current SWPPP Inspection Report, when no permit is required. Use the Department's form or another form that conforms to permit requirements when a permit is required. Provide one copy of the signed inspection report to the Project Manager.

Failure to conduct inspections and submit inspection reports renders the BMPs unacceptable.

Immediately report potential noncompliance in accordance with applicable regulations, guidance, and permit conditions. The Contractor is wholly responsible for all violations including but not limited to those that result during the times when the required monitoring is not conducted, inspection report forms are not submitted, BMPs are ineffective, required maintenance or monitoring of BMPs is not performed.

BMPs will be inspected as part of the final inspection to ensure they are adequate, maintained, and functioning properly.

D. **Erosion Control Plan.** MPDES permits are issued by the DEQ for discharges within the state of Montana not including Indian Countries. NPDES permits are issued by the EPA for discharges inside the boundaries of Indian Countries. Some Tribal governments also have NPDES review authority and/or separate permitting authority. For projects requiring MPDES and/or NPDES General Storm Water Permit coverage, submit one NOI package and the associated fees for ground disturbance areas within the project limits to the appropriate permitting agency. Use Department furnished blank erosion control plans to complete the SWPPP as required by the General Permit. Provide a copy of the NOI package submitted and confirmation for receipt of a complete NOI package from the permitting agency to the Project Manager and Environmental Services Bureau prior to conducting any ground disturbance activities.

Be responsible for erosion, sediment, and water pollution control for Contractor furnished material sources, staging areas, plant sites, or any other Contractor caused ground disturbance outside the project limits. Submit a separate NOI package and the associated fees to the permitting agency for ground disturbance areas outside the project limits. Contractor furnished material sources, staging areas, plant sites, or any other Contractor caused ground disturbance outside the project limits, are the Contractor's responsibility and must be submitted under a

separate NOI package from the ground disturbance within the project limits. Although these areas are permitted separately, the areas of disturbance are considered cumulative with the project disturbance area when determining the requirement for permit coverage.

Comply with the conditions of the permit. Revise and/or update the SWPPP to reflect current conditions, pollution prevention measures, and installed BMPs in accordance with permit requirements. Submit all changes to the Project Manager.

Do not transfer or terminate the General Storm Water Permit coverage until the BMPs are inspected and approved and all records required under the permit, including inspection and monitoring reports, are furnished to the Project Manager. The Department may require that certain BMPs be replaced by another type of BMP as a condition of permit transfer.

When submitting the General Storm Water Permit transfer package/application to the Department, include a check for the permit transfer fee. Make the check for the amount of the fee payable to the DEQ.

208.03.3 Aquatic Resource Protection

A. General. Unless authorized with approved permits and authorizations, meet the following general provisions:

1. Do not operate mechanized equipment in any regulated aquatic resource, unless authorized in accordance with Subsection 208.03.4(B).

2. Isolate work zones from flowing and standing waters during construction, unless authorized in accordance with Subsection 208.03.4(B).

3. Do not spill or dump material from equipment into regulated aquatic resources.

4. Do not discharge wastewater from washout of concrete related equipment, concrete finishing, saw cutting, wet concrete, hydraulic demolition, etc. into any regulated aquatic resource.

5. Do not place fill or other materials in any regulated aquatic resource unless included in the contract. or authorized in accordance with Subsection 208.03.4(B).

6. Locate staging or storage areas at least 50 feet (15.2 m) horizontally from any aquatic resource, top of stream bank, or the highest anticipated water level during the construction period, whichever is furthest from the resource.

7. Store and handle petroleum products, chemicals, cement and other deleterious materials to prevent their entering regulated aquatic resources.

8. Provide sediment and erosion controls for topsoil stockpiles, staging areas, access roads, channel changes, and instream excavations.

9. Shape and contour streambeds and stream banks to their pre-disturbed condition to match adjacent undisturbed ground, unless included in the contract.

10. Clean, maintain, and operate equipment so that petroleum-based products do not leak or spill into any regulated aquatic resource.

B. Temporary Facilities and Construction Activities. Obtain required permits and authorizations for the installation, maintenance, operation, and removal of temporary facilities such as work bridges, work pads, cofferdams, temporary detours, diversions, etc. Department obtained permits and authorizations do not typically include removal and disposal of existing structures, access to and from authorized locations, sequencing and construction methodology to construct authorized features, impacts to areas outside of the planned construction footprint, and other items potentially affecting an aquatic resource.

Plan temporary construction facilities to:

1. Minimize disturbance to regulated aquatic resources;

2. Not restrict or impede fish passage in streams;

3. Not restrict water flow anticipated during use; and
4. Remove temporary facilities as soon as practicable once they are no longer needed.

Complete application forms in accordance with the permitting agency requirements. Plans included as part of the application forms must at a minimum contain the following information:

1. Details depicting regulated aquatic resource features before installation of temporary construction facilities and after removal;
2. Location of facilities relative to permanent work and regulated aquatic resources;
3. Plan and elevation views of facilities showing regulated aquatic resources;
4. Anticipated high water elevation during use of the facilities;
5. Waterway openings and clearances;
6. Type of bridge bent, pier, and superstructure construction (wood, steel, concrete, etc.);
7. Quantity and type of material proposed for use;
8. Written description for installing, operating, maintaining, and removing facilities including proposed construction techniques, containment plans, equipment, stockpile and storage areas, temporary erosion and sediment control measures, site re-vegetation/restoration and weed control plans;
9. Estimated time the temporary facilities are to be in place; and
10. A plan for and written description of existing structure removal, if applicable, as described in Subsection 208.03.4(C).

Shape and contour areas disturbed by the installation or removal of temporary construction facilities to match adjacent undisturbed ground upon removal of the facilities.

Submit copies of the plans and application packages, their modifications, or their revisions to the Project Manager. The Department will review the plans and application packages, their modifications, or their revisions, and either request revisions or submit to applicable resource and regulatory agencies within 21 calendar days. Resource and regulatory agency review time does not begin until the Department submits the application to the applicable agencies. Do not begin work on temporary construction facilities or modifications to approved plans until receiving written approval from the regulatory and resource agencies.

C. **Existing Bridge and Structure Removal.** Furnish the Project Manager a plan and written description detailing how the existing bridge(s) and/or structure(s) are to be removed. Include in the description what methods and equipment are to be used to remove the bridge deck, superstructure, piers, footings, and end bents, and, if applicable, containment plan. Conduct work in accordance with Section 202.

Provide the anticipated start date of removal work and estimated time to complete the work.

Include details of erosion, sediment, and pollution control, and containment measures used during removal.

Remove contract-related debris from the regulated aquatic resources within 48 hours of placement.

Maintain constant progress on all in-stream work until completed.

208.03.4 Seeding

A. **Temporary Seeding.** Temporarily seed or implement other soil stabilization measures approved by the Project Manager on all disturbed soil areas as required by permits/authorizations. When no permit is required, temporarily seed or implement other soil stabilization measures approved by the Project Manager on all disturbed soil areas

when grading activities will not resume for a period of 14 calendar days or more by the 14th day after the last disturbance. Permanently seed areas not requiring further disturbance, if they fall within the seeding dates.

B. **Erosion Seeding.** Conduct erosion seeding on freshly exposed slopes steeper than 3H:1V that will not be top soiled or re-disturbed, unless implementing other soil stabilization measures in accordance with permits or as approved by the Project Manager. Manually broadcast seed the disturbed areas at the completion of each day, regardless of season. Excessively rocky slopes that cannot be excavated by ripping are exempt from erosion seeding. Broadcast seed with the following mixture and rates:

Species	lbs PLS per acre
Cereal barley	10.0
"Pryor" slender wheatgrass	5.0
"MT origin" Canada wildrye	10.0

Erosion seeding does not replace or substitute for final seeding activities specified in the contract.

208.04 METHOD OF MEASUREMENT

Temporary erosion and sediment control devices for use within the project limits are measured as lump sum and will not be measured separately. Only erosion and sediment controls within the project right-of-way and installed in accordance with manufacturer specifications or the Detailed Drawings will be paid for. BMPs and associated permit costs for Contractor furnished material sources, staging areas, plant sites, or any other site not within project limits are not measured for payment.

Permit fees and monitoring costs associated with obtaining and maintaining permit coverage for ground disturbance areas both within and outside the project limits are considered incidental to the project and are not measured separately for payment.

Normal maintenance of BMPs, in accordance with permit requirements and the contract, are considered incidental to the work and no additional measurements will be made. Maintenance includes:

- Removal of BMPs no longer required;
- Removal of sediment and debris in front of and around BMPs;
- Repair and replacement of incorrectly installed devices;
- Mobilization and travel for inspections and maintenance; and
- Maintenance until the permit is terminated or transferred.

Replacement of satisfactory BMPs requested by the Department at the final inspection will be measured in accordance with the Erosion Control Rate Schedule.

208.04.1 Temporary Erosion and Sediment Controls - Units

Temporary Erosion and Sediment Control (TESC) devices are measured by the unit of control devices used and accepted. A unit is the base value for establishing the relative value of each type of TESC device. The relative value of each TESC device in units is shown in the Erosion Control Rate Schedule.

Temporary and erosion seeding are measured parallel to the ground line and include seedbed preparation, fertilizing and seeding.

These will not be used to correct deficiencies of lump sum items.

208.05 BASIS OF PAYMENT

No additional payment will be made for the fees or monitoring costs associated with the General Permit for storm water discharges associated with construction activity. Include these

costs in the temporary erosion control bid item. Include fees associated with transferring the permit in the Lump Sum Temporary Erosion Control bid item.

Failure to implement BMPs identified in the SWPPP, update the SWPPP as required by the Construction General Permit, or conduct BMP inspections and submit inspection reports renders the BMPs unacceptable. No payment will be made for BMPs installed and the total paid to date on progress estimates for BMPs will be deducted on the next monthly progress estimate until SWPPP deficiencies are remedied and the inspection reports are completed and copies received by the Project Manager.

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Temporary Erosion Control	Unit
Temporary Erosion Control - LS	Lump Sum

Payment at the contract unit price is full compensation for all resources necessary to complete the work in accordance with the contract.

208.05.1 Temporary Erosion and Sediment Control - Lump Sum

Partial payment for Temporary Erosion Control will be monthly based on the lump sum contract price as follows:

TABLE 208-1
TEMPORARY EROSION CONTROL
LUMP SUM PROGRESS PAYMENTS

% Of Contract Amount Paid	% Of Erosion Control Bid Amount
First estimate after start of erosion control work	60
25	70
50	80
75	90
substantial work complete date	100

Include the cost of temporary erosion control in the cost of the lump sum item. Anticipate probable adverse weather and stream flow conditions.

A request may be submitted for compensation resulting from the addition of BMPs due to acts of God described in Subsection 107.17 or extra work added by change order. Include documentation in the request that demonstrates such an event has occurred. Payment for quantities required by an event or extra work, and approved by the Project Manager, will be by a change order and in accordance with the Erosion Control Rate Schedule contained in the contract at a unit price of $1.00 per unit.

The installation of additional BMPs requested by the Department at the final inspection will be added by change order and paid for in accordance with the Erosion Control Rate Schedule.

208.05.2 Temporary Erosion and Sediment Control - Units

Temporary erosion and sediment controls are paid for at the contract unit price per temporary erosion control. The units of each type of temporary erosion control paid for will be calculated by multiplying the measured quantity of each device by the assigned value per units shown in the Erosion Control Rate Schedule included in the contract.

Payment for completed and accepted temporary erosion/sediment control devices will be made in accordance with one of the following categories:

1. **Category No. 1 - New Installation.** When a device is new and used for the first time it will be paid at 100% of the rate schedule.

2. **Category No. 2 - Reuse.** When a previously used BMP material that meets contract specifications is placed in a new location, it will be paid at 75% of the rate schedule.

Maintenance of BMPs, in accordance with the MPDES/NPDES permit(s) and the contract, is not paid for separately. Include this work in the unit price bid for temporary erosion control devices.

No additional compensation is made for the removal of BMPs that are no longer required.

SECTION 209

STRUCTURE EXCAVATION

209.01 DESCRIPTION

Structure excavation is excavating bridge foundations and all other structure foundations. The item includes disposing of excess or unsuitable material from the excavations, backfilling to the original ground level, bailing, pumping, draining, sheeting, shoring and cribs.

209.01.1 Structure Excavation Type I

Structure excavation Type I is excavating, de-watering, shoring and cribbing, backfill and compaction for the excavation.

209.01.2 Structure Excavation Type II

Structure excavation Type II is excavating, de-watering, backfill, and compaction for the excavation, excluding shoring and cribbing.

209.01.3 Shoring and Cribs

This is constructing and removing all shoring and cribs, cofferdams or caissons, and for all material, labor, equipment, tools, and incidentals to complete the work.

209.02 RESERVED

209.03 CONSTRUCTION REQUIREMENTS

209.03.1 General

The plan excavation lines in the contract are estimated. Excavate all foundations to the plan elevations and dimensions.

Removing boulders, logs, and other obstructions found in the excavation is incidental to this work.

Remove timber, sheeting, and other material used in the excavation before backfilling.

Remove and stockpile all excavated material that is suitable for backfill.

209.03.2 Treatment of Foundation Materials

When the excavation reaches the designated depth, de-water, clean, and maintain the excavation until the foundation bed is inspected.

Clean and fill rock seams and crevices with concrete mortar.

Obtain the Project Manager's approval of the foundation before placing concrete on the foundation.

Place concrete without disturbing the bottom of the excavation.

Minimize disturbance of the natural ground outside the excavation pay limits except as required for constructing cofferdams.

209.03.3 Cofferdams

Submit drawings and calculations prepared by a professional engineer showing the proposed method of cofferdam construction and de-watering procedures before starting the work. The cofferdam must meet OSHA requirements.

Ensure cofferdams or cribs for foundation construction are watertight to permit de-watering.

Provide clearance within the cofferdam for constructing forms, inspection of the form exteriors, and for pumping.

Re-align or enlarge the cofferdams or cribs that are tilted or moved laterally during the work to provide work clearance at Contractor expense.

Timber bracing may be left in cofferdams or cribs extending into the substructure masonry with the Project Manager's written approval.

When weighted cribs are used to resist the hydrostatic pressure acting against the bottom of the foundation seal, use an anchorage to transfer the entire weight of the crib to the foundation seal.

When the foundation seal is placed, vent or port the cofferdam at the cofferdam design low-water level.

The foundation seal depths in the contract are based on the estimated, normal water-surface elevations or are consistent with those satisfactorily used on past projects.

The specified seal thickness is a minimum. The Contractor may request an increased seal depth. Submit the request in writing to the Project Manager for approval. Any approved increase in seal depth and associated costs are at Contractor expense.

Repair or replace failed cofferdams, foundation seals or both at Contractor expense.

Pump out the cofferdam and place the remaining masonry or concrete in the dry after meeting the time limit in Subsection 209.03.4.

Remove all cofferdam or crib material after the substructure is complete without disturbing or marring the finished work.

209.03.4 Pumping Water from Cofferdams

Pump interior foundation enclosures without disturbing the in-place concrete. Do not pump for at least 24 hours after placing concrete unless pumping from a sump separated from the concrete work by a watertight wall.

209.03.5 Inspection

Place the footings as soon as practical after the excavation depth and the foundation material are approved.

Drill holes or drive rods in the excavation bottom to determine the materials quality when requested by the Project Manager.

Excavate the spread footings and take rod soundings at each individual substructure unit and submit rod soundings simultaneously for the footing elevation approval.

209.03.6 Backfilling

Once approved, backfill and compact all excavated areas without damaging adjacent structures, to match the existing ground line.

Place backfill to be covered by roadway embankment in maximum 8-inch (200 mm) loose thickness, continuous horizontal layers.

Compact each layer in accordance with Subsection 203.03.3.

Remove and dispose of backfill containing large or frozen lumps, wood, or other deleterious materials. Do not jet or pond the backfill.

Serrate or step the slope bounding the excavation for abutments and wingwalls.

Place coarse gravel or broken stone around drain holes in wingwalls or abutments as shown in the contract.

Backfill around piers and in front of abutments and wingwalls with material large enough to resist erosion. If acceptable material is not available, the Project Manager may order stone or lean concrete backfill, paid for as extra work.

Place backfill against masonry abutments, and wingwalls in accordance with Subsection 203.03.2(B). Allow culvert related concrete work to cure 14 calendar days before backfilling.

Dispose of excess material at Contractor expense, in accordance with all applicable laws, rules and regulations.

209.04 METHOD OF MEASUREMENT

209.04.1 Structure Excavation Type I and Type II

Measurement in cubic yards (m^3) is based on the volume bounded on the sides by vertical planes 18 inches (455 mm) outside of the footing neat lines; on the top by the original undisturbed ground surface at the time excavation begins or by the lines in the contract; and on the bottom to the specified footing elevation or the elevation directed by the Project Manager.

Calculations for tie beams, overhangs, or similar volumes extending beyond the footing lines are computed from lines 18 inches (455 mm) outside of and below neat lines. The computed structure excavation includes only those portions not contained in the volume of footing excavation.

209.04.2 Shoring and Cribs

Shoring and cribs used with structure excavation Type I are not measured for payment.

Shoring and cribs used with structure excavation Type II are measured by the lump sum.

209.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Shoring and Cribs	Lump Sum
Structure Excavation Type I	Cubic Yard (m^3)
Structure Excavation Type II	Cubic Yard (m^3)

Additional approved material for backfill provided from other sources is paid for as extra work. Payment includes the costs of obtaining the material, processing, handling, and transporting to the project. The cost of placing and compacting the additional material and disposing of unsuitable material is included in the contact unit price for structure excavation.

No payment is made for additional material placed outside structure excavation pay limits and slope lines to comply with safety regulations.

No payment is made for additional material to replace material removed from the excavation, rendered unsuitable by improper excavation, handling, or stockpiling methods.

Partial payments for structure excavation Type I or II will be made based on the total quantity as follows:

1. 85% when removed to plan elevation.
2. 95% when backfilled and compacted.
3. 100% when the area is cleaned up to the Project Manager's satisfaction.

Partial payments for shoring and cribs will be made based on the lump sum contract unit price as follows:

1. 65% when shoring and crib is in position.
2. 90% when driven to final elevation.
3. 100% when shoring and crib is removed and the area is cleaned up to the Project Manager's satisfaction.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 210

EQUIPMENT USE

210.01 DESCRIPTION

This describes the equipment to be used for the contract work.

210.02 RESERVED

210.03 CONSTRUCTION REQUIREMENTS

210.03.1 General Requirements

Provide equipment in good mechanical condition having sufficient power to perform the work. Repair or replace equipment not meeting these requirements.

210.03.2 Motor Graders

Use self-propelled motor graders either tandem or all-wheel drive equipped with pneumatic tires.

Equip the graders with a moldboard at least 12 feet (3.6 m) long with a cutting edge, a scarifier with nine or more teeth having minimum dimensions of 3 x 1 x 16-inch (75 x 25 x 405 mm), and power-operated controls.

The motor grader manufacturers power rating must be at least 100 horsepower (75 kW).

210.03.3 Dozers

Use dozers of any standard type attached to a crawler tractor of at least 75 horsepower (56 kW) having power-operated controls.

Furnish dozers a minimum 90 inches (2.3 m) wide. The dozer and tractor is considered a single unit.

210.03.4 Rollers

A. General. Provide rollers and compaction equipment of standard manufacture bearing the manufacturer's identification label. Roller weight is the manufacturers rating.

Use self-propelled rollers capable of reversing direction without backlash.

Keep rollers in good mechanical condition with positive, accurate steering control.

Use adequately powered trucks or tractors for pull-type rollers.

Other than traction units, operate rollers separate and distinct from other equipment.

Equip all rollers with self-cleaning devices that prevent material from adhering to the wheels or tamping surfaces.

B. Smooth-wheeled Rollers. Use smooth-wheeled, self-propelled rollers meeting one of the following:

1. Tandem-type weighing up to 10 tons (9 MT); or
2. Three-wheeled type weighing a minimum 10 tons (9 MT); or
3. Towed steel-drum rollers weighing a minimum 4 tons (3.6 MT).

C. Tamping Rollers. Use tamping rollers with grids, drums, or shells surrounded by metal studs, pads, or similar elements that compress small areas of material.

D. Pneumatic-tired Rollers. Use pneumatic-tired rollers meeting the following:

1. Two-axle type, straight or oscillating;
2. Rigid framed providing a platform or body for ballast loading;
3. Effective rolling width of at least 4 feet (1.2 m);
4. Minimum working weight capacity of 250 pounds (113.5 kg) per inch width of tire tread;
5. Smooth tires (no tread) equal in size and diameter;
6. Rear axle tires spaced to overlap the tread gap of the preceding two tires;

7. Uniform tire pressure not varying from each other by more than 5 psi (34.5 kPa); and
8. Self-propelled or tractor or truck drawn (tractive power).

Operate the rollers, while turning, to prevent tearing or loosening of the material being rolled or the adjacent material.

Do not use wobble-wheeled pneumatic-tired rollers for bituminous surfacing work.

E. Vibratory Rollers. Use vibratory rollers capable of obtaining the required compaction.

210.03.5 Watering Equipment

Furnish and operate pneumatic-tired water equipment having spray bars capable of uniformly distributing water over the surface area. The control valves must be positive closing to prevent leakage.

210.03.6 Test Trailer, Transport, and Setup

Transport State-owned test trailers from a designated location to the project site and return it to a designated location as directed. Contact the Project Manager for details concerning the transport of the trailer at least 30 calendar days prior to plant mix operations. The Contractor is responsible for all required permits.

Purchase minimum $85,000 insurance for the trailer and its contents. Provide written proof of the insurance to the Project Manager prior to moving. Verify that the Department has prepared the trailer and contents for transport.

Repair or replace all contents and trailer damage occurring in transport at Contractor expense. Do not move the trailer without the Project Manager's permission.

Provide a level parking area, the required blocking, and electrical power service for the test trailer. Locate and construct the parking area a minimum 200 feet (61 m) from the plant mix dryer drum, mixing plant, and storage silo unless otherwise directed, to accommodate the 12-foot x 32-foot (3.6 m x 9.8 m) trailer. Transport, set up, and make the trailer fully operational at least 2 days before starting plant mix paving. Park, block, level, re-block, re-level and unblock the trailer as directed. Supply electrical power 24 hours a day, 7 days a week. Suspend paving work during power interruptions or periods of insufficient power to the trailer.

Furnish and install a continuous 200-ampere, 220 to 230 volt, single phase, 60 hertz power supply to the trailer. The power must be independent from the hot plant operation. Have the source connected by a Montana licensed electrician using a four wire connection.

210.04 METHOD OF MEASUREMENT

210.04.1 Equipment Use

Equipment use, when specified as a bid item, is measured by the hour for the hours performing the work and includes furnishing the equipment, including operator, servicing, repairs. Time in moving equipment from point to point on the project and for repair and servicing is not measured.

Equipment used in the work but not specified as a bid item is incidental to the work.

210.04.2 Test Trailer, Transport, and Setup

Test trailer, transport, and setup is measured by the mile (km) for the actual miles (km) moved. It includes insurance, transporting, blocking, unblocking, leveling, furnishing and installing electrical power and associated wiring, removing power and wiring, and all other necessary resources to complete the item of work. Maintenance re-blocking and re-leveling is incidental to the work and is not paid separately. The mileage shown in the contract is an estimate only and may be adjusted by the Project Manager.

210.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Dozer	Hour
Motor Grader	Hour
Test Trailer Transport/Setup	Mile (km)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 212

OBLITERATE ROADWAY

212.01 DESCRIPTION

Obliterate roadway includes removal of the existing roadway and related items, rehabilitating the abandoned roadway area by scarifying and shaping, and seeding.

212.02 RESERVED

212.03 CONSTRUCTION REQUIREMENTS

Grade and contour abandoned roadways to blend with the new roadway or existing terrain.

If not specified in the contract, dispose of the existing bituminous materials in conformance with applicable laws, rules, regulations and the Montana Solid Waste Management Act.

After the old roadway surfacing is removed, salvage the topsoil from areas to be graded and perform the rough grading. Grade and contour the obliterated roadway to blend with the new roadway and adjacent terrain. Spread the salvaged topsoil and seed the obliterated roadway area.

Work construction scars, sharp breaks, and steep slopes or cuts to blend with the terrain. Existing aggregate surfacing material may be used to construct fills when covered with 12 inches (305 mm) of soil capable of supporting plant growth. Existing bituminous materials used for embankment of the new roadway must conform to the requirements of Subsection 202.03.3.

Remove and dispose of bituminous materials, old structures, guardrail, and other non-salvageable items not included in other contract items for removal at Contractor expense. Remove and neatly store all material designated as salvageable to prevent damage.

The species of seed, seed bed preparation, fertilizing, mulching, and application rate is specified in the contract.

212.04 METHOD OF MEASUREMENT

Obliterate roadway is measured in stations to the nearest whole station along the centerline of the roadway obliterated.

Topsoil is measured in accordance with Subsection 203.04.

Seeding is measured in accordance with Subsection 208.04.

212.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Obliterate Roadway	Station
Seeding	Acre (ha)
Topsoil	Cubic Yard (m^3)

Material obtained from the obliterated roadway and used in the construction of the new roadway is measured and paid for as unclassified excavation in accordance with Section 203.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 301

AGGREGATE SURFACING

301.01 DESCRIPTION

This work is producing and placing one or more courses of aggregate surfacing on a prepared surface or producing and stockpiling aggregate surfacing.

301.02 MATERIALS

301.02.1 Aggregates

Obtain aggregates from sources meeting Section 106 requirements to produce material in accordance with Subsection 701.02.1 and the following subsection requirements:

Crushed Base Course.....701.02.4 and 701.02.5
Crushed Cover Aggregate.....701.02.8
Crushed Top Surfacing .....701.02.6 and 701.02.7
Sand Surfacing 701.02.3
Selected Surfacing.....701.02.2

Furnish bridge end backfill in accordance with Subsection 701.13.

301.02.2 Binder

Binder material, for binding and gradation requirements, is fine, natural soil particles or crusher dust, free from grass, roots, weeds, humus, or other deleterious matter.

301.02.3 Blending Material

Blending material is selected natural or crushed mineral aggregate combined with the produced aggregate to meet specifications.

Do not use pit strippings, overburden, or other deleterious material as blending material.

Furnish and add blending material to aggregate surfacing materials when required to meet gradation requirements.

The blending material must not increase the liquid limit and plastic limit of the surfacing material.

301.02.4 Aggregate Treatment

Choose the material that will be used to treat the aggregate, which may include MC-70, emulsified prime, calcium or magnesium chloride, or other material approved by the Project Manager.

Furnish liquid magnesium or calcium chloride in accordance with Subsection 713.03 requirements. Furnish liquid asphalt in accordance with Section 702 requirements. If used, furnish MC-70 listed on the QPL.

Blotter material is material with 100% passing the ½-inch (12.5 mm) screen and having a PI of 6 or less.

301.03 CONSTRUCTION REQUIREMENTS

301.03.1 Sampling, Testing, and Acceptance

A. **Production Control.** Develop a quality control sampling and testing plan for production and be responsible for all sampling and testing for gradation and mechanical fracture control during aggregate production.

B. **Acceptance Sampling and Testing.** The Project Manager will randomly select samples taken by the Contractor and witnessed by an Inspector, for gradation and fracture testing from processed material in its final position on the roadway in accordance with MT 201. Samples for other tests will be taken at the point of production.

The following acceptance tests are used:

Gradation ..... MT 202
Mechanical Fracture..... MT 217

The quantity represented by 5 samples is a lot when production schedules and material continuity permit. The Project Manager may establish a lot consisting of a quantity represented by 3 to 7 consecutive random samples when there are short production runs, significant material changes, or other unusual characteristics of the work.

C. Acceptance. Surfacing aggregates are evaluated for gradation and mechanical fracture on a lot-by-lot basis. The upper and lower limits in the gradation tables in Section 701 are the upper and lower limits in the evaluation formulas. The specified minimum fracture is the lower limit.

Acceptance is made in accordance with Subsection 105.03.2.

301.03.2 Equipment

A. Rollers. Use rollers in accordance with Subsection 210.03.4.

B. Watering Equipment. Use watering equipment in accordance with Subsection 210.03.5.

C. Scales. Furnish scales in accordance with Subsection 109.01.1 or use certified permanently installed commercial scales. Furnish and have readily available at least 10 50-pound (22.7 kg) weights for testing Contractor furnished scales. Furnish housing for the scale recording devices. Scale accuracy must be ½ of 1% at any weight.

Alternate weigh methods or devices may be acceptable, if they produce the required accuracy. Platform and belt-conveyor scale requirements are as follows:

1. **Platform Scales.** Use platform scales having the length to weigh an entire vehicle in an unbroken operation.

   Truck-trailer combinations may be weighed separately if the scale approaches are:

   a. Compacted gravel or asphalt;

   b. Long enough and level with the scale platform to accommodate the entire truck-trailer units; and

   c. Continually maintained.

   Release all brakes as the unit is weighed.

2. **Belt-conveyor Scales.** Belt-conveyor scales may be used for non-asphaltic materials when meeting the requirements of Subsection 109.01.1 and the following:

   a. The scale meets the National Bureau of Standards requirements for belt-conveyor scales, except as modified below.

   b. A daily static-load test is made after approximately ½ hour of continuous belt conveyor operation and whenever the air temperature varies 15 °F (9 °C) or more. Have a calibration test performed once daily and whenever the daily static-load test shows adjustments are required.

   c. Make calibration computations, calibration procedures and results, and related documents available for the Project Manager's review. Clearly mark test chains with calibration constants. Carry test chains and test weights in protective containers and make immediately available for belt-conveyor scale testing.

   d. Perform accuracy checks by checking the average of 5 or more sequential payloads of hauling units on approved platform scales. The acceptable accuracy is ± 0.5% of the payload of the average hauling unit. If the recording odometer of the belt-conveyor scales in use is graduated to 0.1-ton (91 kg) increments and is a cumulative recording process, differences in readings and variations less than

0.1-ton (91 kg) may carry over from one hauling unit to another. Conveyor weight conformation is based on the tonnage obtained from readings taken from the sealed odometer at the beginning and end of each check period. The number of check loads will be increased should the test results fluctuate.

Furnish a lock to secure the recording tape, odometer, totalizer, calibration adjustment, and clock-time imprinter. The Project Manager will lock the equipment and retain the keys before materials are delivered to the roadway.

301.03.3 Reject

Dispose of reject material produced from Department sources as directed.

301.03.4 Crushed Aggregate Course

When crushed aggregate course is a bid item, construct the aggregate surfacing section to the specified typical cross section and profile grade.

Select one of the following two options to construct the aggregate section:

1. Full depth crushed base course.

2. Top 0.15 foot (45 mm) crushed top surfacing, remaining depth crushed base course.

Indicate the selected option and the grade of crushed base course (Type “A” grade 5 or Type “A” grade 6) before beginning aggregate production. Only one grade of crushed base course will be permitted. If option 2 is selected use Type “A” grade 2 crushed top surfacing.

Quality assurance lot sizes, test intervals and material tolerances will be based upon the materials selected.

301.03.5 Aggregate Surfacing Construction

A. Surface Preparation. Do not place aggregate surfacing material on any of the following:

1. Any surface not meeting the dry density requirements for that surface;

2. A rutted or frozen subgrade or aggregate surface; or

3. Any surface not meeting grade or surface smoothness specifications.

B. Pugmill Mixing. Pugmill mix all surfacing aggregates except crushed cover aggregate.

Uniformly mix aggregate surfacing and water in a central plant pugmill mixer. Proportion all blending material, filler, and binder by weight to within ± ½ of 1% of the specified quantity before mixing.

Add the water needed to reach the specified density.

Additional water may be added only once to the aggregate surfacing once it’s placed on the roadway to replace moisture lost to surface evaporation. If additional water is needed, pick up the mixture and remix it in the pugmill.

After pugmilling, transport, place, and spread aggregate surfacing on the roadway.

Spread in maximum 8-inch (200 mm) compacted layers to the required grade and typical section. Spot fill low areas by scarifying roadway, spreading aggregate and compacting to specified density.

C. Road Mixing. When specified, place, mix and spread the surfacing aggregates on approved surfaces at optimum moisture using motor graders or other approved equipment.

Water may be added to the aggregate to reach optimum moisture during or after crushing.

Once uniformly mixed, spread in maximum 8-inch (200 mm) compacted layers to the required grade and typical cross section. Roller compact the spread layer.

Correct or remove equipment from the work failing to maintain uniform gradation of the material for the entire width and thickness of the roadway.

D. Compaction. Compact aggregate surfacing to 98% of the target density.

The initial target density is the average of the maximum density of at least 2 tests on samples representing the material to be compacted. Maximum density is determined in accordance with MT 230.

The Project Manager may take samples from the materials placed on the roadway. They will be tested and the results averaged to determine a new target density for the material remaining to be placed.

The Project Manager will establish a target density for each course, grade, and type of surfacing aggregate. A new target density will be established if the aggregate characteristics change.

The Department will test the lift(s) of surfacing aggregate in 2,000-foot long (610 m) sections based on full typical section width. The in-place dry density of each lift is determined within each section at 10 randomly selected locations. The average of the 10 tests must be a minimum of 98% of the target with not more than 2 out of 10 tests being less than 98% of the target. The number of tests will be pro-rated for sections with partial lengths and widths. In pro-rated sections, the average of the tests must be a minimum of 98% of target density.

Be responsible for controlling compaction and all necessary control testing.

Notify the Project Manager once compaction is complete on a section so it may be tested.

Re-compact sections not meeting density requirements.

Re-compacted sections will be tested at 10 new random locations.

Compaction and testing will continue until the section meets density requirements.

Densities will be determined in accordance with MT 212, MT 218, and MT 230.

E. Finishing. Finish each course of compacted aggregate surfacing to the specified grade and section. The final lift will be accepted in accordance with Subsection 105.08.

Use trimmings on the inslopes, on sections of uncompleted roadway or return to the pit area. When quantities are measured by the ton (MT), excess material returned to the pit is deducted from the pay quantities.

F. Curing. Allow the final lift of crushed aggregate course to cure for a minimum of 72 hours and until in-place moisture content is 2% or more below optimum moisture content or a maximum of 5% final moisture content, whichever is lower. Meet these requirements prior to aggregate treatment or paving. Notify the Project Manager when a section is complete and ready for Department testing. The in-place soil moisture content will be determined on the final lift of surfacing aggregate in 2,000-foot (610 m) long sections. Moisture content will be tested within each section at 10 random locations. Not more than 1 test may be above the target value. The number of tests will be prorated for sections with partial lengths. Additional tests may be taken at the Project Manager's discretion.

The Contractor is responsible for corrective actions on sections not meeting moisture content requirements. After corrective actions have been taken, the sections will be tested at 10 random locations or prorated as determined by the Project Manager.

G. Restrictions. The Project Manager may restrict equipment speed and load weights to prevent damage to existing and new work, public thoroughfares or safety.

Unstable or pumping material is unacceptable. Rework or remove and replace the material prior to placing additional lifts or materials.

H. Surface Smoothness. Finish the aggregate surface to the specified grade within Table 301-1 tolerances.

TABLE 301-1
SURFACE SMOOTHNESS

Aggregate Size	Tolerance	Distance
1½-inch (40 mm) and larger	+0.08-foot (24 mm) to -0.05-foot (15 mm)	30 feet (9.2 m)
1-inch (25 mm) and less	±0.04-foot (12 mm)	60 feet (18.4 m)

301.03.6 Shoulder Gravel

Compact shoulder gravel to provide a firm, hard surface. Finish the slope to provide a smooth surface from the edge of pavement to the catch point.

Furnish gravel in accordance with Table 301-2 gradation requirements.

TABLE 301-2
SHOULDER GRAVEL GRADATION REQUIREMENTS

Percentage By Weight Passing Square Mesh Sieves	
Sieve Size	**Percent Passing**
¾-inch (19.0 mm)	100
No. 4 (4.75 mm)	25-85
No. 200 (0.075 mm)	5-20

Cold milled pavement is not required to meet the above gradation when used as shoulder gravel.

301.03.7 Traffic Gravel

Furnish traffic gravel in accordance with Subsections 701.02.4 or 701.02.6. Traffic gravel is not evaluated in accordance with Subsection 105.03.2.

Place traffic gravel in the locations and quantities directed by the Project Manager.

Milled and/or pulverized plant mix material may be used as traffic gravel in accordance with the following conditions:

1. Submit in writing a detailed plan showing locations for the use of the milled or pulverized material. Include an updated traffic control plan and stockpile locations.
2. Place all milled/pulverized material below the finished subgrade elevation unless approved in writing by the Project Manager.
3. Do not mill/pulverize areas outside the planned limits unless approved in writing by the Project Manager.
4. 100% of the milled/pulverized material must pass the 2-inch (50 mm) sieve.

301.03.8 Aggregate Treatment

Furnish and apply aggregate treatment on aggregate surfaces. Submit the material(s) and application rates to be used for aggregate treatment to the Project Manager 10 business days before beginning the construction of the aggregate surfacing. The material must bond with the aggregate and the treated surface must be durable under vehicular traffic.

Apply aggregate treatment material and necessary blotter according to the manufacturer's recommendations.

301.03.9 Bridge End Backfill

Place bridge end backfill full width of the roadway embankment typical section to 10 feet (3.0 m) behind the base of the pile cap then ascending on a 6H:1V slope. The top of the bridge end backfill is subgrade elevation. When the bridge end backfill does not daylight at an embankment slope to provide drainage, extend the bridge end backfill 3 feet (915 mm) beyond the wingwall

and daylight to the slope facing the span. Place bridge end backfill material in conformance with moisture and density requirements of Section 301.

Do not contaminate bridge end backfill with water while performing bridge work.

301.04 METHOD OF MEASUREMENT

301.04.1 Aggregate

Aggregate surfacing, blending material, fillers, binder, water, producing, handling, mixing, hauling, placing, spreading, compacting, trimming, use of trimmings, maintenance and all necessary incidentals to complete the work is measured by the cubic yard (m^3) or ton (MT), as specified.

When removing oversize surfacing material from the roadway, the oversize material is measured by the ton (MT) returned to the aggregate source, and deducted from the total surfacing material placed on the roadway.

A. Measurement by Weight. Aggregate surfacing is measured by the ton (MT) in accordance with Subsection 301.03.2(C).

Excess material removed from the roadway and returned to the pit area is deducted from the pay quantities.

B. Measurement by Volume. Traffic gravel and shoulder gravel are measured by the cubic yard (m^3). Aggregate surfacing is measured by the cubic yard (m^3), in accordance with Subsection 109.01, from:

1. Plan dimensions;
2. Haul vehicles; or
3. In-place roadway or stockpile volumes.

When measured in place, each course thickness of each grade of surfacing aggregate will be measured at random locations in a section. The section length and number of measurements is the Project Manager's discretion. The thickness measurements for each section are averaged and the average must equal or exceed the plan thickness. The minimum measured thickness at any location must be at least plan thickness less ½ the largest aggregate size permitted for the material.

Bring all sections of a completed course not meeting these specifications into compliance before placing the next course.

Aggregate surfacing for small or irregularly shaped areas ordered in writing by the Project Manager, are measured in the haul vehicle in accordance with Subsection 109.01.

Aggregate surfacing to fill in subgrade low areas or placed outside the lines and slopes shown in the contract or established by the Project Manager is not measured for payment.

301.04.2 Bridge End Backfill

Bridge end backfill is measured by the cubic yard (m^3).

301.04.3 Reserved

301.04.4 Reserved

301.04.5 Compaction

Compaction is incidental to the aggregate surfacing.

301.04.6 Crushed Aggregate Course

The entire aggregate surfacing section will be measured as crushed aggregate course regardless of the construction option selected in accordance with Subsection 301.03.4.

301.04.7 Aggregate Treatment

Aggregate treatment is measured by the square area. Blotter material is not measured separately for payment and is to be included in the bid price for aggregate treatment.

301.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Aggregate	Cubic Yard (m^3) or Ton (MT)
Aggregate Treatment	Square Yard (m^2)
Bridge End Backfill	Cubic Yard (m^3)
Crushed Aggregate Course	Cubic Yard (m^3) or Ton (MT)
Shoulder Gravel	Cubic Yard (m^3)
Traffic Gravel	Cubic Yard (m^3)

Binder is not measured separately but is to be included in the cost for aggregate material.

Payment at the contract unit price for traffic gravel includes all costs necessary to furnish and place the gravel.

Sale of excess crushed traffic gravel meeting all specifications is the Contractor's option. Traffic gravel meeting all specifications that is crushed and stockpiled on the project, but not placed or sold, will be paid for at 35% of the contract unit price. Traffic gravel from a commercial source or a source supplying multiple projects and not transported to the project is not measured for payment. If milled/pulverized plant mix is used on any portion of the project, no payment for excess traffic gravel will be made.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 302

BITUMINOUS PAVEMENT PULVERIZATION

302.01 DESCRIPTION

This work consists of processing the existing plant mix surfacing with existing crushed aggregate course, additional crushed aggregate course, or combination of these to restore the roadway section.

302.02 MATERIALS

Furnish crushed aggregate course in accordance with Subsection 701.02.1 and one of the following subsections:

Crushed Aggregate Course Type “A” Grade 5 ..... 701.02.4
Crushed Aggregate Course Type “A” Grade 6 ..... 701.02.4

302.03 CONSTRUCTION REQUIREMENTS

302.03.1 Pulverization

Pulverize the bituminous surfacing to the depth(s) specified in the contract. Pulverize the existing material so that 100% by weight passes a 2-inch (50 mm) sieve.

302.03.2 Equipment

Equipment used to pulverize the existing surfacing must not reduce the aggregate size in the existing surfacing.

302.03.3 Mixing

Add crushed aggregate course as necessary to construct the roadway to the specified typical section and profile grade. Uniformly mix the pulverized material and crushed aggregate course by pugmilling or by using the pulverization equipment.

302.03.4 Compaction

Compact the pulverized mixture in maximum 8-inch (200 mm) compacted lifts to 98% of the target density. The target density will be determined by one of the following methods:

A. **Pugmill Mixing.** MT 230 determines maximum density when the pulverized plant mix and crushed aggregate course are blended at a constant ratio by pugmill. The initial target density is the average of the maximum density of at least 2 tests on samples representing the material to be compacted.
B. **In-place Mixing.** MT 219 determines maximum density when in-place pulverized plant mix and crushed aggregate course mixtures are combined at varying ratios.

   The Project Manager will determine target densities and moisture corrections. A new target density will be established if the ratio of pulverized material and crushed aggregate course change by more than 20% or the Project Manager determines the pulverized material characteristics or site conditions change.

302.03.5 Testing and Acceptance

Each lift of pulverized mixture material will be divided into 2,000-foot long (610 m) sections. The in-place dry density of each lift will be determined within each section at 10 randomly selected locations. The average of the 10 tests must exceed 98% of the target density with no more than 2 out of the 10 tests being less than 98% of the target density.

Be responsible for controlling compaction and all necessary quality control testing.

Notify the Project Manager when compaction is complete on a section so it can be tested.

Re-compact sections not meeting density requirements. Re-compacted sections will be tested at 10 new random locations.

Compaction and testing will continue until the section meets density requirements.

302.04 METHOD OF MEASUREMENT

302.04.1 Aggregate

Virgin crushed aggregate course is measured by the ton (MT) in accordance with Subsection 301.03.2(C) or by the cubic yard (m^3).

302.04.2 Pavement Pulverization

Pavement pulverization is measured by the square yard (m^2) based on the bottom width of the pulverized material. The contract unit price may be adjusted if the average pavement depth varies by more than 0.10-foot (30 mm) from plan and the Project Manager issues a written order to increase or decrease the pulverization depth.

302.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Crushed Aggregate Course	Ton (MT) or Cubic Yard (m^3)
Pavement Pulverization	Square Yard (m^2)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 303

STOCKPILED SURFACING AGGREGATE

303.01 DESCRIPTION

This is stockpiling surfacing aggregates at the specified location.

303.02 MATERIALS

Furnish materials in accordance with Subsection 301.02 and the contract requirements.

303.03 AGGREGATE STOCKPILING METHODS

Clear stockpile sites of weeds, roots, stumps, rocks, and other contaminating matter. Dispose of this material in accordance with Subsection 201.03.5 or level as directed.

Make the stockpile floor firm, smooth, well drained, uniform in cross-section, and able to support the stockpile.

Place an aggregate bed on the floor to prevent stockpile contamination.

Construct stockpiles in at least 3 layers. Place each layer approximately 4 feet (1.2 m) high before starting the next layer. Prevent each layer from spilling down over the next lower tier.

Do not drop material stockpiled by conveyor more than 12 feet (3.7 m). Deposit the material in succeeding merging cone piles. Do not permit the piles to exceed 12 feet (3.7 m) in height. Level each completed layer to 4 feet (1.2 m) thick.

Operate stockpiling trucks to produce a stockpile width that exceeds the single dump trucks width. Do not dump over the stockpile sides.

Maintain separation between different gradation stockpiles to prevent aggregates from intermingling.

Use equipment and methods to prevent segregation, degradation, or contamination of the aggregate when constructing stockpiles or delivering materials.

Department sieve test samples are taken from the stockpile to determine degradation.

Re-mix and re-stockpile segregated stockpiles.

Bring stockpiled material failing specifications back within specifications at Contractor expense.

303.04 METHOD OF MEASUREMENT

303.04.1 Aggregate

Stockpile surfacing aggregate is measured at the stockpile site by the ton (MT) or cubic yard (m^3) in accordance with Subsection 301.04.1.

303.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Aggregate	Ton (MT) or Cubic Yard (m^3)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 304

CEMENT TREATED BASE

304.01 DESCRIPTION

This work is producing and placing one or more courses of a mixture of water, hydraulic cement, and aggregate or soil on a prepared surface in conformity with the lines, grades, and thicknesses established in the contract.

304.02 MATERIALS

304.02.1 Cement

Furnish Type I or II portland cement listed on the QPL, in accordance with Subsection 551.02.1. Blended hydraulic cement that conforms to one of the following may be substituted:

AASHTO M 240 Type IP or Type IP (MS)
ASTM C1157 Type GU or Type MS

Fly ash may be used to replace a maximum of 25% of the cement by weight. Furnish fly ash in accordance with AASHTO M 295, Class C requirements. Mixtures with fly ash must meet all of the requirements of cement treated base (CTB).

304.02.2 Water

Furnish water in accordance with Subsection 713.01 requirements.

304.02.3 Aggregate

Obtain aggregates from sources in accordance with Section 106 requirements to produce aggregates in accordance with Subsection 701.02.9 requirements.

Stockpile aggregates in accordance with Subsection 303.03.

304.02.4 Blending Material

Blending material, consisting of selected natural or crushed mineral aggregate may be combined with the produced aggregate to meet gradation requirements. For fine aggregate passing the No. 40 (0.425 mm) sieve; the liquid limit may not exceed 30, and the plasticity index may not exceed 7, tested in accordance with MT 208.

304.02.5 Composition and Proportioning

Develop and submit a proposed CTB mix design for approval. Submit the mix design a minimum of 10 business days before production. Develop a mix design with cementitious materials content that:

- Ensures a 7-day unconfined compressive strength of 500 – 1,500 psi (3,450 – 10,350 kPa) in accordance with MT 216, and
- Is a minimum of 4.5% the weight of the dry aggregate.

Include the following items as part of the mix design submittal:

1. Cement and fly ash certifications;
2. Optimum moisture content and maximum density determined in accordance with MT 211;
3. Aggregate gradations determined in accordance with MT 202;
4. Soil-cement losses, moisture changes, and volume changes (swell and shrinkage) produced by the repeated wetting and drying of hardened soil-cement specimens determined by AASHTO T 135;
5. Soil-cement losses, moisture changes, and volume changes (swell and shrinkage) produced by the repeated freezing and thawing of hardened soil-cement specimens determined by AASHTO T 136. The maximum freeze/thaw weight loss is 14%;
6. 7-Day compressive strength tests determined in accordance with MT 216;

7. Atterberg limits determined in accordance with MT 208; and
8. Sand equivalent determined in accordance with MT 213, or AASHTO T 176 alternate method No. 2.

Acceptance of the mix design will be based on a review of the submitted results for all the above testing procedures.

Do not place CTB until the submitted mix design has been approved.

304.03 CONSTRUCTION REQUIREMENTS

304.03.1 Aggregate Production, Testing, and Acceptance

A. **General.** Perform all work meeting the approved job-mix target values within the specified tolerances.

Sample and test aggregates during production to control gradations.

B. **Acceptance Sampling and Testing.** The Project Manager will randomly select samples of the stockpiles taken by the Contractor and witnessed by an Inspector, for acceptance of the aggregate's physical properties, excluding combined gradations. Aggregate gradation samples will be taken before hydraulic cement and water are added to the mixture. Provide aggregate samples as directed by the Project Manager using an aggregate sampling device, just before the aggregate enters the pug mill mixer.

The approximate quantity represented by each sample is 1,500 tons (1,500 MT). Additional samples may be taken and tested.

The quantity represented by 5 samples will represent a lot whenever production schedules and material continuity permit. The Project Manager may establish a lot consisting of a quantity represented by 3 to 7 consecutive samples when there are short production runs, significant material changes, or other unusual characteristics of the work.

C. **Acceptance.** CTB is evaluated for gradation requirements on a lot-by-lot basis. Acceptance is determined in accordance with Subsection 105.03.2.

304.03.2 Weather Limitations

Do not mix or place CTB when the ambient temperature is below 40 °F (4 °C) or the ground temperature is below 35 °F (2 °C). Do not mix or place cement treated base when the weather forecast for the project site includes a predicted temperature of 25 °F or below for the following night.

Do not incorporate frozen aggregate in the CTB or place on a frozen subgrade.

304.03.3 Subgrade Preparation

Prepare the subgrade in accordance with Section 203.

Trim the subgrade to the thickness tolerances in accordance with Subsection 304.03.4.

304.03.4 Mixing and Placing

Mix the CTB in a central plant.

Proportion the aggregate and cement by weight. Water may be proportioned by weight or by volume.

Use weigh systems and meters accurate to within ± 0.5% of the total quantity batched and are equipped to indicate the total quantity of each ingredient batched between one-half and 10 hours.

Calibrate the feed system before production mixing begins.

Periodically verify the mix ingredient proportions from the weigh indicators.

Produce CTB having a minimum of 4.5% cementious materials. Maintain cementious content to within ± 0.5% of the job mix target at any periodic check and within ± 0.3% for each day's

production. Mixing will be suspended until corrections are made if the cement content is not maintained within the above tolerances.

Do not lower cement content during production that will result in freeze/thaw losses exceeding 14% based on mix design testing.

Uniformly mix aggregate, cement, and water. Modify mix procedures when evidence of a non-uniform mix is identified.

Place CTB in 4 to 8-inch (100 to 200 mm) compacted lifts. Place all lifts required to achieve full depth within 48 hours. Replace any partial depth section damaged prior to placement of successive lifts as directed by the Project Manager at Contractor expense. Keep the compacted material of previous lifts moist until placement of successive layers. Keeping lower layers moist or furnishing and applying curing seal to partial depth layers is incidental to the CTB.

304.03.5 Compaction

Compact the CTB to 98% of the maximum dry density within 2 hours of mixing.

The moisture and density relationship is determined in accordance with MT 211 using samples taken from the aggregate stockpiles before starting mixing operations. If a moisture and density test varies from the running average (as determined in accordance with MT 216) during production, a new moisture-density relationship will be determined.

Moisture and density tests will be taken in accordance with MT 212 on the roadway approximately every 750 cubic yards (575 m^3). Five tests will represent one lot of production.

Remove and re-process any un-compacted sections where the weather or contractor operation has increased the average moisture content above optimum by more than 1%. Removed mix may be re-processed as aggregate for producing CTB.

If the density of any section is less than or equal to 95% of the maximum dry density, 2 additional tests will be taken in that section and the average of all 3 test results will represent the section. The average density for the 3 tests must be at least the specified density, with none of the 3 tests less than 93% of the maximum dry density. Remove any section with an average density less than or equal to 95% of the maximum dry density. Removed mix may be re-processed as aggregate for producing cement treated base.

CTB with densities between 95% and 98% is evaluated on a lot-by-lot basis in accordance with Subsection 105.03.2.

304.03.6 Finishing

Shape the compacted surface to the specified lines, grades, and cross sections.

Finish and compact to produce a smooth, dense surface free of compaction planes, cracks, irregularities, or loose material.

Complete the surface finishing within 2 hours of compaction.

Scarify and re-compact surface deformations in the base caused by equipment.

Do not permit the moisture content to fall below the specified optimum during finishing. Apply water in a uniform fog spray.

304.03.7 Construction Joints

Construct straight vertical-faced transverse joints at the end of each day’s work and when CTB operations are delayed or stopped for more than 2 hours. Do not place additional material until the transverse joint has been approved by the Project Manager.

Construct straight vertical faced longitudinal joints in compacted material that has been in place for more than one hour by cutting vertically approximately 3 inches (75 mm) from the existing edge. Dispose of the cut material in accordance with Subsection 304.03.12.

Moisten joints prior to placing adjacent CTB material. Repair all construction related damage to finished sections of the CTB at Contractor expense.

304.03.8 Protection and Curing

When the CTB is finished to grade, apply the specified bituminous curing seal at 0.15 to 0.25 gallons per square yard (0.68 to 1.13 L/m^2).

Keep the CTB surface moist between the final compaction and application of the curing seal. Apply the curing seal within 48 hours of finishing the cement treated base to grade.

Before applying the curing seal, ensure the base surface is tightly knit, free of all loose material, and has sufficient moisture to prevent asphalt penetration.

Apply the specified blotter material at approximately 15 pounds per square yard (8.2 kg/m^2) when directed.

The actual application rate of curing seal and blotter may be adjusted by the Project Manager.

Remove CTB areas that have absorbed the curing seal, down to a hard, clean surface, within 24 hours of the curing seal application. Re-moisten and patch the area with approved cement treated material. Re-apply the curing seal as directed by the Project Manager.

Apply the curing seal and blotter material in accordance with Section 409.

304.03.9 Curing Period

Do not perform any work on the CTB for 3 calendar days after the curing seal is applied. Do not place pavement on the CTB until the compressive strength reaches 400 psi (2760 kPa).

304.03.10 Maintenance

Maintain the finished surface and seal before placing the wearing course. Make all repairs or patches the full depth of the base. Repair damage to the curing seal or cement treated base as directed by the Project Manager at the Contractor's expense. Remove any loose material from the CTB surface prior to paving operations.

304.03.11 Surface Smoothness and Thickness Requirements

Finish CTB in accordance with Subsection 105.08.

304.03.12 Use of Trimmed Material

CTB trimmings may be used for shoulder construction in lieu of aggregate, subject to the following:

1. The shoulder subgrade is prepared in accordance with Subsection 304.03.3.
2. Hardened material is reworked to the maximum size specified for aggregate placed on the shoulder.
3. The trim material does not exceed 25% of the shoulder aggregate depth
4. The trim material is uniformly distributed in the shoulder area before spreading additional shoulder material.

304.03.13 Testing and Acceptance of CTB

Samples for determining the compressive strength will be taken in accordance with MT 201. Test method MT 216 will be used to mold cylinders for strength testing.

The approximate quantity represented by each sample is 750 cubic yards (575 m^3). Additional samples may be taken and tested.

The compressive strength tests will be conducted at 7 days and the material represented will be accepted or rejected in accordance with Table 304-1. Any corrective action is at Contractor expense.

The Contractor may make additional cylinders to determine strength gain and to maintain quality control.

TABLE 304-1
PAY FACTORS FOR CTB

Cement Treated Base Lot Acceptance Strength, x psi (1 psi = 6.9 kPa)	
Strength, x (psi)	**Strength Pay factor, PF**
x > 2000	PF = 0.90
2000 ≥ x ≥ 500	PF = 1.0
500 > x ≥ 400	PF = 1.0 - 0.50 (500 - x) / 100
x < 400	PF = 0, remove and replace

304.04 METHOD OF MEASUREMENT

304.04.1 Cement Treated Base

CTB is measured by the cubic yard (m^3) of in-place volume.

CTB placed outside the lines and grades shown in the contract or established by the Project Manager is not measured for payment.

No measurement is made of the width required for forms or equipment operations.

Gravel used in trimmings and lateral support sections outside the planned typical section dimensions is not measured for payment. Blending material is not measured for payment.

304.04.2 Curing Seal

Curing seal is measured by the gallon (L) or by the ton (MT) in accordance with Subsection 409.04.1.

304.04.3 Blotter Material

Blotter material is measured by the square yard (m^2) based on the length and width of CTB placed and accepted.

304.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Blotter Material	Square Yard (m^2)
Cement Treated Base	Cubic Yard (m^3)
Curing Seal	Gallon (L) or Ton (MT)

No separate payment will be made for cement, fly ash, blending material or surface preparation. Include the cost in the unit price bid for CTB.

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract.

SECTION 401

PLANT MIX SURFACING

401.01 DESCRIPTION

This work is producing, furnishing, placing, and compacting plant mix asphalt pavement.

Plant mix pavement is 1 or more courses of plant mixed aggregate, hydrated lime or chemical additive when required, and bituminous material, constructed on a prepared foundation.

Warm mix surfacing (warm mix) is plant mix surfacing which has been modified with additives or processes that allow a reduction in the temperature at which plant mix surfacing is produced and placed.

401.02 MATERIALS

Provide aggregate from sources meeting the Section 106 requirements.

The Contractor is responsible for all sampling, testing and control of the aggregate. Furnish the Project Manager the quality control test results upon request.

Ensure that the aggregate, when combined at the job mix formula, meets Table 701-15, and Subsection 701.03.1.

401.02.1 Aggregate

Meet aggregate requirements in accordance with Subsection 701.03.

For commercial mix, when no aggregate size is specified, use either ½-inch (12.5 mm) or ¾-inch (19 mm) nominal aggregate sizes.

401.02.2 Hydrated Lime

Furnish hydrated lime in accordance with Subsection 713.02.

Sample fillers and hydrated lime in accordance with MT 601.

401.02.3 Asphalt Cement

Furnish asphalt cement in accordance with Section 402.

Asphalt cement modified with warm mix additives will be tested with the additives and must meet the contract requirements.

401.02.4 Additives for Warm Mix

Comply with the warm mix technology manufacturer's recommendations for incorporating additives and/or processes when producing warm mix. Comply with manufacturer's recommendations regarding receiving, storage, and delivery of warm mix additives. Mix warm mix at a minimum temperature of 220 °F (104 °C) and within the range recommended by the manufacturer and approved by the Department. Use asphalt additives listed on the QPL for the production of warm mix.

Use foaming technology that is manufactured and marketed for the purpose of producing warm mix.

Ensure a manufacturer's technical representative is present during production and placement of warm mix for at least the first 10,000 tons (10,000 MT) of mix placed and as directed by the Project Manager for the remainder of the project. This requirement may be waived if successful experience in warm mix construction is demonstrated.

In addition to the information specified in Subsection 401.03.1, provide the following information at least 30 calendar days before warm mix production:

1. Warm mix technology and/or warm mix additives information;
2. Manufacturer's established recommendations for usage;

3. Manufacturer's established target rate for water and additives, the acceptable variation for production, and documentation showing the impact of excessive production variation;
4. Warm mix technology material safety data sheets;
5. Temperature ranges for mixing and compacting;
6. Asphalt binder performance grade test data over the range of warm mix additive percentages proposed for use;
7. The warm mix design and testing sample preparation may differ from conventional hot mix asphalt. Provide manufacturer's sample preparation recommendations for warm mix design and testing; and
8. Include the binder supplier's recommendations for warm mix additive content, methods for incorporating warm mix additive into mix design samples and mixing and compaction temperature ranges.

401.02.5 Recycled Asphalt Pavement (RAP)

Up to 15% RAP by weight may be incorporated into mix used in the top 0.15-foot (45 mm) and up to 30% RAP by weight may be incorporated into mix used in lower lifts. If RAP is included in the job mix formula and the final mix, meet all of the plant mix requirements. It is recommended that at least 2 separate RAP stockpiles be produced.

401.02.6 Emulsified Asphalt

Furnish an emulsified asphalt, when required, meeting the requirements of Section 702.

401.03 CONSTRUCTION REQUIREMENTS

Produce plant mix in accordance with Table 701-15, Table 701-16 Table 701-17, Table 701-18 and form CB30QA-VM (S).

Produce plant mix in a plant capable of accurately proportioning and uniformly mixing all ingredients. Do not begin plant mix production until receiving notification that the Department's mix design verification is complete.

For commercial mix, produce plant mix with actual asphalt cement content within +/- 0.3% of the mix design or field established job mix formula.

For non-commercial mix, set the initial job mix targets before producing more than 2000 tons (2000 MT) of plant mix surfacing. Plant mix produced prior to setting initial targets is defined as start-up mix. Furnish the Project Manager copies of form CB30QA-VM (S) with the proposed job mix targets for VMA, VFA, VTM, and D/A. Once the job mix targets are set, Quality Assurance (QA) will be applied to all subsequent plant mix produced. No pay incentive or disincentive will be applied to the plant mix until the targets are set. Produce start-up mix meeting the criteria listed in accordance with the Start-Up Job Mix Range in Table 701-18. A Hamburg wheel track test (Hamburg) will be run when the produced mix does not meet all the criteria specified in accordance with the start-up job mix range in Table 701-18.

The Contractor may revise the job mix targets one time during the contract. Submit revised job mix targets no later than 2 business days following completion of plant mix production, or initial job mix targets will be used to determine payment. If more than one project is included in the contract (tied projects), the job mix targets may be revised for each project only if the projects use different mix designs. Submit to the Project Manager 4 signed copies of form CB30-QA-VM (S) with the revised job mix targets for VMA, VFA, VTM and D/A. The revised targets will be applied retroactively to all plant mix produced after the initial targets are set, and payment will be recalculated.

No monetary, time or other compensation will be allowed for Department actions required due to the setting of initial targets, (e.g. P-value shutdowns, etc.).

401.03.1 Mix Design

Submit to the Project Manager 4 copies of a plant mix design following AASHTO R 35 and meeting AASHTO M 323. Include the binder supplier's recommended mixing and compaction temperature ranges. This compaction temperature range is for testing purposes only. Choose the design air voids target to be the lowest value, within the range of 3.4 to 4.0, as long as all other criteria are met. Report the D/A for the target asphalt content. The mix design is to be produced on a total weight of mix basis. On contracts with multiple gravel sources, or combination of gravel sources, provide a mix design and meet all the requirements for each source or combination of sources and suppliers. For mix designs using RAP, furnish the asphalt content and gradation of the RAP prior to mixing and after mixing with the virgin aggregate. Furnish all specific gravities.

Furnish samples of aggregate from each stockpile to produce an 800-pound (363 kg) sample, when combined at the mix design blend ratio and 5 gallons (19 L) of the asphalt cement.

The Department has 30 calendar days from receipt of the mix design materials and signed mix design documents to review the mix design. The mix design verification consists of passing Hamburg test results and a review of the submitted mix design documents to ensure all applicable design and aggregate requirements have been met. Tensile strength ratio test results do not have to be submitted with the signed mix design documents but must be received and reviewed before a mix design will be considered verified. Contract time will be extended for the actual contract time the Contractor's paving start date was delayed, as verified by their most recent submitted schedule, and only for contract time assessed after the 30 day verification time frame. No additional compensation is allowed for these Department-caused delays. Contract time will not be extended if the delay occurs between November 1st and April 15th.

Use AASHTO T 283 to determine the mixture resistance to moisture induced damage, modified to compact the 6-inch (150 mm) diameter specimens to 3.75 inches ± 0.20-inch (95 mm ± 5 mm), at 7 ± 1.0% air voids. Meet a tensile strength ratio of 0.7 or greater.

A change in the asphalt supplier or aggregate source(s) will not require a new mix design, provided no change in the established job mix targets is requested, and the aggregate and Hamburg requirements are met. Establish job mix targets immediately if changing asphalt supplier or aggregate source prior to setting initial targets on non-commercial mix projects. For commercial mix, any mix produced after a change in supplier will be considered production mix and subject to full disincentives. Provide the apparent and bulk dry specific gravities and absorption for the aggregate, and the specific gravity for asphalt cement when there are changes in the source(s).

In lieu of developing a new mix design, a previous Department verified mix design may be requested for transfer. To be eligible for transfer, the transferred mix design must utilize the same material constituents, from the same sources, and in the same proportions as the original mix design. Mix design transfers will not be considered if the design traffic warrants different mix design criteria. Approval for transferring a mix design is at the discretion of the Department and may require Hamburg testing re-verification. Proposed transfers with variations to the original mix design such as asphalt supplier or other factors such as changes to the crushing operation which could create uncertainty in the performance of the mix design will be subject to re-verification testing. When submitting a request for a mix design transfer, furnish quantities from each stockpile to produce a 300-pound (136 kg) sample if the Department determines Hamburg testing re-verification is necessary.

401.03.2 Hamburg Wheel Track Testing (Hamburg)

Provide the Project Manager a sample of plant mix surfacing material for Hamburg acceptance after initial job mix targets have been established for non-commercial mix and as

directed by the Project Manager for commercial mix. The Department may require Hamburg samples at any time, including during the production of start-up mix.

If production non-commercial plant mix fails the Hamburg, make adjustments to produce plant mix meeting the requirements specified in the contract. After a failing Hamburg no more than 300 tons (300 MT) of plant mix may be produced until passing Hamburg results are received.

When 2 consecutive Hamburg samples do not meet the requirements, suspend production and submit a revised mix design and samples for verification and Hamburg testing. The initial mix design requirements will be used for verification. Do not resume production until the revised mix design is verified and Hamburg mix design requirements are met.

Plant mix lots represented by samples that do not meet Hamburg specifications are not eligible for QA incentives including ride and density incentives.

For non-commercial mix, remove and replace any start-up plant mix represented by a failing Hamburg test. For commercial mix, remove and replace any mix represented by a failing Hamburg test. Plant mix removal and replacement is at no cost to the Department.

401.03.3 Test Procedures

Plant mix will be evaluated in accordance with the following test procedures:

MT 303 - Sampling Bituminous Materials
MT 314 - Method of Test for Bulk Specific Gravity of Compacted Bituminous Mixtures
MT 319 - Ignition Oven Burn Procedure
MT 320 - Gradation of Aggregate Recovered by MT 319
MT 321 - Maximum Specific Gravity of Bituminous Mixtures (Rice Method)
MT 328 - Method of Establishing Field Target Density for Plant Mix Surfacing Density Control
MT 332 - Gyratory Compaction of Bituminous Mixtures
MT 334 - Wheel Tracking Test Procedure (Hamburg Device)

401.03.4 Composition of Mixtures

A. Job Mix Formula. Establish target asphalt cement and warm mix additive content (if applicable). Base the target asphalt cement content on design and field gyratory mix test results. Mix design specific gravities will be used during plant mix production unless otherwise directed by the Project Manager.

Include 1.4% hydrated lime by total weight of mix as part of the aggregate gradation.

B. Sampling. Furnish samples of plant mix surfacing in accordance with MT 601 as directed by the Project Manager. The Project Manager will randomly select when plant mix samples are taken. Sample in accordance with MT 303. A Department Inspector will witness plant mix sampling. Furnish the sample to the Inspector immediately after it is taken or deliver the sample to the Department's designated test location after the Inspector seals the sample in a tamper proof container.

Plant mix sampling will begin after the initial daily 100 tons (100 MT) of plant mix has been produced or when a hot plant is cleaned out and 100 tons (100 MT) of plant mix has been produced. No sampling delay will be permitted at any other time, unless approved by the Project Manager.

401.03.5 Acceptance Commercial Plant Mix Surfacing

The asphalt content used for calculations is determined in accordance with MT 319. The D/A is calculated in accordance with MT 319, and the gradation determined in accordance with MT 320 on the aggregate remaining after the ignition oven test.

A $3.00/ton price reduction in the unit bid price for plant mix surfacing will be applied for any start up mix represented by a test not meeting the VMA, VFA, VTM, or D/A specified. A $3.00/ton price reduction ($9.00/ton maximum) in the unit bid price for plant mix surfacing will be applied to production mix for each test not meeting the VMA, VFA, VTM, or D/A specified. For commercial plant mix, startup mix is the first 1,000 tons (1,000 MT) of mix produced and production mix is all subsequent mix. Price reductions will be assessed on the quantity of material represented by each failing sample. The quantity of material represented by each sample is the total tons of material produced divided by the total number of samples representing the material.

A minimum of 1 sample will be taken on projects with a plan quantity of 500 tons (500 MT) or more and samples will be tested at a minimum rate of one per 2,000 tons (2,000 MT). Commercial plant mix will not be tested on crossovers, detours, guardrail widening, patching or where the volume is less than 500 tons (500 MT). Acceptance in these areas will be based on conformance with the established mix design proportions or agreed upon adjustments. Compact these areas to 97% of a control strip as determined necessary by the Project Manager.

401.03.6 Acceptance of Non-Commercial Plant Mix Surfacing (QA)

The properties listed in Table 701-18 for non-commercial plant mix are designated for acceptance on a lot-by-lot basis in accordance with Subsection 105.03.2. The pay factor in Table 401-1 is applied to plant mix surfacing lots for VMA, VFA, VTM and D/A. The asphalt content used for calculations is determined in accordance with MT 319. The D/A is calculated in accordance with MT 319, and the gradation determined in accordance with MT 320 on the aggregate remaining after the ignition oven test.

The approximate mix quantity represented by each sub-lot is 1,000 tons (1,000 MT). The quantity represented by 5 tests or approximately 5,000 tons (5,000 MT) of mix constitutes a lot whenever production schedules and material continuity permit. A lot represented by 3 to 7 consecutive random sub-lots will be established when there are short production runs, significant material changes, or other unusual characteristics of the work.

All other contract items are evaluated for acceptance in accordance with the applicable specifications covering those items.

Each element of a lot will be evaluated for pay adjustments.

All the individual test results in the lot for the element to be evaluated will be averaged, and the percent of price reduction for the lot determined by the applicable formula.

F is the price reduction factor to be applied for each element as shown in Table 105-2 and Table 401-1.

TABLE 401-1
TABLE OF PAY FACTORS

Incentive Item	“F” Factor	Maximum Pay Factor
VMA	6	1.02
VFA	2	1.02
VTM	6	1.02
D/A	30	1.02

When adjustments are being made for one of the two reasons in accordance with Subsection 105.03.2, the Department may require additional samples to test the material being produced, in addition to the planned random samples. These additional tests will be used to determine if the adjustments are effective and whether production may continue. These tests will be used to identify obviously defective sections.

401.03.7 Quality Incentive Allowance

For each element with a P value of less than 3, the incentive is calculated by subtracting the calculated P value from 3 to determine the pay factor. The maximum pay factor for each element is 2%. An additional 4% incentive will be applied to the lot payment if the sum of the pay factors for the individual elements for a lot is 6% or greater. The maximum pay factor for a lot is 12%.

401.03.8 Equipment

A. Mixing Plants. Use mixing plants that produce a mix meeting the contract requirements. Adapt the mixing plant as required by the manufacturer to introduce warm mix technology. Plant adaptations may include additional plant instrumentation, the installation of asphalt cement foaming systems and/ warm mix additive delivery systems, tuning the plant burner and adjusting the flights in order to operate at lower production temperatures and/or reduced tonnage.

B. Weigh System.

1. Automatic Weighing. Use state certified automatic weigh systems to weigh materials. Ensure the weigh accuracy is within plus or minus 0.5% of the true weight throughout the use range.

Include in the system an automatic printer that provides the following information:

(a) Contract number
(b) Project number (as shown in the contract)
(c) Item name (as shown on detail estimate)
(d) Date
(e) Time
(f) Ticket number (consecutive)
(g) Haul unit number
(h) Net tons (MT) in load (to nearest 0.05 ton)
(i) A subtotal of tons (MT) for each haul unit since the beginning of the shift.
(j) An accumulated total for all haul units since the beginning of the shift.

Use a pre-programmed printer or one equipped to prevent manual override of any weight information. Have the weigh system tested, certified and sealed by the State Bureau of Weights and Measures after each plant move and before production for a project. Immediately stop production should the printer malfunction or breakdown and do not resume until corrected. Delivery of material from storage or surge bins will be permitted only if the weight can be maintained within weigh specifications.

If an independent certified scale is within a 20 mile (32 km) round trip distance from either end of the project, the Project Manager will randomly re-weigh loaded vehicles at least 3 times per project.

Re-test the plant weigh system any time the difference between the re-check and the plant system exceeds ± ½ of 1% of the load. Any weight difference will be addressed in accordance with Subsection 109.01.1.

2. Manual Weighing. The Contractor may manually weigh and record weights instead of using an automatic weigh system. Ensure manual weighing includes platform scales in accordance with Subsection 301.03.2(C), a competent weigh person, and dump person.

Direct the weigh person to record, on Department furnished forms, weights to the nearest 100 pounds (45.4 kg) as well as the other required information regarding delivery and placement.

Certify that weights and totals furnished are a true and correct record of materials delivered and placed in the work. Deliver the records and totals to the Project Manager before 10:00 a.m. the next work day following the shift.

401.03.9 Safety Requirements

Install and maintain stairs, ladders, walkways and all other plant facilities meeting State and Federal safety requirements.

Provide access to the plant mix within the trucks for taking samples and mix temperature data.

401.03.10 Burner Fuel Restrictions

Use one of the approved fuels below to heat and dry aggregates.

- Propane
- Butane
- Natural gas
- Fuel oil (grades 1, 2, and 5 only)
- Coal

EPA Specification-used oil fuel (EPA-UOF) may be used instead of the approved burner fuels provided Table 401-2 requirements are met.

TABLE 401-2
EPA SPECIFICATION - USED OIL FUEL REQUIREMENTS

Physical Properties	
Property	**Range**
API Gravity	20-28
Viscosity at 122 °F (60 °C) (Saybolt Flurol)	10-20
Pour point	+10 °F(−12 °C)
Flash point, minimum	100 °F (37.8 °C)
Water by distillation	Under 1%
Solids by separation	Under 1%
Ash	Under 0.4%
Sulfur	Average 0.5%
Kinematic viscosity at 100 °F (37.8 °C)	54-100 (centistokes)
Kinematic viscosity at 122 °F (60 °C)	15-75 (centistokes)
Chemical Properties	
Element or Compound	**Permitted Level**
Vanadium	Under 100 ppm (100 mg/L)
Cadmium	Under 2 ppm (2 mg/L)
Chromium	Under 10 ppm (10 mg/L)
Lead	Under 100 ppm (100 mg/L)
Arsenic	Under 5 ppm (5 mg/L)
Total halogens	Under 1,000 ppm (1,000 mg/L)
PCB's	Under 2 ppm (2 mg/L)

Furnish a copy of certified test results from the supplier for each load of EPA-UOF delivered to the project. Furnish plant manufacturer information showing the plant burner is designed and

equipped to burn EPA-UOF or grade 5 fuel oil. Upon request, provide a 1-quart (1 L) sample of EPA-UOF from the tank on the project.

Immediately stop using EPA-UOF or grade 5 fuel oil if burner flame outs or other evidence of incomplete combustion or mix contamination is evident. Begin using one of the other approved fuels to complete the work. Remove and replace all contaminated plant mix at Contractor expense. No additional compensation will be allowed.

401.03.11 Dry Warm Mix Additive, Hydrated Lime Feed System

Introduce dry hydrated lime into drum dryer mixing plants just below the asphalt cement introduction point. Introduce dry warm mix additive as directed by manufacturer.

Ensure the system provides positive, accurate material feed and is automatically synchronized to the aggregate feed. Ensure the system indicates the weight entering the mixing unit on a time-coordinated basis.

Weigh using an automatic indicating electronic system. The lime may be weighed directly, or the storage container including lime may be weighed.

Provide a continuous digital readout showing the weight or rate of feed in tons (MT) per hour. Record the information using a production monitor/recorder system or by a de-cumulating balance ticket-printing system. Record the information at minimum 5-minute intervals or as directed.

Silo or storage container system weights are not used for acceptance during filling or transfer. Limit filling or transfer periods to one hour per three hours of plant operation. Record and furnish start and finish times for filling or transfer and the total quantity added.

Suspend mixing for erratic feeding or failure to feed hydrated lime to a minimum of 85% of the job mix formula. Do not resume until corrected or repaired.

401.03.12 Flow Rate Meter

Measure the asphalt cement and liquid warm mix additive (if applicable) discharged into the mixing unit using a flow rate meter with totalizer and temperature compensation.

Ensure the totalizer records up to 1,000,000 gallons (3,785,000 L) and is certified to ± 0.2% of the measured quantity.

Use a flow rate meter and totalizer that automatically corrects to a temperature of 60 °F (16 °C) with an operating range of +60 to +450 °F (16 to 232 °C).

Locate the totalizer readout in the plant control room so it is readily accessible to the Inspector.

Ensure the flow rate meter automatically shuts off any time asphalt cement is diverted or stops entering the mixing unit.

Calibrate the flow rate meter and totalizer before the start of the project and as necessary during production. The Project Manager will witness the calibration.

Provide the equipment and assistance for initial and subsequent calibration checks and furnish the Project Manager a copy of all calibration checks.

Use a calibration volume of at least 3,000 gallons (11,355 L). Ensure the weigh scales have been tested and certified.

Furnish the Project Manager 1 copy of a test report showing the asphalt cement specific gravity.

Spot check failure will require re-testing and certification of the above. The Project Manager will establish the spot check interval.

401.03.13 Production Monitor Recorder

Use recording equipment that automatically monitors and records, on a time coordinated basis, the aggregate, lime, warm mix additive and asphalt cement weight entering the mixing unit. The records may be continuous (chart recorder) or digital printout.

Ensure that chart recorders clearly record asphalt cement content changes of 0.1% or more and aggregate feed rate changes of 1.5% or more.

Ensure the digital printout equipment records the day's total production at minimum 5-minute intervals, or the interval directed by the Project Manager.

Digitally display the aggregate, warm mix additives, and asphalt cement rates in tons (MT) per hour and daily totals. Display lime by tons (MT) per hour or on a de-cumulating balance.

Ensure the monitor system operates on unprocessed signals from measuring devices.

Provide the Project Manager continuous access to the recorder during production.

Submit the permanent record to the Project Manager daily.

Operate the production/monitor recorder at all times during production. Stop production when the recorder is not operational.

401.03.14 Plant Mix Preparation

Mix the aggregate, all additives and asphalt cement to produce a homogeneous mixture. Ensure all aggregates are thoroughly and uniformly coated with bitumen.

Immediately suspend operations if aggregate is not being completely dried prior to mixing.

Remove, dispose of, and replace all mix that is damaged by burning, improper mixing, or fails to meet the specifications at Contractor expense.

Maintain the mix discharge temperature within the asphalt cement manufacturer's recommended mix temperature range not exceed 355 °F (179 °C).

The discharge temperature will be periodically checked and recorded.

Remove and replace any mix produced when the mix discharge temperature exceeds the maximum temperature at Contractor expense.

401.03.15 Roadway Equipment

A. Pavers. Use self-propelled pavers that spread, shape, and finish the combined plant mix material to the specified profile and cross slope.

Immediately stop paving if the paver tears, shoves, segregates or otherwise damages the plant mix, and repair or replace the paver before resuming paving operations.

Equip the paver with a mobile grade reference system that provides a uniform pavement profile. Ensure the paver maintains the transverse slope at all times and is able to adjust the slope throughout super-elevated curves.

Ensure auger extensions are used to match the screed width.

Equip the paver with an attachment that produces joints in accordance with Subsection 401.03.19 as the plant mix is placed.

B. Trucks. Remove trucks from service that leak fluids. When directed, cover each load with canvas or other approved material to protect the mix at Contractor expense.

C. Rollers. Furnish and use rollers that compact the plant mix to the specified density. Remove rollers that crush the paving aggregates or otherwise damage the plant mix and replace the damaged plant mix at Contractor expense.

D. Cleaning Agents. Do not use diesel fuel as a cleaning agent or as a release agent for any paving equipment or operations. Use a commercially manufactured release agent approved by the Project Manager.

401.03.16 Existing Surface Preparation

Dispose of existing bituminous surface, designated to be removed, in accordance with Subsection 202.03.3.

Re-work all existing bituminous surfaces designated to remain in place as specified.

Before placing the leveling course, clean the existing surface of dirt and loose, extraneous material. Apply a prime or tack coat of bituminous material to the cleaned surface as specified.

Correct dips, depressions, sags, excessive or nonexistent crown, and other surface irregularities using a premixed bituminous mixture. Spread the mixture in 2-inch (50 mm) compacted layers.

Correct surface irregularities exceeding 6 inches (150 mm) deep, using untreated aggregate material before leveling with a bituminous mixture.

401.03.17 Tack Coat

Apply tack coat in accordance with Section 407 and the contract.

Apply tack coat on the prepared surface, existing surfacing to be overlaid and between lifts when pavement is constructed in multiple lifts.

401.03.18 Surface Conditions, Weather Limitations and Paving Dates

Stop plant mix paving when the surface temperature is less than 35 °F (2 °C); the surface is wet; the roadbed is unstable or the Project Manager determines adverse weather conditions prevent the proper handling, finishing or compacting of the mix.

Complete all sections of plant mix surfacing, to be open to traffic during winter shut down, to the full plan width and thickness, excluding the seal and cover. Complete this work meeting the specifications before the November 1st paving cessation date.

The Project Manager will suspend time assessment between November 1st and November 16th when the next scheduled significant work item is paving and all grading, gravel and other operations affecting the safe and convenient use of the roadway by the traveling public are complete.

Submit a written request to the Project Manager and obtain written approval in order to pave after November 1st. and before April 15th.

Plant mix surfacing placed after November 1st and before April 15th is at the Contractor's risk and subject to the following conditions:

- The surface temperature to be paved is at least 35 °F (2 °C), measured by the Project Manager.
- All applicable specifications are met.

Make permanent repairs and restore partially completed pavement to the required profile, section and condition at Contractor expense before placing the remaining lifts.

This is not a waiver by the Department of any other contract requirement regarding the work sequence or traffic operation.

If the paving operation causes transverse joints spaced at less than ½-mile (805 m), suspend work until the next April 15th.

No payment is made for the plant mix or asphalt cement on progress estimates between November 1st and April 15th for partial width or thickness.

Promptly repair damage to all partial width or thickness of plant mix surfacing used by traffic during this period for any reason including suspension of work due to adverse weather.

Provide all required interim traffic striping and traffic control on partially completed pavement at Contractor expense.

Failure to promptly make repairs and provide interim striping and traffic control is cause for the Department to perform or have the work performed and deduct the cost from monies due or that may become due the Contractor.

Payment for partial width or thickness pavement in acceptable condition will be made on the estimates following the end of the period on the next April 15th.

401.03.19 Spreading and Finishing

Place and spread the mix in accordance with Table 401-3. Thinner lift thicknesses must be approved by the Project Manager.

TABLE 401-3
MINIMUM LIFT THICKNESS

Aggregate Size	Minimum Lift Thickness
⅜-inch (9.5 mm)	0.1-foot (30 mm)
½-inch (12.5 mm)	0.12-foot (36 mm)
¾-inch (19 mm)	0.15-foot (45 mm)

Place and spread the mix to the widest practical width on the approved surface. Place shoulder-widening material with approved equipment.

Establish and maintain line control for paving. The Project Manager will furnish the Contractor the necessary information to establish these controls. Maintain the paving control line tolerance within 0.25-foot (75 mm) of a true line from the existing reference points.

Failure to maintain the paver control line within the specified tolerance is cause for corrective action or pavement removal and replacement, as directed by the Project Manager, at Contractor expense.

Include the cost of furnishing horizontal line control in the plant mix surfacing bid item.

Remove and replace segregated pavement areas behind the paver with new plant mix before initial rolling begins. Correct all segregated areas at Contractor expense.

On small or irregular areas, approaches, turnouts, around manholes, inlets, walls and on other areas not readily accessible to a paver, plant mix may be spread to the specified thickness using a specialty paver or other approved methods. Compact these areas as directed.

Remove and replace all plant mix that is segregated, loose, broken, contaminated, damaged or otherwise defective, with new plant mix that meets contract requirements at Contractor expense.

Remove any plant mix dropped from equipment onto any existing or new plant mix surfacing as directed by the Project Manager.

Roadways having a design ESAL of 100 or less may be opened to traffic or to haul units subject to the Project Manager's approval.

Roadways having a design ESAL of 100 or greater may be opened to traffic and haul units when the mat is compacted and the surface cools to 140 °F (60 °C).

401.03.20 Constructing Joints

Continuously place each lift and provide at least a 6-inch (150 mm) offset between longitudinal joints in successive lifts. Offset transverse joints in successive lifts by at least 6 feet (1.8 m).

Correct joints that do not meet the surface tolerance requirements in accordance with Subsection 401.03.23

Uniformly coat the exposed face of all joints, excluding those formed by echelon paving, with a double shot of emulsified asphalt before placing the abutting course.

Construct longitudinal joints in the top lift of plant mix at the centerline or lane line. If these locations are not practical, construct the joint outside the wheel paths as approved by the Project Manager.

Construct a vertical transverse joint the full lift depth if the mix cools below the low temperature in accordance with Subsection 401.03.21. Remove loose material, brush the joint face with asphalt, and compact the fresh mix against the joint face when paving is resumed.

Taper the end of paving lifts at bridge ends and on roadways under traffic to a minimum 50H:1V ratio. When paving of the lift resumes, remove the taper and construct the transverse joint.

Ensure transverse joints in lifts of plant mix surfacing or other lifts to be used by traffic for 15 calendar days or more do not vary more than ⅜-inch (9.5 mm) from any point on a taut 25-foot (7.6 m) string line placed parallel to centerline.

Taper the longitudinal paving joint edges at a 4H:1V to 6H:1V slope. Compact the joint between abutting passes to the specified plant mix density. Do not permit an exposed longitudinal joint length to exceed one day's paving run.

Sign the new pavement end at the close of work each day meeting the project's traffic control plan and the contract.

Construct the joints at bridge ends or other rigid structures after the existing base is prepared and compacted. Apply a coat of emulsified asphalt to the portions of structures abutting the plant mix surfacing.

401.03.21 Compaction, Compaction Control Testing, and Density Acceptance Testing

Complete compaction rolling within the temperature range recommended by the asphalt cement manufacturer included in the mix design or before the mat temperature falls below 175°F (80 °C). Compaction rolling after the temperature is below 175 °F (80 °C) is cause to suspend paving operations. Compaction rolling is rolling in the vibratory mode. The Project Manager may adjust the minimum 175 °F (80 °C) temperature if compaction rolling damages the new pavement or has received written approval from the asphalt cement manufacturer. Compact Warm Mixes in accordance with Subsection 401.02.4.

Perform all necessary density testing to control compaction.

Once the plant mix is spread, struck off, and surface irregularities are corrected, compact to the plant mix to at least 93.0% of target maximum specific gravity as determined in accordance with MT 328 with the following exceptions:

- 92.0% - ⅜-inch (9.5 mm) mixes with plan depths of less than 0.12-foot (36 mm).
- 92.0% - any mix placed directly on a crushed aggregate surfacing.

Compact plant mix placed over any typical section containing CTB to 93.0% for the full width of the typical section.

Provide core samples of the compacted plant mix from the roadway. Core locations will be randomly selected based on the tons (MT) of mix placed. Core the locations selected after all rolling is complete and before the roadway is opened to traffic. The center of the core location will not be within 12 inches (305 mm) of longitudinal paving joints, 12 inches (305 mm) of a shoulder hinge point, or where the planned nominal thickness is less than 0.10-foot (30 mm). The pavement density is determined from cores taken at randomly selected locations after all rolling is complete and before the roadway is open to traffic.

Density acceptance by cores does not apply to leveling or isolation lifts that have a depth of less than 0.10-foot (30 mm) thick.

Take cores after all rolling is complete. Provide two 4-inch (100 mm) cores the full depth of the plant mix surfacing, extracted from within a 5-inch (125 mm) radius of each designated location. Mark the core as directed.

Separate the plant mix lift to be tested from the total core. Cut the core to the actual lift thickness within ± 0.15-inch (4 mm). The Department recommends using a saw to separate the

lift to be tested from the total core. Perform this work within the project limits or other approved location.

The Inspector will witness all of the above activities before traffic is permitted to use the plant mix lift being tested.

Furnish the core immediately to the Inspector after it is removed, marked and separated. Do not remove the cores from the Inspector's visual control at any time. Re-core as directed any time either the Contractor requirements or procedures within this section are not met. The test results of the replacement core to be used in the QA evaluation for the lot represented will be the actual relative in-place density unless it exceeds:

- 92%; then 92% will be used for the relative in-place density of that core in the QA evaluation.
- 91% for ⅜-inch (9.5mm) mixes with plan depths of less than 0.12 foot (36 mm); then 91% will be used for the relative in-place density of that core in the QA evaluation.
- 91% for any mix placed directly on a crushed aggregate surfacing; and then 91% will be used for the relative in-place density of that core in the QA evaluation.

The plant mix in the sub lot represented is considered to be not meeting density specifications.

Remove free water from each core hole; place and compact new hot plant mix, not exceeding 2-inch (50 mm) lifts, to the finished surface immediately after the core is removed. If approved by the Project Manager, fill with a commercially manufactured quick setting non-shrink grout to the finished surface. Apply a double shot of emulsified asphalt over the core holes when the patch material has set. Mark each core as directed by the Inspector witnessing the coring.

MT 328 is used to establish the target Rice density. The bulk specific gravity (MT 314) determined for each core will be divided by the target Rice density in effect at the time the plant mix was produced to determine the relative in-place density. The average of the results of the pair of cores from each location will be expressed as the percent of relative density. All results will be reported to the tenth of one percent (0.1%).

The approximate mix quantity represented by each sub-lot is 600 tons (600 MT). Additional locations and tests may be required. The quantity represented by 5 tests or approximately 3,000 tons (3,000 MT) of mix constitutes a lot whenever production schedules and material continuity permit. A lot represented by 3 to 7 consecutive random sub-lots will be established when there are short production runs, significant material changes, or other unusual characteristics of the work.

All costs of furnishing the cores will be considered incidental to the plant mix surfacing item and no separate measurement or payment will be made.

Plant mix surfacing is evaluated for density on a lot-by-lot basis in accordance with Subsection 105.03.2.

401.03.22 Pavement Repair

Cut out the defective pavement section to at least 0.15-foot (45 mm) depth or as directed by the Project Manager. Clean the sides and bottom of the repair area and apply tack coat to the surfaces. Fill the repair area with contract specified mix, level, and compact to the specified density and surface smoothness.

401.03.23 Surface Tolerance for Flexible Pavement

A. Ride Specification. Construct all surfacing courses to provide completed plant mix pavements that meet surface smoothness levels derived from the IRI for the category specified in the contract and that meet the surface profile requirements for the finished surface. Surface smoothness and surface profile will be analyzed from data collected by the Department using a Class I laser road profiler following Department procedures for

profiler operations. The IRI will be measured in inches/mile, regardless of the unit of measure used on the contract.

Target IRI values are determined by project category based on the opportunities for improving the ride, by the pre-paving IRI value, paving constraints or by a combination of these as follows:

1. **Category I projects:**
   Target IRI values - 45 to 55 inches per mile
   - Projects with 2 or more opportunities for improving the ride.
   - Single lift overlays with a pre-paving IRI value less than 110 in/mi
2. **Category II projects:**
   Target IRI values - 55 to 60 inches per mile
   - Single lift overlays with a pre-paving IRI greater than or equal to 110 in/mi and less than 190 in/mi
3. **Category III projects:**
   Target IRI values - 55 to 70 inches per mile
   - Urban projects with a posted speed limit of 55 MPH or less and curb and gutter controlling 1 or more edges of the paving

   Projects with high pre-paving IRI value:
   - Projects with an average pre-paving IRI value greater than or equal to 190 in/mi and 2 or more opportunities to improve the ride are considered a Category I project.
   - Projects with an average pre-paving IRI value greater than or equal to190 in/mi and one opportunity to improve the ride must have a post-paving IRI less than or equal to 50% of the pre-paving IRI. There is no pay adjustment factor based on smoothness; corrective action is required to produce a post-paving IRI less than or equal to 50% of the pre-paving IRI at Contractor expense.

   Each opportunity to improve the ride is one of the following:
   - Placing a gravel base or surfacing course;
   - Placing plant mix base;
   - Placing cement treated base;
   - Placing pulverized plant mix surfacing;
   - Milling;
   - Cold recycling (milling and laydown); or
   - Each full 0.10-foot (30 mm) increment for ⅜-inch (9.5 mm) aggregate mix, 0.12 foot (36 mm) increment for ½-inch (12.5 mm) aggregate mix, and 0.15-foot (45 mm) increment for ¾-inch (19 mm) aggregate mix of new plant mix surfacing.

   Leveling and isolation lifts are not included as an opportunity to improve the ride.

Correct surface profile defects greater than 0.40 inches (10 mm) in a distance of 25 feet (7.62 m) within 30 calendar days of notification but prior to seal and cover or plant mix seal operations. Correct surface profile defects by milling and filling deficient pavement depths or by diamond grinding excess pavement depths. Corrected surface profile defects will be retested and evaluated. Pavement thickness will be measured after profile corrections are made. Ensure corrected pavements do not create a transverse height difference between adjacent lanes exceeding ⅛-inch (3 mm). Fog seal corrected areas if the roadway is not chip sealed prior to winter shutdown.

The Department will test for surface smoothness and surface profile prior to the placement of seal and cover or plant mix seal on the final lift of plant mix surfacing pavement. Testing will consist of 2 passes in each travel lane. Data collected for each

wheel path will be averaged for that lane. Tests will be performed within 10 business days (extended by rain or other inclement weather conditions) of completion of all mainline paving. The Department will test divided highways within 10 business days (extended by rain or other inclement weather conditions) of completion of mainline paving for each direction of travel. Ensure that the entire finished lane width to be tested is not impeded and is available to Department personnel at the time of testing. Test results will be furnished within 2 business days.

If the entire final lift of pavement cannot be completed before winter shutdown, data will be collected for all roadway sections paved through the final lift. Evaluation of the remaining pavement will be performed once the paving is completed.

The surface smoothness analysis will be used to determine the actual IRI for calculating pay factors for the surfacing section.

Actual IRI values will be determined on all mainline travel lanes including climbing lanes, passing lanes, and ramps that are 0.2 miles (0.30 km) or longer. Bridge decks will be included only if they are paved as part of the project.

Smoothness data will not be evaluated for the following roadway sections:

1. Climbing lanes and passing lanes less than 0.2 miles (0.30 km) long;
2. Turning lanes;
3. Acceleration and deceleration lanes less than 0.2 miles (0.30 km) long;
4. Shoulders and gore areas;
5. Road approaches;
6. Horizontal curves 900 feet (275 m) or less in centerline radius, and pavement within the super-elevation transitions of these short radius curves; or
7. Pavement within 50 feet (15 m) of bridge decks, approach slabs, and the terminal paving points of the project.

Areas requiring corrective work will be identified using the surface profile measurements of the finished surface.

Correction of profile defects will not be cause to reevaluate any section for surface smoothness except for locations identified as remove and replace as described below. Quality incentive allowances will be used to offset any price reductions on progress estimates.

Remove and replace any 0.5 mile (0.8 km) segment of roadway requiring corrective action. Remove and replace the segment by milling 0.15 feet (45 mm) or to the lift line if within 0.02 feet (6 mm), whichever is greater and replacing with new material meeting the contract requirements. Remove and replace sections of roadway less than 0.5 miles (0.8 km) that do not meet the applicable IRI requirements for the project category unless other corrective action is approved by the Project Manager. Sections requiring removal and replacement or other corrective action will be rerun once the corrective work has been performed. The maximum pay adjustment factor for the affected segment after corrective action is 1.00. Disincentives will be applied if applicable.

All work to prepare the roadway for testing, including sweeping, grinding and traffic control prior to the ride test, is incidental to the work and is not measured for payment. All work to complete any corrective action and re-testing, including but not limited to sweeping and traffic control, is incidental to the work and is not measured for payment. Include all costs and resources to prepare the roadway for surface tolerance testing in the plant mix surfacing item.

B. Surface Smoothness. Finish the surface of the final lift to the specified grade and cross section meeting the surfacing smoothness values for all paved areas excluded from the ride specification in accordance with Subsection 401.03.23(A). The Contractor will be

notified of sections to be corrected within 3 business days after the surface was placed. Perform all corrective work at Contractor expense. Table 401-4 values specify the maximum allowable variance and divergence from the mean constructed grade.

TABLE 401-4
MAXIMUM ALLOWABLE VARIANCE AND DIVERGENCE

Surface	Total Variation Per 100 feet	Rate
New plant mix	0.02-foot (6 mm)	0.20%
Plant mix overlays (≥ 90 mm)	0.03-foot (9 mm)	0.30%
Plant mix overlays (< 90 mm)	0.03-foot (9 mm)	no rate

Note: The rate is applicable only to the longitudinal direction.

The mean constructed grade for each section is the planned grade or a grade parallel to plan grade, acceptable to the Project Manager.

Surfaces will be checked for compliance at joints, bridge ends, and other sections where ride characteristics or other evidence indicates the surface tolerance is outside the specifications.

Surface smoothness is measured longitudinally in 100-foot (30.5 m) sections at 10-foot (3 m) intervals, and transversely at 4-foot (1.2 m) intervals. Correct out of specification plant mix surfacing by diamond grinding, cold milling a minimum depth of 0.15 feet (45 mm) the full width of the defect but not less than the paver width, or other approved method. If removing and replacing, extend the repair area for a minimum of 50 feet (15.2 m) each side of the defective pavement and fill with like material compacted to the specified density.

Ensure the corrected pavement and adjoining surface meet the smoothness specifications.

401.03.24 Rumble Strips

Construct rumble strips when specified. Cut the rumble strips into the finished plant mix surfacing. Use a machine equipped with a rotary type cutting head capable of making the cuts to the dimensions and pattern shown in the Detailed Drawings.

Produce the rumble strips without tearing and snagging the pavement. Remove resulting debris from the roadway before opening to traffic. Do not allow debris to enter any waterways.

Establish a control line and locate the rumble strips on the shoulder 6 inches (150 mm) outside of the travel lane. The offset may be adjusted to avoid longitudinal pavement joints. Do not place rumble strips where concrete barrier rail or other roadside features prevent placement as specified.

Do not cut rumble strips if the seal and cover operation will not be completed before winter shutdown. If seal and cover is not scheduled to be completed within 10 business days after cutting rumble strips, fog seal the finished rumble strips.

Apply fog seal to finished rumble strips as follows:

1. Apply a double shot of emulsified asphalt meeting Section 407 for fog seal.
2. Keep traffic off the fog seal until the emulsion has cured to no-tack.
3. Apply the fog seal to the rumble strip for each lane in the direction of travel for that lane.

401.04 METHOD OF MEASUREMENT

401.04.1 Plant Mix Surfacing

Plant mix surfacing is measured by the ton (MT) on approved scales after complete mixing of all ingredients. The pay weight includes the asphalt cement and hydrated lime in the mixture.

401.04.2 Commercial Plant Mix Surfacing

Commercial plant mix surfacing is measured by the ton (MT) on approved scales after complete mixing of all ingredients. The pay weight includes the asphalt cement and hydrated lime in the mixture.

401.04.3 Asphalt Cement

When not included in another item, asphalt cement is measured by the ton (MT) as specified to the nearest ton (MT), in accordance with Subsection 402.04, excluding anti-stripping additive.

401.04.4 Hydrated Lime

When not included in another item, hydrated lime is measured by the ton (MT) in accordance with Subsection 109.01. Hydrated lime exceeding 1.6% by total weight of mix is not measured for payment as hydrated lime.

401.04.5 Rumble Strips

Rumble strips are measured by the mile (km) along the centerline of the roadway, less all gaps in the rumble strips due to ramp terminals, objects, etc. Each individual line of rumble strips is measured separately.

Fog seal for rumble strips is not measured for payment.

401.04.6 Tack Coat

Tack coat is incidental to the plant mix surfacing and is not measured for payment.

401.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Asphalt Cement	Ton (MT)
Commercial Plant Mix Surfacing	Ton (MT)
Hydrated Lime	Ton (MT)
Plant Mix Surfacing	Ton (MT)
Rumble Strip	Mile (km)

For commercial plant mix no separate payment will be made for asphalt cement, fillers, hydrated lime, and additives.

The contract unit price for rumble strips will be adjusted as shown in Table 401-5:

TABLE 401-5
PRICE ADJUSTMENTS DUE TO LINE DEVIATIONS

Line Deviation From The True Line	Price Adjustment
0.0 to 0.15-foot (0 to 45 mm) in 500 feet (152 m)	none
0.15 to 0.25-foot (45 to 75 mm) in 500 feet (152 m)	50% price reduction
greater than 0.25-foot (75 mm) in 500 feet (152 m)	correct as directed

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract.

SECTION 402

BITUMINOUS MATERIALS

402.01 DESCRIPTION

This work is the furnishing and applying bituminous materials, on bases and surfacing.

402.02 MATERIALS

Furnish bituminous materials meeting Section 702 and the contract requirements.

402.03 CONSTRUCTION REQUIREMENTS

Mix and apply bituminous material meeting the applicable requirements in Sections 401, 406, 407, 409, and 410.

402.03.1 Materials Source

Obtain the Project Manager's approval of the bituminous source before delivering the material to the project. Do not change the source of supply once work is started, without the Project Manager's written approval.

402.03.2 Sampling

A. General. Take bitumen samples, other than products accepted under quality assurance, at the point of delivery on the project.

The Contractor or designated representative is responsible for sampling the bituminous materials on the project in accordance with MT 302.

Drain off and discard at least 1 gallon (3.8 L) of the bituminous material before drawing samples.

Draw 2 one-quart (0.9 L) samples from each shipment, witnessed by the Project Manager. Submit both samples to the Project Manager for testing. One sample will be tested and the 2nd sample will be retained for use in accordance with Subsection 702.02.

Equip all transport vehicles with a spigot or gate valve in the unloading line, or in the tanker at the centerline of the tank, or in the pressure line from the unloading pump, or at another approved location. The spigot or gate valve diameter must be between ⅜ and ¾-inch (9.5 and 19 mm). Locate the spigot or valve to prevent plant dust or other sample contamination.

B. Asphalt Sampling (Quality Assurance Sampling). Sample asphalt cement for plant mix surfacing and base and plant mix seal course using a sampling device located in the line between the storage facilities and the mixing plant.

Provide a sample of the asphalt cement entering the mixing plant. One approved in-line sampling device is shown in AASHTO T 40.

Place the samples in Department furnished containers. Give the samples to the Project Manager immediately after sampling.

The Project Manager will randomly designate the time of sampling based on the tons (MT) of asphalt cement incorporated into the completed mix produced. The approximate quantity of asphalt cement represented by each sample is 25 tons (25 MT). The Project Manager may require additional samples and testing.

Six samples represent approximately 150 tons (150 MT) of asphalt cement and constitute a lot whenever production schedules or material continuity permit. The Project Manager may establish a lot consisting of the quantity represented by any number of consecutive random samples, from 3 to 7 inclusive, when necessary to represent short production runs, significant material changes, or other unusual characteristics of the work.

402.03.3 Shipping

Ship the bituminous material in clean, uncontaminated, fully insulated cars or trucks, sealed by the supplier after loading.

402.03.4 Testing

Bituminous materials are accepted on the test results of samples selected and tested in accordance with Subsection 702.02 by the Department or its authorized representative.

402.03.5 Acceptance

A. General. Provide the Project Manager a copy of the original bill of lading and a copy of the certificate of compliance, with each shipment. Ensure the certificate is signed by the supplier's representative and attests that the bituminous material meets the Department's specifications for the type and grade of material provided and that the shipping container was inspected and found free of contamination. The certificate of compliance is the basis for tentative material acceptance and use.

B. Failures. If a shipment of bituminous material fails to meet any of the specifications the material will be accepted at a 10% price reduction of the bituminous material cost if the test results are within the tolerances shown in Table 402-1.

If a shipment fails to meet any one of the specifications after twice the allowable tolerances have been applied, the price reduction will be 25% of the unit price bid for bituminous material when it is paid as a separate item or the invoice price when it is part of a bid item.

If a shipment fails to meet any one of the specifications after triple the allowable tolerances have been applied, the Project Manager may reject the material and require its removal from the work, or the Project Manager may accept the material at a 50% price reduction of the cost of the bituminous material.

The cost of the bituminous material for calculating price reductions is the material's contract unit price.

If a shipment fails more than one of the specifications, the failure causing the largest percentage price reduction is assessed.

TABLE 402-1
SCHEDULE OF TOLERANCES

Test	Allowable Variation		Remarks
	From Min. Specification Requirement	From Max. Specification Requirement	
Penetration distillation residues	-10%	+10%	
% Residue from distillation	-5%		% of total distillate: 2 mL may be added or subtracted at any distillation temp. before calculating the % recovered
Viscosity cutback asphalts emulsified asphalts	 -10% -5%	 +10% +25%	
Ductility	-10%		
Flash test cutback asphalt	 -10%		
Particle charge	NO TOLERANCE - Materials in violation of spec. and any aggregate used in conjunction with its use will, at the Project Manager's discretion, be either rejected or paid for at a unit rate not to exceed 50% of the cost of the materials.		

402.03.6 Loading and Application Temperatures

The Project Manager will designate the recommended application temperature ranges in accordance with Table 402-2.

Do not heat bituminous mix any higher than is necessary for proper hauling and placing.

Do not introduce aggregate into a mixer higher than 25 °F (14 °C) above the bituminous material temperature.

Furnish the Project Manager with data on the temperature-viscosity relationship of each asphalt to be used on the project. The data must cover the recommended temperature range and viscosities at which the asphalt may be used. The Project Manager will use this data to specify the temperature at which the material will be used.

TABLE 402-2
RECOMMENDED APPLICATION TEMPERATURES
FOR BITUMINOUS MATERIALS

Liquid Asphalts - RC, MC and SC				
Grade	**Loading Temp. Max.[1] °F (°C)**	**Spraying Temperature**	**Mixing Temp. of Aggregates for MC & SC Liquid Asphalts**	
			Min. °F (°C)	**Max. °F (°C)**
70	195 (91)	As required to achieve viscosity of 50-200 centistokes (25-100 Sec. Saybolt Furol)[2]	90 (32)	155 (68)
250	245 (118)		125 (52)	200 (93)
800	275 (135)		160 (71)	225 (107)
3000	310 (154)		200 (93)	260 (127)

Emulsified Asphalts				
Grade	**Mixing Temperature**		**Spraying Temperature**	
	Min. °F (°C)	**Max. °F (°C)**	**Min. °F (°C)**	**Max. °F (°C)**
slow and medium setting	50 (10)	130 (54)	50 (10)	130 (54)
rapid setting	125 (52)	185 (85)	120 (49)	160 (71)

Asphalt Cements		
Grade	**Mixing Temperature**	**Spraying Temperature**
		Max. °F (°C)
all penetration grades	established by Project Manager	350 (177)

Notes:
1. Line temperatures
2. Temperature – viscosity charts provided by manufacturer

402.03.7 Alternate Type or Grade of Bituminous Materials

The Engineer may change or substitute, in writing, the type and grade of bituminous material specified.

Payment for the changed or substituted bituminous material is the contract unit price for the type and grade of bituminous material plus or minus the difference in Contractor's cost at the refinery between the specified and substitute type and grade.

402.03.8 Performance Graded Asphalt Binder (PGAB)

Furnish PGAB meeting Table 702-2 requirements for the binder specified in the contract. PG 64-28, PG 64-34 and PG 70-28 binders, after aging in the rolling thin film oven, and testing in accordance with AASHTO T 51 must meet the following:

- Pull Rate: 2 inches per minute (5 cm per minute);
- Sample Temperature: 77 °F (25 °C); and
- Ductility: 1-foot (30 cm) minimum.

Notify the Project Manager in writing before making changes to the PGAB components.

A. PGAB Shipping, Handling, and Storage. Ship, handle, and store the PGAB following the supplier's requirements. Furnish a copy of the requirements before delivering the PGAB to the project. Ensure that the supplier's requirements are consistent with the material manufacturers. PGAB exhibiting separation, crusting, or foaming during delivery or in storage tanks will be rejected.

B. Sampling. Sample the PGAB in accordance with Subsection 402.03.2(B). A sample is 2 one-pint (two 500 mL) containers of PGAB.

C. Acceptance. The Department will grade samples representing each lot in accordance with the PGAB grading system, and Table 702-2, with duplicate containers retained for testing in case of dispute. PGAB is accepted in accordance with Subsection 105.03.2 using an "F" factor of 4. The "P" value is determined for the high temperature components of the resulting grade (e.g. 64, 58, etc.) using the formula:

$$P = (TL + aR - Xn) \times F$$

The "P" value is determined for the low temperature component of the resulting grade (e.g. -34, -28, etc.) using the formula:

$$P = (Xn + aR - Tu) \times F$$

Positive "P" value is added to determine the lot's total price reduction. No disincentive will be assessed for "P" values less than 13, based upon the Department's initial grading. This disincentive exclusion in "P" value will not be applied to averaged results described below.

If the calculation results in a price reduction ("P" value of 13 or greater), the Contractor may make a written request for an independent laboratory to grade the duplicates for the lot in question. Ensure the Department receives the written request within 30 calendar days of the notification of price reduction. The Contractor and the Department will agree upon the choice of independent laboratory before release of the duplicate samples for testing. The independent laboratory results will be averaged with the results provided by the Department. The averaged results are binding on both parties for acceptance and payment of the material in question. The "P" value will be calculated based upon the averaged results, with no exclusion allowed for results less than 13. Pay the cost of the duplicate testing, on a per lot basis, if the price reduction is confirmed or increased. The Department will pay the cost of the duplicate testing, on a per lot basis, if the price reduction is reduced.

The ductility requirement has no tolerance. Immediately stop paving if the binder fails the ductility requirement. Do not start paving until binder meeting the specifications is furnished.

402.04 METHOD OF MEASUREMENT

Bituminous material is measured by the gallon (L) or the ton (MT), as specified in the contract.

If measured by the gallon (L), the volume of bituminous material is determined at a temperature of 60 °F (15.6 °C) or corrected to this using the appropriate group table designated in the ASTM D1250 volume correction tables. Transport bituminous materials measured by the gallon (L) in tanks certified as to capacity. Provide a measuring rod and calibration card with each tank. Railroad tank cars must have available inage and outage tables and dome capacity charts.

When measured by the ton (MT), the bituminous material weight is measured on scales furnished by the supplier or on public scales close to the source. Weigh each transporting vehicle for bituminous materials, other than railroad tank cars, empty and loaded. The weight

difference is used for computing the tonnage (metric tonnage). Furnish an approved scale that can weigh the transporting unit in an unbroken operation. Test and seal the scales at Contractor expense when directed.

For plant mix operations, the bituminous material may be weighed by the plant scales, if approved.

If railroad tank cars transport the bituminous materials, the railroad car weights may be used for computing the weight of bituminous material, if the loaded cars are weighed over track scales. The stenciled tare on the car used for determining the net weight is subject to verification.

Use flow rate meters in accordance with Subsection 401.03.2(D)(7), to measure the material. Document meter readings by invoices. The Project Manager may take tank stabs for verification purposes.

402.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Bituminous Material	Gallon (L) or Ton (MT)

Payment includes all costs to furnish, deliver, heat, haul, and apply the bituminous material.

For plant mix operations, the maximum volume of bituminous material eligible for payment on a shift basis is the target bituminous content plus 0.3%.

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract.

SECTION 403

CRACK SEALING

403.01 DESCRIPTION

This work consists of routing, cleaning and sealing the transverse and specified longitudinal cracks in accordance with Subsection 403.03.1 in the roadway surface with the specified sealant.

403.02 MATERIALS

A. Crack Sealant. Use a sealant that is listed on the QPL and in accordance with Table 403-1.

TABLE 403-1
CRACK SEALANT SPECIFICATIONS

Property	Requirement
Cone penetration, 77 °F (25 °C), dmm (ASTM D5329)	100-150
Cone penetration, 0 °F (−18 °C), dmm (ASTM D5329 modified)	25 min.
Flow, 140 °F (60 °C), 5h (ASTM D5329)	0.4-inch (10mm) max.
Resilience, 77 °F (25 °C), (ASTM D5329)	30% to 60%
Bond, −20 °F (−29 °C), 200% ext. (ASTM D5329)	pass 3 cycles
Recommended pour temperature	380 °F (193 °C)
Safe heating temperature	410 °F (210 °C)
Asphalt compatibility (ASTM D5329)	pass

Submit a 30 pound (13.6 kg) sample for the first lot of the sealer proposed for project use to the Helena Materials Bureau for testing at least 20 calendar days before its intended application. Submit the sample in its original packaging with the batch number legible.

Do not use the first lot of sealant before it is approved.

The Department will take 1 random sample from each additional lot for testing.

B. Backer Rod. Furnish backer rod that is listed on the QPL. The backer rod must be compatible with the crack sealant placement temperature listed in Table 403-1, and also meet ASTM D5249, Type 1, sized for cracks in accordance with Subsection 403.03.4.

C. Blotter Material. Use toilet paper or an approved liquid blotter material. The liquid blotter must be a commercially manufactured surfactant. Provide blotter that is not detrimental to the crack sealant or the surfacing material.

403.03 CONSTRUCTION REQUIREMENTS

403.03.1 General

Work half of the roadway at a time.

Limit routing and crack sealing work to 1 maximum 2.0-mile (3 km) work area.

Submit the type of blotter material and application rates to be used to the Project Manager 10 calendar days before beginning crack seal operations. The application rate must be sufficient to protect the crack sealant material.

403.03.2 Routing

Rout all existing cracks that are between ⅛ and 1-inch (3 and 25 mm) wide.

Rout all longitudinal cracks to produce straight ¾-inch (19 mm) vertical walls and a ¾-inch (19 mm) wide flat bottom reservoir.

Rout the transverse cracks to produce straight ½-inch (13 mm) vertical walls and a 1½-inch (38 mm) wide flat bottom reservoir.

Rout when the roadway is dry.

Remove and dispose of the routed material from the roadway before opening the roadway to traffic.

403.03.3 Cleaning

The reservoir and crack must be dry and free of dust, dirt and loose materials immediately before placing the backer rod, if applicable, and applying the sealant.

403.03.4 Sealing

Install backer rod in cracks 1½-inch (38 mm) wide and larger. Place sealant material as soon as practicable after the routed cracks are deemed clean and dry. Do not rout further than sealant can be placed during the same day's shift.

Follow the sealant manufacturer's handling, mixing and application temperature requirements. Meet the following requirements:

- Ensure no moisture is present in cracks or reservoirs to prevent bubbling and non-adhesion of sealant during installation;
- Apply sealant filling the reservoir flush to the top using a pressure type applicator;
- Do not allow sealant to collect or pool at the low end of crack or reservoir elevation;
- Open the completed work to traffic once the sealant does not track; and
- Repair or replace all seal work damaged by traffic at Contractor expense.

Seal previously repaired cracks to restore water resistance. Spread and smooth the sealant as required to seal the reservoir, but do not exceed 2 inches of spread sealant on the roadway.

Apply blotter material to all sealed cracks.

403.03.5 Temperature Limitations

Do not rout when the mat temperature is below 35 °F (2 °C).

Apply the sealant when the roadway surface temperature is between 35 and 120 °F (2 and 49 °C).

403.04 METHOD OF MEASUREMENT

Crack sealing is measured by the pound (kg) of material placed.

Blotter material is not measured separately.

403.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Crack Sealing	Pound (kg)

Blotter material is included in the contract unit price and is not paid for separately.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 407

TACK COAT

407.01 DESCRIPTION

The work is furnishing and applying emulsified asphalt to a prepared aggregate, constructed bituminous or concrete surface before placing bituminous surfacing.

407.02 MATERIALS

407.02.1 Bituminous Material

Furnish emulsified asphalt meeting Section 702 requirements for the type and grade specified.

The Project Manager may change or substitute the type and grade of emulsified asphalt to be used in accordance with Subsection 402.03.7.

A one step change in grade will not change the contract unit price.

The Contractor may substitute CSS-1 emulsified asphalt for SS-1 emulsified asphalt for tack coat.

407.03 CONSTRUCTION REQUIREMENTS

407.03.1 Weather Limitations

Apply tack coat to a dry surface.

Apply the tack coat when the ambient temperature is 50 °F (10 °C) or higher, or when the surface temperature is 35 °F (2 °C) and rising.

Do not place plant mix on any surface with a tack coat until the tack coat has cured (breaks) as determined by the Project Manager.

Apply the tack coat after the Project Manager has approved the surface to receive the bituminous material.

Apply tack coat subject to the surface conditions and weather limitations in accordance with Subsection 401.03.18.

407.03.2 Equipment

Use equipment in accordance with Subsection 410.03.1.

407.03.3 Application of Emulsified Materials

Dilute emulsified asphalt to a 50-50 ratio with water, unless other approved proportions are directed by the Project Manager. Apply diluted emulsified asphalt for tack coat as specified by the Project Manager at a minimum rate of 0.1 gallon per square yard (0.45 L/m^2).

When a double shot of emulsion is called for in the contract, apply 2 applications at the minimum rate specified above. Ensure the first shot is cured prior to applying the second.

407.03.4 Maintenance of Surface

Maintain tack coated surface until covering with subsequent surfacing.

Repair all defects, deterioration or disintegration of the underlying surfacing course or courses as directed.

407.03.5 Traffic Control and Protection of Highway Structures

Furnish traffic control meeting the approved traffic control plan and Section 618.

Furnish highway structure protection in accordance with Subsection 410.03.9.

407.04 METHOD OF MEASUREMENT

Emulsified asphalt is measured by the gallon (L).

When not specified as a contract pay item, emulsified asphalt is not measured or paid for but is incidental to and included in the payment for other items of work. Water for diluting emulsified asphalt used in the work is not measured for payment.

407.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Emulsified Asphalt	Gallon (L)

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract. The emulsified asphalt quantities in the contract are estimated and may be increased or decreased with no adjustment of the contract unit prices.

SECTION 409

SEAL COAT

409.01 DESCRIPTION

Seal coat is the application of a bituminous material, covered with aggregate on an existing roadway surface.

409.01.1 Contract Time

In cases where seal coat and pavement marking application are the only remaining items of work, contract time will be charged in accordance with Subsection 108.07.3 beginning the first working day following the July 4th (Independence Day) holiday.

Submit written notice to perform seal coat work prior to the July 4th (Independence Day) holiday or holiday weekend.

Time charges in accordance with Subsection 108.07.3 for seal coat work performed prior to the July 4th (Independence Day) holiday will commence on the date indicated in the Contractor's written notice.

In cases where seal coat and pavement marking application are the only remaining items of work as of August 21st, contract time will not be charged after August 20th if seal coat work is not performed. Contract time will be charged in accordance with Subsection 108.07.3, beginning on the day seal coat work begins, from August 21st through August 31st if seal coat work is performed.

Submit written notice to perform seal coat work from August 21st through August 31st.

409.02 MATERIALS

409.02.1 General

Furnish aggregate and bituminous materials that are compatible. Submit compatibility test results for each aggregate source for informational purposes. One recommended compatibility test method is MT 322.

409.02.2 Bituminous Material

Furnish material in accordance with Table 702-3.

409.02.3 Cover Aggregate

Furnish cover aggregate in accordance with Subsection 701.02.8.

The responsibility for furnishing the aggregate source is specified in the contract.

409.03 CONSTRUCTION REQUIREMENTS

409.03.1 Sampling, Testing, and Acceptance

The Project Manager will randomly select samples taken by the Contractor and witnessed by an Inspector, for gradation and fracture testing. Sample from the belt on the chip spreader, in accordance with AASHTO T 2 procedures, or at another location approved by the Project Manager.

The following acceptance tests are used:

MT 202	Gradation
MT 217	Mechanical Fracture

The quantity of material placed in 192,500 square yards (178,500 m^2) is considered equivalent to a 2,500-ton (2,500 MT) lot, and the quantity of material placed in 38,500 square yards (35,700 m^2) is considered equivalent to a 500-ton (500 MT) sublot for the purposes of aggregate analysis and acceptance.

The quantity represented by 5 samples is a lot when production schedules and material continuity permit. The Project Manager may establish a lot consisting of a quantity represented

by 3 to 7 consecutive random samples when there are short production runs, significant material changes, or other unusual characteristics of the work.

Surfacing aggregates are evaluated for gradation and mechanical fracture, on a lot-by-lot basis. The upper and lower limits in the gradation table, Table 701-12 are the upper and lower limits in the evaluation formulas. The specified minimum fracture values are the lower limit. Acceptance is made in accordance with Subsection 105.03.2.

409.03.2 Aggregate and Bituminous Material Application Rates

Determine the application rates for aggregate and bituminous material used to complete a test section and the project. Submit the following for informational purposes before starting full production or any time the source of aggregate or bituminous material changes:

1. Aggregate and bituminous material application rates;
2. Bituminous materials supplier's recommended ambient and pavement surface temperatures;
3. Bituminous material supplier's recommended application temperature range; and
4. Elapsed time between the application of the bituminous material and the cover aggregate.

Before starting full production or after changing sources of either aggregate or bituminous material, complete a test section at least 2,000 feet (0.6 km) long to verify the following:

1. Optimum bituminous material and aggregate application rates;
2. Time frame to complete each phase of the seal coat operation to meet the requirements for opening the roadway to traffic; and
3. Roller type, number of passes and pattern of rolling operations.

Do not begin production seal coat work until the test section has been placed and approved by the Project Manager.

409.03.3 Seal Coat Limitations

The following conditions govern seal coat work:

1. Perform seal coat operations between May 1st and August 31st.
2. Do not perform seal coat work during the 48-hour period immediately preceding a holiday or a holiday weekend except for pilot car operation in accordance with Subsection 618.03.11.
3. Perform seal coat work when both the ambient and pavement surface temperatures meet the bituminous material supplier's recommended temperatures.
4. Stop seal coat work at least ½ hour before sunset, to include equipment off of the roadway and placement of traffic control devices for non-construction activities.
5. Do not apply bituminous material to damp or wet roadway surfaces.
6. Do not apply bituminous material to plant mix pavement which has been placed, in accordance with the contract, within the previous 72 hours.

409.03.4 Protection of Traffic and Highway Structures

Provide traffic control meeting Section 618 and the approved traffic control plan. Provide highway structure protection in accordance with Subsection 410.03.9(B). Provide dust control during sweeping and brooming.

409.03.5 Surface Preparation

Do not apply bituminous material unless the roadway surface is free of all dust, dirt, and foreign material. Remove excess crack seal blotter material placed in accordance with the contract prior to seal coat operations.

409.03.6 Reserved

409.03.7 Application of Seal Coat Materials

Apply bituminous material at the rate established by the test section. Apply the bituminous material within the bituminous material supplier's recommended temperature range.

Ensure that transverse and longitudinal joints are smooth and match the adjacent surfaces. Keep meet lines to a minimum. Locate longitudinal joints at the centerline or lane line. Obtain approval from the Project Manager to construct the joint at any other location.

For requests to apply full roadway width bituminous and aggregate applications in a single, continuous operation, provide the Project Manager 2 copies of a sequencing plan that ensures the least traffic impact for approval, at least 5 business days before the planned operation.

Uniformly apply the cover aggregate on the bituminous material at the rate established by the test section. When constructing longitudinal joints, one recommended method is to cover the joint with aggregate and sweep the aggregate back before applying adjacent bituminous material. When longitudinal joints are covered to permit vehicle cross over, sweep back the cover aggregate to expose the joint before applying adjacent bituminous material.

409.03.8 Warranty

The Contractor warrants the seal coat work. If the seal coat experiences chip loss, tracking, flushing or bleeding, at any time between the date the seal coat is completed and the 1st Wednesday in December of the same calendar year, perform repairs to the seal coat, and replace pavement markings covered by the repairs at no additional cost to the Department. Areas of cover material loss determined to result from means beyond the Contractor's control (snow plow damage, tire chain damage, or others) are not considered under these warranty requirements. Final determination regarding cover material loss will be made by the Engineer. When repairs are deemed necessary, reference is made to the Department's *Seal Coat Warranty Administration Guide*. Submit a detailed repair plan to the Project Manager for approval within 14 calendar days of notification of required repairs. The repair plan must address the area of failure and transitions required to ensure a uniformly bonded, smooth surface. Make warranty repairs in accordance with the provisions of this specification when performing warranty work. Furnish traffic control meeting Section 618 requirements at no additional cost to the Department.

409.03.9 Application of Blotter Material

Monitor the finished seal coat and apply blotter material on live oil areas throughout the specified warranty period. Live oil is defined as bituminous materials that have not fully set or bonded to cover material particles. Live oil has a glossy appearance and is present in tracking, flushing and bleeding conditions. Failure to apply blotter material within 24 hours of written notification by the Project Manager will be cause for the Department to have the work performed. Costs incurred by the Department associated with application of blotter material will be deducted from subsequent progress estimates.

409.03.10 Sweeping and Brooming

Provide a roadway free of loose cover material. In curb and gutter and guardrail sections, remove and dispose of all loose cover material from the roadway and sidewalks. Do not allow material to get into the storm drain system or any aquatic resource.

Correct surface irregularities affecting the ride quality at the Contractor's expense.

A. **Initial Sweeping and Brooming.** Remove all loose cover material before terminating pilot car use, dispose of the material if required. If pavement markings are not placed within 72 hours of completion of the seal coat work, the Department may have work performed and deduct the costs from monies due to the Contractor. Traffic control

beyond these 72 hours, unless ordered by the Project Manager is at the Contractor's expense.

Apply final pavement markings as specified elsewhere in the contract.

B. Final Sweeping and Brooming. Perform final sweeping and brooming operations to remove excess loose material no sooner than 5 calendar days before final pavement markings.

409.04 METHOD OF MEASUREMENT

409.04.1 Bituminous Material

Bituminous material used for seal coat work is measured by the gallon (L) or by the ton (MT) in accordance with Subsection 402.04.

409.04.2 Cover Aggregate

Aggregate for "Cover - Type 1" and aggregate for "Cover - Type 2" is measured by the square yard (m^2), based on the length and width of seal coat placed and accepted.

409.04.3 Fog Seal

Bituminous material used for fog seal is measured by the gallon (L) or by the ton (MT) in accordance with Subsection 402.04.

409.04.4 Traffic Control

Traffic control is measured in accordance with Subsection 618.04.

409.04.5 Rolling

Rolling is not measured for payment.

409.04.6 Sweeping and Brooming

Initial sweeping and brooming and the disposal of excess material necessary for traffic control operations as outlined in accordance with Subsection 409.03.10(A) are not measured for payment.

Final sweeping and brooming operation is measured by the course mile (CR km). A course mile (CR km) is defined as a roadway portion consisting of 2 travel lanes and adjacent shoulders or turn lanes for a 1 mile (km) length. Roadways with additional travel lanes or that require less than full width sweeping will be prorated. Traffic control from an approved plan necessary for final sweeping and brooming is measured in accordance with Section 618.

409.04.7 Water

Water used for dust control or wetting chips is not measured for payment.

409.04.8 Blotter Material

Blotter material is not measured for payment.

409.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Bituminous Material	Gallon (L) or Ton (MT)
Cover - Type 1	Square Yard (m^2)
Cover - Type 2	Square Yard (m^2)
Final Sweep and Broom	Course Mile (CR km)
Traffic Control	See Subsection 618.05

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract.

409.05.1 Excess Crushed Cover Aggregate

Sale of excess crushed cover aggregate is the Contractor's option. The Contractor cannot sell material from Department-owned or Department-optioned sources without a written agreement establishing and providing royalty refunds to the Department.

The Department may purchase acceptable unused crushed cover aggregate remaining in the stockpile, if the quantity exceeds 100 tons (100 MT). The conditions of purchase are described in Subsection 109.07.

Haul from the stockpile site to the site selected by the Project Manager will be by the most practical route as determined by the Project Manager. Payment for haul is 15 cents per ton-mile (0.907 MT per 1.6 km) for distances exceeding 2,000 feet (610 m).

SECTION 410

BITUMINOUS SURFACE TREATMENT

410.01 DESCRIPTION

This work is applying 1 or more coats of bituminous material on a prepared aggregate roadway surface, covering each application with aggregate surfacing material.

410.02 MATERIALS

410.02.1 Bituminous Material

Furnish the specified bituminous material in accordance with Section 702.

410.02.2 Aggregate

Furnish the specified aggregate in accordance with Section 701.

410.03 CONSTRUCTION REQUIREMENTS

410.03.1 Equipment

Maintain the following equipment on the project throughout the work.

A. Distributor. One pressure distributor for bituminous material with a minimum 1,000-gallon (3785 L) capacity insulated tank, internally heated.

Equip the distributor with a full-circulating spray bar:

1. At least 9 feet (2.8 m) long;
2. Capable of 1-foot (305 mm) incremental length adjustments up to 16 feet (4.9 m);
3. Having vertical nozzle adjustment that conforms to the roadway crown;
4. Capable of lateral shifting of the entire spray bar while operating; and
5. With vertical height adjustment capable of maintaining a preset height above the road surface.

Use spray bars and flat-slotted nozzles designed to not clog during intermittent operation and provide positive cutoff of the bituminous material. Use positive-acting flow control valves to produce a uniform, unbroken spread of bituminous material.

Remove or repair distributors not uniformly distributing the bituminous material.

Ensure the distributor has devices and charts to provide for accurate, rapid determination and quantity control of the bituminous material application.

Equip the distributor with a pressure pump, pressure gauge, thermometer well, thermometer, and a calibrated fluid content gauge.

Use pneumatic-tired distributors meeting legal load requirements.

B. Rollers. Furnish pneumatic tired rollers in accordance with Subsection 210.03.4(D).

C. Aggregate Spreader. Provide one self-propelled aggregate spreader:

1. Equipped with at least 4 pneumatic tired wheels on 2 axles;
2. Capable of uniformly spreading the material over the full width of the bituminous material; and
3. The spreader application rate being independent of motive power.

D. Cleaning Equipment. Use power brooms, blowers, or hand brooms.

E. Watering Stockpiles. Provide equipment for wetting the cover aggregate stockpiles, when required.

F. Watering Equipment. Furnish water-distributing equipment in accordance with Subsection 210.03.5.

G. Scales. Furnish scales in accordance with Subsection 301.03.2(C).

410.03.2 Existing Surface Preparation

Prepare the aggregate to receive bituminous surface treatment to the requirements and tolerances found elsewhere in the contract.

When required, apply a light, uniform water application to the roadway surface just before applying the bituminous material. Do not exceed 3% moisture by weight in the top 2 inches (50 mm) of the aggregate course.

When required, apply an aggregate treatment at the rate directed before the initial application of bituminous surface treatment. Apply the aggregate in accordance with Section 301.

410.03.3 Sweeping

Clean the roadway surface of all dust, dirt, and foreign material before applying the bituminous material.

410.03.4 Application of Bituminous Material

Apply the bituminous material with a maximum allowable variation of 0.02 gallon per square yard (0.4 L/m^2) from the specified application rate.

Apply bituminous material only with the Project Manager's approval. Apply the material when the surface temperature is at or above 60 °F (16 °C).

Do not work when rain, wind, or temperatures would prevent obtaining the specified results.

Uniformly apply the bituminous material at the temperature and rate specified. Provide uniform surface cover and true lines.

Ensure high viscosity bituminous materials are covered with aggregate within 5 minutes.

Apply bituminous material to produce smooth and consistent transverse and longitudinal joints in successive applications with the adjacent completed surfaces.

Longitudinal joints may be from 6 to 10 inches (150 to 255 mm) wide but not overlap at the application ends. Prevent lapping at transverse joints by inserting a drip pan under the nozzles if necessary. Before continuing the application, spread protective sheets over the treated surface on the cover aggregate to provide bituminous coverage at the joint.

Apply the material to keep meet lines to a minimum.

The Project Manager may approve full width application of bituminous material and cover aggregate in a single, continuous operation.

Re-apply bituminous material at joints where the uncovered bituminous material has set and does not bond the aggregate at Contractor expense.

410.03.5 Application of Cover Material

When directed, water the stockpiled cover aggregate before spreading it on the bituminous material.

Cover the first bituminous material application within 60 minutes. Uniformly cover all bituminous material with cover aggregate at the specified rate. When directed, use brooms to uniformly distribute the cover aggregate. Avoid displacement or loosening of the cover aggregate.

Do not permit haul trucks and traffic to drive on any uncovered bituminous material. Furnish traffic control for fresh spread cover aggregate areas as specified in the traffic control plan.

Before applying the adjacent bituminous material, broom all joints the full width to remove loose aggregate.

410.03.6 Rolling

Roll the cover aggregate immediately after spreading within 30 minutes of spreading.

Use self-propelled pneumatic-tired rollers with a ground contact pressure of between 50 psi (345 kPa) and 95 psi (656 kPa). Provide 2 rollers for each aggregate spreader used.

Roll parallel to the centerline, starting on the low side of the lane and working towards the crown or high side. Overlap roller passes at least 6 inches (150 mm).

Continue rolling until a smooth, compacted surface is produced.

Avoid displacing or loosening the cover material while rolling.

410.03.7 Curing and Cleaning

When the rolling is completed on each surface course and the surface is accepted, it may be opened to traffic.

Allow the surface to cure for at least 5 calendar days.

Repair all surface defects in the treated surface immediately with the specified bituminous material or use a pre-mix bituminous aggregate at Contractor expense.

Cover areas of excess bituminous material with aggregate and roll at Contractor expense.

When the Project Manager determines the first course of bituminous material and cover aggregate has cured and set, all repairs have been accepted, all excess cover aggregate is removed, clean the surface of dirt, dust, and foreign materials.

Begin construction of the succeeding course on the cleaned surface.

410.03.8 Completion

When the final course is complete, open the surface to traffic for 3 days, using the specified traffic control. During this time, broom and roll the surface as required.

Repair all surface defects in accordance with Subsection 410.03.7.

Cover all areas exhibiting excess bituminous material with aggregate and roll it.

410.03.9 Protection of Traffic and Highway Structures

A. Traffic Control. Furnish traffic control meeting the contract requirements and Section 618.

B. Structure Protection. Cover exposed bridge elements, culverts, curbs, gutters, guard fences, road signs, and other roadside structures to protect them from splash or spray when applying bituminous material.

Clean these same items of all bituminous material, dirt, or other material caused by the Contractor's operations.

Repair all Contractor caused damage to the highway or structures at Contractor expense.

410.04 METHOD OF MEASUREMENT

410.04.1 Bituminous Material

Bituminous material is measured by the gallon (L) or the ton (MT) in accordance with Subsection 402.04.

410.04.2 Cover Aggregate

Cover aggregate is measured by the ton (MT) or the cubic yard (m^3) measured in the vehicle at the point of delivery on the roadway, as specified in the contract and in accordance with Subsection 301.04.1.

410.04.3 Traffic Control

Traffic control is measured in accordance with Subsection 618.04.

410.04.4 Existing Surface Preparation

Where base construction is a part of the contract with bituminous surface treatment, the items of work for surface preparation are incidental to and included in payment for the base construction.

Where bituminous surface treatment is applied to an existing aggregate surface, the work for existing surface preparation is incidental to and included in payment for the bituminous surface treatment.

410.04.5 Rolling and Watering

Rolling and watering are incidental to other items of the contract and not measured for payment.

410.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Bituminous Material	Gallon (L) or Ton (MT)
Cover Aggregate	Cubic Yard (m^3) or Ton (MT)
Traffic Control	See Subsection 618.05

Surface sweeping or cleaning, watering of aggregate stockpiles and the roadway surface, repairing damaged surfaces or surfaces with excess bituminous material, and protection and repair of structures specified in accordance with Subsection 410.03.9 are incidental to and included in payment for other items of the contract.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 411

COLD MILLING

411.01 DESCRIPTION

This work is the removal of existing bituminous pavement at the locations and depth specified in the contract or designated by the Project Manager.

411.02 RESERVED

411.03 CONSTRUCTION REQUIREMENTS

411.03.1 Equipment

Use a power-operated cold milling machine equipped to control cross slope and to establish profile grade from the existing pavement or an external reference.

411.03.2 General

Do not start cold milling until the surfacing plant is fully operational.

Starting at the center of the road, begin milling on a longitudinal line parallel to the centerline with succeeding passes progressing to the outer edge of the pavement, unless approved by the Project Manager.

Remove all thin delaminated or loose layers of existing pavement left after cold milling.

Replace the milled pavement at bridge ends and cattle guards with new bituminous surfacing the same day leaving no transverse joints in the milled areas.

If new surfacing cannot be placed on the milled area the same day, transition at no less than a 50H:1V to the original surface. The completed milled surface is to be free from transverse and longitudinal irregularities exceeding ¼-inch (6 mm) when measured with a 10-foot (3 m) straightedge. Each successive pass will be pulled even with the previous and not staggered.

After cold milling, do not leave the remaining pavement exposed to traffic more than 72 hours before placing the plant mix surfacing. The 72 hour duration may be modified by the project manager depending on the durability of the milled surface.

The Contractor will be responsible to repair any damage that occurs to the roadway prior to plant mix paving. Do not proceed with paving without the approval of the Project Manager.

Replacing existing pavement is a separate operation from any succeeding overlay or lift.

411.03.3 Milling

A. **Connections.** Mill the existing bituminous surfacing from bridge decks, bridge approaches, cattle guards, and project connections at the locations specified in the contract or as directed by the Project Manager.

   1. **Bridge Decks.**
      - Mill the depth shown in the contract or as adjusted to meet field conditions.
   2. **Bridge Ends.**
      - Mill full depth from the bridge end out for a distance of 30 feet (10 m) prior to the milling taper.
      - For milling depths less than or equal to 0.35 feet (105 mm), mill a taper distance of 200 feet (60 m).
      - For milling depths greater than 0.35 feet (105 mm), mill a taper distance based on a rate of 30 feet per 0.05 feet (10 m per 15 mm) of milling depth.
   3. **Cattle Guards or Railroad Crossings.**
      - Mill full depth from the cattle guard or railroad crossing out for a distance of 15 feet (5 m) prior to the milling taper.
      - Mill a taper distance of 50 feet (15 m).

4. **Project Connections.**
    - For milling depths less than or equal to 0.35 feet (105 mm), mill a taper distance of 200 feet (60 m).
    - For milling depths greater than 0.35 feet (105 mm), mill a taper distance based on a rate of 30 feet per 0.05 feet (10 m per 15 mm) of milling depth.

B. Milling at Other Designated Areas. Mill the existing pavement at the locations, widths and depths specified. The depth is measured below the existing pavement plane projected from points on un-distorted pavement near the centerline and the edge of the driving lane.

C. Cold Milling for Seal and Cover. Meet the following requirements when seal and cover goes directly on the cold mill surface:

1. Use a cold milling cutting head having maximum ¼-inch (6 mm) tooth spacing.
2. Equip the milling machine with automatic controls and sensors on both sides to maintain the specified grade and transverse slope.
3. Do not operate the milling machine in excess of 75 feet/minute (23 m/minute) unless it can be demonstrated to the Project Manager that the milled surface can meet the plant mix overlay surface tolerance specified in accordance with Subsection 401.03.23(B).
4. Do not begin placing the seal and cover until all cold millwork is complete.

411.03.4 Salvage of Pavement Millings

Salvage, haul, and stockpile the milled pavement to the specified site.

Milled pavement is the Contractor's property when specified and must be removed from the project.

411.03.5 Replacing Removed Pavement

Pave all milled areas in the contract with the specified bituminous mixture, placed to the specified depth.

Grades will be provided at 50-foot (15 m) intervals for placing the new pavement for 250 feet (75 m) from each bridge end and 100 feet (30 m) from cattle guards. Set a wire line for grade control with intermediate supports to prevent wire deflection exceeding $^{3}/_{16}$-inch (5 mm). Stop paving if the deflection exceeds $^{3}/_{16}$-inch (5 mm) and make appropriate corrections.

Apply a tack coat on all milled areas before paving.

411.03.6 Traffic Control

Furnish traffic control in accordance with Section 618.

411.04 METHOD OF MEASUREMENT

Cold milling is measured by the square yard (m^2) of pavement removed to the specified depth.

411.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Cold Milling	Square Yard (m^2)

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract.

The contract unit price may be adjusted if the Project Manager issues a written order to increase or decrease the milling depth.

SECTION 501
PORTLAND CEMENT
CONCRETE PAVEMENT

501.01 DESCRIPTION

This work is the construction of PCCP on a prepared subgrade or base course.

501.02 MATERIALS

501.02.1 Concrete

Furnish concrete in accordance with Section 551 for Class Pave concrete.

A. Cement. Furnish Type I or II portland cement listed on the QPL, in accordance with Subsection 551.02.1.

B. Air-entraining Admixtures. Furnish air-entraining admixtures in accordance with Subsection 551.02.2.

C. Aggregates. Furnish aggregates in accordance with Subsection 701.01.

D. Water. Furnish water for concrete in accordance with Subsection 713.01.

501.02.2 Reinforcing Steel

Steel-wire fabric and steel bar mat sizes and dimensions are specified in the contract.

Furnish steel-wire fabric reinforcement in flat sheets.

Furnish bar mats and bars of structural or intermediate grade, as specified in the contract.

Furnish all reinforcing steel in accordance with Subsection 711.01.

501.02.3 Dowel Bars and Sleeves

Furnish Grade 40 plain round dowel bars in accordance with AASHTO M 31.

Bar dimensions and placement in the pavement are specified in the contract.

Do not use bars having burrs or other deformation that restrict slipping in the concrete.

Before delivery to the project, coat one-half the length of each dowel bar with one coat of zinc or tar paint. Furnish sleeves for dowel bars meeting the contract requirements.

501.02.4 Tie Bars

Furnish Grade 40 deformed steel bars in accordance with Subsection 711.01. The length, size, and spacing of the bars are specified in the contract.

501.02.5 Expansion Joint Filler and Joint Sealing Material

Furnish expansion joint filler and joint sealing material listed on the QPL and in accordance with Subsection 707.01.

501.02.6 Curing Compound

Furnish Type 2 curing compound in accordance with Subsection 717.01.3.

501.03 CONSTRUCTION REQUIREMENTS

501.03.1 Equipment

A. General. Do not begin paving operations until all equipment and tools for the pavement construction are available at the site.

Ensure the equipment is in good mechanical condition, adjustment, design, and capacity.

Adjust, repair, or replace equipment failing to produce the specified work.

Use handling, batching, mixing, and concrete transporting equipment in accordance with Section 551 and the following.

Use batch plants for projects having 300 cubic yards (229.5 m^3) or more PCCP that proportion aggregates and cement by weight using automatic and interlocked proportioning devices.

Use non-agitating hauling equipment with smooth, mortar-tight metal bodies that completely discharge the concrete at a uniform rate without segregation. Provide covers when necessary to prevent the concrete from drying out or being exposed to weather-related moisture.

Use belly-dump trucks only with the Project Manager's written approval.

Remove and dispose of concrete remaining in haul units before reloading with fresh concrete.

B. Stationary Side Forms. Use metal side forms strong enough to resist displacement from concrete and mechanical equipment pressures.

Use flexible or curved forms for curves with 100-foot (30.5 m) radii or less.

Forms must:

1. Hold abutting sections in alignment;
2. Be adjustable for vertical and horizontal curvature;
3. Have a minimum depth equal to the specified concrete edge thickness;
4. Not have horizontal joints;
5. Have a base width greater than or equal to the depth;
6. Have at least 3 staking points for each 10 feet (3 m) of length that securely lock to the form stake; and
7. Have flange braces and staking pockets that extend outward on the base at least ⅔ the height of the form.

Use wooden forms only with the Project Manager's written approval. Include in the request to use wooden forms complete details showing they meet the requirements for steel forms regarding strength, lines, grades, and depth.

Do not use forms in poor condition in the work. Repaired forms must be inspected and approved before use.

C. Placing, Consolidating, and Finishing Equipment. Place, consolidate, and finish concrete in accordance with Section 551.

Operate only rubber-tired equipment on adjacent pavement. Pad crawler units to prevent pavement damage.

Keep the adjacent pavement and form tops clean to provide good contact with tires or crawler units.

1. Slip-form Pavers. Use slip-form pavers having automatic controls for longitudinal and transverse grade from continuous wire control lines.

Maintain the control wire tension, support interval, and sensor operating pressure to prevent control wire deflection in excess of $^{3}/_{16}$-inch (5 mm) below supports at mid-span. Immediately stop paving operations when deflection exceeds $^{3}/_{16}$-inch (5 mm) and resume once corrected.

Use self-propelled slip-form pavers to place and finish the concrete that are capable of negotiating all grades without external tractive force.

Equip the slip-form paver with an auger or other approved strike-off device to distribute the concrete to a uniform depth ahead of the screed.

Use sliding forms that are laterally rigid to prevent spreading.

Use slip-form pavers that consolidate the plastic concrete by internally vibrating the full paving width and depth. Use transverse vibrating units that do not project outside the specified paving section thickness and are positioned ahead of the screed a minimum distance equal to the pavement thickness. A series of longitudinal

vibrating units may be used as an alternate. Vibrators may be the immersed tube type or a series of equally spaced longitudinal vibrating units.

The maximum spacing of each unit in a series of longitudinal units is 24 inches (610 mm) measured center-to-center of the units.

Each vibratory unit must provide at least 7000 vibrations per minute with the amplitude visibly perceptible on the concrete surface within 1-foot (305 mm) of the entire length of the vibrating unit. Equip the paver with a tachometer or other approved device for measuring the actual vibration frequency.

2. **Auxiliary Finishing Equipment.** Use finishing equipment behind the slip-form paver that automatically maintains alignment from an external reference.

   Provide hand floats, edging tools, and other hand-finishing equipment to finish the surface as specified. Steel concrete hand tools are prohibited from being used on the project as a finishing aid.
3. **Stationary Side Form Method.** Submit details for all equipment proposed for spreading, strike-off, consolidating, screeding, and floating before use.
4. **Roadbed Planers.** Equip the roadbed planer with adjustable steel cutting edges mounted in a rigid frame to trim the roadbed to the specified elevation and crown under all operating conditions. The planer wheels must ride on the forms or adjacent pavement.
5. **Concrete Spreaders.** Use a self-propelled spreader that uniformly spreads the concrete between forms and has an adjustable blade or head for striking off the concrete to the required height and crown.
6. **Vibrators.** Use full-width concrete slab vibrators of the surface pan type or the internal type with immersed tube or multiple spuds.

   The vibrators may be mounted on the spreader, the finishing machine, or on a separate carriage.

   Do not allow the vibrators to come in contact with the joint load transfer devices, the subgrade, or side forms.

   Use vibrators in accordance with the following:
   - Surface vibrators having a minimum frequency of at least 3,500 impulses per minute.
   - Tube vibrators with a minimum frequency of at least 5,000 impulses per minute.
   - Spud vibrators with a minimum frequency of 7,000 impulses per minute.
   - Hand-operated or machine-mounted spud-type internal vibrators next to forms having a minimum frequency of 3,500 impulses per minute.
7. **Bridge Deck Finishing Machines.** Use transverse-finishing rotating drum bridge deck finishing machines when stationary side forms are allowed.
8. **Mechanical Floats.** Use mechanical floats that produce a surface true to the required crown and smoothness, free from honeycomb or excessive mortar.

   Ensure the float makes accurate incremental adjustments to the required crown without interrupting the float operation.

   The mechanical float may be self-propelled or attached to the rear of the transverse finishing machine.

501.03.2 Pre-paving Conference

Attend a pre-paving conference, conducted by the Department, to be held at least 24 hours before paving starts.

The conference topics will include equipment, construction methods, specification requirements, and lines of communication.

The conference must include the foreman, other Contractor personnel that will supervise the concrete paving operations and key Department inspection personnel.

501.03.3 Aggregate Sampling and Testing

Furnish aggregates that meet the gradation requirements, fineness modulus, and deleterious material limits specified in Subsection 701.01. Provide all sampling and testing to meet these requirements during aggregate production.

501.03.4 Aggregate Production

Produce aggregate in accordance with Section 551.

Produce and stockpile at least ⅓ of the quantity of each size aggregate necessary to produce the plan quantity of PCCP before paving operations begin.

501.03.5 Acceptance of Aggregate

A. Sampling and Testing. The Project Manager will determine when samples are taken and will test the aggregate for acceptance.

Furnish and operate the aggregate sampling devices, witnessed by the Project Manager. Take samples at a point immediately before the aggregates are combined and enter the mixer, witnessed by the Project Manager. Samples may be split to a minimum 50 pounds (23 kg). Furnish the samples to the Project Manager immediately after sampling.

Acceptance samples will be randomly selected.

The approximate quantity represented by each sample is specified in MT 601.

Additional samples may be selected and tested.

B. Lot Size. The concrete quantity in each day's production constitutes a lot whenever production schedules and material continuity permit.

The Project Manager may establish a lot consisting of the quantity represented by any number of consecutive random samples from 3 to 7 inclusive if the Project Manager determines it is necessary due to production runs, significant material changes, or other unusual characteristics of the work.

C. Acceptance. PCCP is evaluated for price adjustment on a lot-by-lot basis in accordance with Subsection 105.03.2, when deviation from specified aggregate gradation limits, fineness modulus limits for fine aggregate, or percent passing the No. 200 (0.075 mm) sieve for coarse aggregate occurs on 1 or more tests for a lot.

Payment for a lot where a price reduction applies in accordance with Subsection 105.03.2 is calculated using the following formula:

Price Reduction = Contract Unit Price x 0.40 x P/100 x Lot Quantity

Where:

P = the percent reduction in contract unit price as defined in Subsection 105.03.2.

Lot Quantity = the plan quantity in cubic yards (m^3) or square yards (m^2) of the pavement section where the lot was placed.

501.03.6 Mixing

Mix concrete in accordance with Subsection 551.03.3.

501.03.7 Transporting Concrete

Transport concrete in equipment in accordance with Subsections 501.03.1 and 551.03.4.

501.03.8 Placing and Finishing Concrete

Submit a plan for placing and curing PCCP to the Project Manager for approval a minimum of 15 business days before the start of paving work. Include specific detail of joint layout at manholes, water valves, drop inlets, monument boxes and other structures in the PCCP section.

Place and finish concrete using either the slip-form method or the stationary side form method using bridge deck finishing equipment.

Place the fresh concrete on the prepared roadbed as close as possible in front of the paving machine to minimize concrete handling. Do not routinely use front-end loaders or other equipment at the paver for moving the fresh concrete once it's placed on the roadbed.

Place concrete hauled in non-agitating equipment within 45 minutes from when the ingredients were charged into the mixer. Dispose of concrete hauled in non-agitating equipment that does not meet slump requirements at Contractor expense.

Place concrete hauled in agitator trucks within the time limits in Subsection 551.03.4(A).

Distribute the concrete to the specified slab thickness, with the finished surface at the specified grade, once the concrete is consolidated and finished.

Do not use vibrators to distribute concrete.

Place concrete only after the foundation course or subgrade has been approved by the Project Manager.

Prepare the foundation course ahead of the paving operation equal to the anticipated daily production.

Place concrete around manholes or other structures once the structures are brought up to the required grade and alignment.

Dampen the base or subgrade with a fine water mist immediately before placing concrete. Do not permit free-standing water to puddle on the surface.

If concrete placing is delayed or stopped in excess of 1 hour, construct an emergency transverse construction joint as directed.

Except for emergency transverse joints, do not construct a joint at any location other than as directed or specified.

Construct the pavement in full lane widths in a single operation.

Construct longitudinal joints between lanes or sections in accordance with Subsection 501.03.13(F).

Do not place concrete in longitudinal sections until the adjacent slab is 14 days old or has reached a minimum compressive strength of 2,000 psi (13,800 kPa), determined by testing the standard cylinders cured under the same environmental conditions as the slab.

A. Slip-form Method.

1. **General.** Place the concrete with a slip-form paver in accordance with Subsection 501.03.1(C) that spreads, consolidates, screeds, and float-finishes the fresh placed concrete in 1 pass.

   Operate the slip-form paver to maintain a continuous, forward movement. Ensure all concrete mixing, delivering, and spreading provides uniform progress without stopping and starting the paver. If it is necessary to stop the paver, immediately stop the vibrators and tamping.

   Maintain a uniform consistency in the concrete with a slump of 1 to 2-inch (25 - 50 mm).

   The paver may be set to form a 3-inch (75 mm) or less battered edge while maintaining the top riding surface at the specified width.

   Apply additional hand vibration at construction joints as required for consolidation.

2. **Finishing.** Finish the concrete surface to meet Subsection 501.03.14.

Correct any pavement edge slump, excluding specified edging, exceeding ¼-inch (6 mm) before the concrete has hardened.

If the edge slump on any 1-foot (305 mm) or longer length of hardened concrete exceeds 1-inch (25 mm), remove and replace the entire panel between the transverse and longitudinal joints.

Before the initial concrete set, round the pavement edges on each side of the transverse expansion joints, formed joints, transverse construction joints, and emergency construction joints to the required radius. Construct a well-defined, smooth, dense mortar finish radius.

Hand finishing is permitted only for finishing sections with narrow irregular dimensions and to finish any concrete already deposited on the grade should a machinery breakdown occur.

Grind high spots exceeding ¼-inch (6 mm) using approved methods. Fill low spots exceeding ¼-inch (6 mm) with an approved epoxy-bonded grout as directed.

B. Stationary Side Form Method.

1. **Preparation of Subgrade or Foundation Course.** Once the roadbed is finished and compacted in accordance with Section 203, trim, shape, and compact the subgrade or foundation course in accordance with Section 301 to the specified lines, grades, and cross sections.

   Extend the finished subgrade 2 feet (610 mm) beyond each side of the planned pavement width.

   Once the forms are set, re-shape and re-compact all disturbed subgrade or foundation course using rollers or compactors working between the fine grading equipment and the paver.

   Test the subgrade or foundation course in advance of the paver for section and grade using an approved template. Mount the template on visible rollers with the tooth edge conforming to the required shape of the subgrade when riding vertically on the forms. Remove excess material and fill low areas to the finish elevation with subgrade or foundation material and compact to the specified density.

   Maintain the finished subgrade or foundation course in a smooth, compacted, undisturbed condition until the pavement is placed.

   Moisten the subgrade or foundation course as specified in Subsection 501.03.8 when placing the concrete.

2. **Form Setting.** Do not permit the forms to deviate more than ⅛-inch (3 mm) from the true plane of the form face or top. Do not permit the forms to warp, bend, or kink. Clean and oil forms before each use.

   Cut the compacted foundation course or the subgrade to grade providing firm contact for each form for its entire length at the specified grade. Fill low areas to grade in ½-inch (13 mm) lifts or less for 18 inches (455 mm) on each side of the base of the form and compact to the specified density. Settlement or springing of forms under the finishing machine is not allowed.

   The forms will be checked for alignment and grade. Make any corrections before placing the concrete.

   Correct unstable or disturbed forms or foundation courses and re-check the forms.

   Prepare the foundation course and forms ahead of the paving operation equal to the average daily production.

Leave the forms in place at least 12 hours after the concrete has been placed unless earlier removal is necessary to permit sawing of transverse weakened plane joints.

Exercise care in removing forms to avoid damage to the pavement edges.

3. **Strike-off and Consolidation.** Strike-off, screed, and consolidate the concrete with mechanical equipment to the specified crown and cross section providing a uniform surface texture. Avoid prolonged work over any area.

   Maintain a uniform ridge of concrete ahead of the front screed of the finishing machine except when making construction joints.

4. **Floating.** Following strike-off and consolidation, finish the concrete surface with a mechanical float in accordance with Subsection 501.03.1(C)(8).
5. **Finishing.** Finish the concrete surface to meet Subsection 501.03.14(A) or (B).

C. **Final Surface Finish.** Hand-float the surface only as needed to produce a uniform surface and sharp corners. Adding finishing water to unfinished concrete is prohibited. Do not use excess mortar to build up slab edges or round the slab corners. Before the concrete's initial set, work the pavement edges along each side of transverse isolation joints, transverse construction joints, and fixed forms to produce a ¼-inch (6 mm) continuous radius and a smooth, dense mortar finish. Check the surface of the fresh concrete with a long-handled straightedge that is 10 feet (3 m) or longer. Remove high areas indicated by the straightedge.

D. **Texturing.** After surface finishing, texture all concrete surfaces within the travel lanes. Use either hand operated or mechanical tools to produce a uniform texture that conforms to the dimensions shown in the contract.

For artificial carpet and burlap drag, furnish carpet or burlap that is long and wide enough to cover the entire pavement width and that produces a uniform texture. Clean drag periodically to remove encrusted mortar or replace with new burlap or carpet.

Meet an average surface texture of 0.040 to 0.060-inch (1 - 1.5 mm), as measured by MT 113 (sand patch test).

If repair of high spots or low spots results in surface texture loss, repair the affected area to the specified texture at the Contractor's expense.

1. **Design Speed Greater than 50 MPH (80 km/h).** Produce the final surface finish with transverse tining, followed by longitudinal artificial carpet or burlap drag.

   Space transverse tines randomly as follows:

   - Minimum spacing ½-inch (13 mm);
   - Maximum spacing 1½-inch (38 mm); and
   - No more than 50% of the tines apart by more than 1-inch (25mm).

   Use tines that are ⅛-inch (3 mm) wide, with a tolerance of ± 0.02 inch (± 0.5 mm) and apply them to a depth of ⅛ to ¼-inch (3 - 6 mm) (provided minimum dislodging of the aggregate particles result).

2. **Design Speed Less than 50 MPH (80 km/h).** Produce the final surface finish by broom texturing, followed by a longitudinal artificial carpet or burlap drag.

   Produce a uniform texture with corrugations $^{1}/_{16}$-inch (1.5 mm) deep.

501.03.9 Protection of Concrete from Rain

Maintain materials at the project site to protect all un-hardened concrete surfaces from rain.

When rain appears imminent, stop paving operations and cover all surfaces of the un-hardened concrete with the protective covering.

501.03.10 Evaluation and Repair of Rain-damaged Concrete

Follow *The American Concrete Paving Association Technical Bulletin No. 17* for the evaluation of and acceptable repair methods for rain-damaged concrete.

All protective, remedial, and corrective work to produce acceptable pavement is at Contractor expense.

501.03.11 Curing

A. Membrane. After the concrete is finished and the free water has left the surface, seal the entire surface area by machine spraying a uniform application of curing compound in accordance with Subsection 501.02.6.

Apply the curing compound following the manufacturer's recommendations before surface hair checking develops.

Do not apply curing compound to the inside faces of joints to be sealed.

If the groove coverage is not complete after the first application, apply a second coverage in the opposite direction from the first. Apply the second application within 30 minutes of the first application.

Ensure the equipment controls the curing compound application rate and uniformity. Use the coverage rate of 1 gallon per 150 square feet (0.27 L/m^2) or follow the manufacturer's recommendations.

Re-apply membrane curing compound to areas protected for less than 72 hours and that are damaged by sawing, rain, or other causes.

B. Other Methods. The Contractor may submit for approval, other curing methods.

501.03.12 Handling and Placing Reinforcement

Keep reinforcing steel clean, rust free, straight and distortion free, placed and held in position as specified.

Store reinforcing steel out of the weather, distributing only the steel needed for immediate placing within the work.

Assemble and place reinforcement for bar mats as specified. Maintain bar mat placement during concreting operations. Tie all intersections. Lap all adjacent ends at least 40 bar diameters.

501.03.13 Joints

Construct the joints as shown in the contract. Submit an alternate plan for longitudinal and transverse joint layout with details that are determined by Contractor sequencing to the Project Manager for approval a minimum of 15 business days before the start of paving work.

A. Transverse Expansion Joints. Construct transverse expansion joints in accordance with the contract.

B. Expansion Joints at Structures. Construct and seal joints between concrete approach slabs and structures or concrete pavement as specified.

C. Transverse Construction Joints. Make transverse construction joints as detailed in the contract, at the end of each day's run, or where concrete work is interrupted for more than 1 hour.

Form the joint using a clean plank cut to the plan cross section with an attached beveled strip to form a key-way. Remove the header and clean excess concrete on the subgrade and joint face before placing fresh concrete against the joint.

D. Transverse Contraction Joints. Saw transverse contraction joints to the specified width, depth, and spacing using a power-driven gang saw with at least 4 separate blades.

Saw initial or "control" transverse contraction joints at 54-foot (16.5 m) intervals or another multiple of the specified joint spacing that reduces uncontrolled cracking with the

least number of initial contraction joints. Saw initial contraction joints as soon as possible after the concrete is placed. Do not permit the saw to tear or ravel the adjacent concrete. Saw the remaining contraction joints typically within 24 to 48 hours after concrete is placed.

Be responsible for determining joint-sawing methods, sequences, and timing to prevent random cracking. Immediately revise methods that cause random cracking. Repair or replace concrete defects resulting from errors in the work methods at Contractor expense.

Repair or replace broken slabs, random cracks, nonworking contraction joints near cracks, and spalls along joints and cracks in accordance with Subsection 501.03.15.

Protect saw cuts in concrete 60 hours old or less from rapid drying using twisted paper, fiber or rope cords, waterproof covering, or other approved methods.

Have at least one stand-by saw in good condition and additional saw blades at the job site during sawing operations.

Cut curbs and gutters to the required depth to prevent erratic cracking.

Immediately after the joints are sawed, flush the groove with pressurized water and blow the groove out with compressed air to remove all dust, water, and slurry. Clean the groove using compressed air just before filling with joint filler.

Place hot-poured joint sealer in sawed joints to within ¼ to $^{3}/_{16}$-inch (6 - 5 mm) of the pavement surface when the pavement temperature is at least 40 °F (4 °C).

Do not use polyethylene strips to form transverse contraction joints.

E. Longitudinal Joints. Saw longitudinal joints to the specified width and depth within 3 days of placing the concrete.

Do not use plastic tape as a joint sealer.

Saw and apply hot-poured joint sealer in accordance with Subsection 501.03.13(D).

Ensure the finished joint alignment is parallel to the centerline of the pavement and does not have irregularities exceeding 0.04-foot (12 mm), measured by a 12-foot (3.6 m) straightedge, except for normal centerline curvature.

F. Key-way Longitudinal Joints. Construct key-way joints as specified when adjacent pavement slabs are constructed separately.

501.03.14 Surface Test

Test pavement surfaces in accordance with the following criteria using the straightedge method.

- Sections less than 300 feet (91.5 m) in length.
- Sections within 50 feet (15.2 m) of existing pavements or bridge ends.
- Sections within 50 feet (15.2 m) of intersections requiring warping to match side streets.
- Sections having horizontal curves with a centerline radius less than 1000 feet (305 m) and the superelevation transitions of those curves.
- Sections having vertical curves with L/A (K-value) less than 100 where L is the length of the curve in feet and A is the grade change in percent (L/A less than 30.5 where L is in meters).

Test all other surfaces in accordance with Subsection 501.03.14(B).

A. Straightedge. Once the concrete has hardened, test the pavement surface with a 10-foot (3 m) straightedge placed parallel to the pavement centerline.

Span each low spot and touch each high spot with the testing edge revealing all irregularities.

Correct all pavement showing a variation from the testing edge exceeding $^{1}/_{16}$-inch per foot (2 mm per 305 mm) from the nearest contact point with the testing edge or showing a total variation exceeding ¼-inch (6 mm) from the 10 foot (3 m) straightedge by grinding until the areas are within the above limits.

Where the grinding methods would result in an unsatisfactory surface or in a slab thickness less than specified, the affected pavement may require an adjustment in the contract unit price or removal and replacement in accordance with Subsection 501.03.20.

B. Profilograph. Furnish a 25-foot (7.6 m) wheel base California type profilograph and a competent operator to measure the surface smoothness before joint sealing. Do not exceed a maximum 3 mph (4.8 km/h) operational speed. Calibrate, adjust, and operate the profilograph following the manufacturer's instructions and California Test Method 526.

Provide the Project Manager 24 hours advance notice before using the profilograph. The Project Manager will witness all profilograph recordings. The profilogram must record a scale of 1-inch to 25 feet (25 mm to 7.6 m) longitudinally and 1-inch to 1-inch (25 mm to 25 mm) vertically. Take a profile on a line parallel to and 3 feet (0.9 m) inside the outside edges of each traffic lane. Run the profilograph parallel to the pavement edge at all times. Additional profiles may be taken to define the limits of an out-of-tolerance surface. The Project Manager will determine the profile index using California Test Method 526.

Calculate an average profile index in 0.1-mile (161 m) lane segments, and segments greater than 300 feet (91 m) with no adjacent lanes. If a segment less than 0.1 mile (161 m) remains for a lane, that segment will be combined with the adjacent segment for an average profile index.

Perform corrective work when the lane average profile index exceeds the value specified in Table 501-1. Remove all high points in excess of 0.3-inch (8 mm) in 25 feet (7.6 m) or less using a method approved by the Project Manager. Re-profile corrected areas to demonstrate that the segment is acceptable.

Use the following definitions for Category 1 and Category 2 surfaces. Category 1 surfaces are through lanes with a speed limit of 45 mph or greater. Category 2 surfaces include ramps, acceleration lanes, turn lanes, and all other lanes not meeting the criteria of Category 1. Lane segments containing both Category 1 and Category 2 criteria will be evaluated as Category 2.

Contract unit price adjustments are made following Table 501-1. The Contractor may elect to perform corrective work to reduce the average profile index when it is less than the corrective index but greater than the incentive index. Incentive will not be paid on sections with an initial index requiring corrective work.

TABLE 501-1
CONTRACT UNIT PRICE ADJUSTMENT

English		
Lane Average Profile Index (Inches per Mile-per 0.1 Mile)		**Contract Unit Price Adjustment**
Category 1	**Category 2**	
Less than 6	Less than 6	$0.50 per square yard incentive pay
6 to 10	6 to 14	Contract unit price
10 to 15	14 to 20	$1.00 per square yard deduction
Over 15	Over 20	Corrective work required
Metric		
Lane Average profile Index (mm per 1.6 km-per 161 m)		**Contract Unit Price Adjustment**
Category 1	**Category 2**	
Less than 150 mm	Less than 150 mm	$0.60 per square meter incentive pay
150 mm to 255 mm	150 mm to 355 mm	Contract unit price
255 mm to 380 mm	355 mm to 510 mm	$1.20 per square meter deduction
Over 380 mm	Over 510 mm	Corrective work required

The price adjustment applies to the entire area of concrete for the lane segment, calculated using the plan lane width.

No payment is made for any section with an average profile index exceeding the corrective index until it is re-worked and re-profiled to an acceptable profile index. Re-profiled areas are not subject to incentive pay.

Complete all corrective work before measuring the pavement thickness.

Include all profilographing costs in the contract unit price for PCCP.

Perform all pavement corrections at Contractor expense.

501.03.15 Correcting Spall and Cracks

Remove and replace pavement slabs cracked through the full depth into 3 or more parts.

Repair pavement slabs containing a single diagonal crack intersecting the transverse and longitudinal joints within ⅓ of the width and length of the slab from the corner by removing and replacing the smaller portion of the slab. Repair broken slabs as directed.

Groove and seal random cracks that penetrate the full depth of the pavement. Groove the top of the crack to ¾-inch (19 mm) minimum depth and a width between ⅜ to ⅝-inch (10-16 mm) using an approved grooving machine. Use a vertical rotary-cutting machine that can follow the crack path and widen the top of the crack to the required section without spalling or damaging the concrete. Remove all loose and fractured concrete, and thoroughly clean and seal the groove with the sealant specified in the contract.

The Project Manager will determine what random cracks are tight, don't penetrate the full depth of the pavement and will be left undisturbed. When requested by the Project Manager, determine the crack depth penetration by drilling and inspecting cores at Contractor expense.

When a transverse random crack terminates in or crosses a transverse contraction joint, fill the un-cracked portion of the joint with epoxy-resin mortar or grout, and route and seal the crack.

When a transverse random crack nearly parallels the planned contraction joint and is within 5 feet (1.5 m) from a contraction joint, route, seal, and fill the crack with epoxy-resin grout or mortar.

When a transverse random crack is more than 5 feet (1.5 m) from the nearest contraction joint in the pavement, seal both the joint and the crack. Thoroughly clean the joints before filling with epoxy-resin mortar or grout.

Repair spalls by making a saw cut at least 1-inch (25 mm) outside the spalled area and to a minimum depth of 2 inches (50 mm). When the spalled area abuts a joint, make a saw-cut 2 inches (50 mm) deep or $^1/_6$ the slab thickness, whichever is greater. Chip out the concrete between the saw cut and the joint or primary crack to solid concrete. Thoroughly clean the resulting cavity of all loose material. Apply a prime coat of epoxy-resin binder to the dry, cleaned surface of all cavity sides, except the working joint faces to be retained. Apply the prime coat by scrubbing it into the surface with a stiff bristle brush. Place hydraulic cement concrete or epoxy-resin concrete or mortar immediately following the prime coat application.

For spalled areas abutting working joints or working cracks penetrating full depth, place an insert or other bond breaker to maintain the joint or crack during the patch repair.

501.03.16 Opening to Traffic

Do not permit traffic or Contractor equipment, excluding joint sawing and sealing equipment, on the concrete until flex beam test results indicate the concrete has developed a minimum 350 psi (2,415 kPa) modulus of rupture.

Prepare the concrete flex beams in accordance with MT 101 and test for modulus of rupture using AASHTO T 97.

One test set consists of 3 beams. Take the concrete for the test beams from different concrete batches for each 2,500 square yards (2,100 m^2) of concrete pavement and make at least 2 sets per day. Test the beam sets for modulus of rupture. Cure the test beams under the same environmental conditions as the pavement they represent. The pavement, represented by the beams, may be opened to traffic when the average modulus of rupture of the set exceeds 350 psi (2,415 kPa) and no individual beam's modulus of rupture is less than 300 psi (2,070 kPa).

The Contractor may select the time for testing the beams. Test the flex beams on or near the project, using Contractor furnished equipment and with a Department Inspector witnessing the tests.

Include all costs to make, cure and test the flex beams in the contract unit price for PCCP.

Opening to traffic does not constitute a final acceptance of the pavement. The pavement is accepted upon confirmation of the 28-day flexural strength. Repair all concrete damaged prior to the final acceptance at Contractor expense.

501.03.17 Integral Curb

Construct the curb monolithically with the pavement.

Construct the inside face of the curb true to the lines and grades in the contract using the finish specified for the concrete pavement, including longitudinal floating and burlap drag finishing.

Test the surface for longitudinal trueness with a straightedge while the concrete is still plastic. Meet the same surface requirements specified for the concrete pavement.

Continue concrete pavement joints through the integral curb at the same locations, of the same type, and constructed in the same manner.

Cure the integral curb as specified for concrete pavement.

501.03.18 Weather and Night Limitations

Place concrete at night only with the Project Manager's written approval.

Stop concrete work when the ambient temperature falls below 40 °F (4 °C) and do not resume until the ambient air temperature reaches 35 °F (2 °C) and is rising.

Do not place concrete on a frozen foundation course or subgrade.

Remove and replace all concrete damaged by frost at Contractor expense.

501.03.19 Protection of Concrete

Cover the concrete with an approved commercial insulating blanket, covering all pavement if the ambient temperature falls below 35 °F (2 °C) during the cure period. Leave in place for 7 days.

The Project Manager may direct the leaving the blanketing in place beyond the 7-day curing period.

501.03.20 Pavement Thickness

Construct concrete pavement to the specified thickness. Pavement not meeting the required thickness will be subject to replacement in accordance with Subsection 501.03.20(B) or to the price adjustments according to Table 501-2. Tolerances allowed for subgrade or base course construction do not modify the thickness requirements.

A primary unit of pavement is the pavement area placed in each day's paving operations. Within each primary unit there may be several secondary units as specified in 501.03.20(B)(2).

A. Thickness Verification.

1. **Survey Method.** Thickness measurement locations will be determined by random sampling in accordance with MT 606. A minimum of 10 random locations will be tested for each 12,000 square feet (1,115 m^2) of pavement placed within the primary unit. Elevations will be recorded to the nearest 0.01-foot (3 mm). Measurements will be taken as follows:

   The locations will be selected on the finished surface before paving and at the same location on the finished concrete surface.

   The thickness variation will be determined by subtracting the planned thickness from the constructed thickness at each surveyed location. Variations exceeding the planned thickness will be considered as a 0.00 feet (0.0 mm) deviation in the average. The average of the measurements will represent the variation for that primary unit.

2. **Coring Method.** The Project Manager reserves the right to verify the thickness or resolve discrepancies by coring using MT 106, recording that measurement to the nearest 0.01-foot (3 mm). Fill core holes with concrete of the same quality as used for the pavement at no cost to the Department.

B. Thickness Deficiency.

1. Variation less than or equal to 0.07-foot (21 mm). If the thickness variation in a primary unit is less than 0.07-foot (21 mm), a deduction will be applied in the amount determined in Table 501-2 times the area of pavement in the primary unit. No incentive or contract adjustment will be allowed for constructed thicknesses exceeding the planned thickness.

TABLE 501-2
CONCRETE PAVEMENT THICKNESS DEFICIENCY

Pavement Greater Than 5 inches (127 mm)		
Average Thickness Deficiency		Price Deduction (%)
Feet	mm	
0.02	6	0
0.03	9	20
0.04	12	32
0.06	18	43
0.07	21	50

Average thickness deficiencies greater than 0.02-foot (6 mm) are rounded to the nearest 0.01-foot (3 mm) and the deficiency adjustment made using Table 501-2.

2. Variation greater than 0.07-foot (21 mm). For each section in a primary unit with a thickness variation greater than 0.07-foot (21 mm), the Project Manager will determine the dimensions of the secondary unit area. The secondary unit is made up of entire panels only. Panels are the areas bound by longitudinal and transverse joints and pavement edges.

C. Acceptance. The Project Manager will randomly measure the thickness in each panel adjacent to the panel(s) in the primary unit which exceeded 0.07-foot (21 mm), by either the survey method or MT 106. Measurements are taken in each panel until the panels which exceed 0.07-foot (21 mm) are isolated. The Project Manager will determine which panel(s) will require replacement and which may remain in place when the limits of the secondary unit have been defined. Acceptance will be in accordance with procedures (a) or (b) below:

a. Remove and replace the deficient panels at Contractor expense with new concrete. If the area to be removed is not bounded by longitudinal or transverse joints, saw the weakened plane joints at Contractor expense at the locations designated by the Project Manager. Lower the subgrade or base to meet the full thickness requirements. Replaced pavement will be tested for thickness requirements using additional secondary measurements and is subject to all of the contract requirements.

b. The Contractor may leave deficient pavement panels in place if the panels meet all of the other contract requirements. A deduct equal to 50% of the contract unit price per square yard (m^2) will be imposed for those pavement panels left in place. The Department may deduct that amount from any monies due or that may become due the Contractor in accordance with the contract. The decision to leave a deficient panel in place will be by contract modification in accordance with Subsection 105.03.

The cost of all secondary thickness measurements made under this subsection will be deducted from any monies due or that may become due the Contractor in accordance with the contract.

After isolating the secondary unit area(s) from consideration, the average thickness deficiency of the remainder of the primary unit areas will be determined in accordance with Subsection 501.03.20(B)(2). Secondary measurements made outside of a secondary unit area will be used to determine an average in the remaining primary unit area in which the measurements are taken.

No contract adjustment will be allowed for meeting these requirements.

501.03.21 Accelerated Paving Techniques

Submit a request with details for any proposed accelerated paving techniques to the Project Manager a minimum of 7 calendar days before use. Accelerated paving techniques may include but are not limited to; admixtures, cement, alternative curing methods, sawing methods, and joint sealing.

501.04 METHOD OF MEASUREMENT

Furnishing and installing all tie bars, dowels, setting and maintaining wire control lines, sawing longitudinal and transverse joints, sealant, reinforcing steel, accelerated paving techniques, and testing for opening to traffic is not measured for payment. Include all costs in the unit price of PCCP.

501.04.1 Area Measurement

PCCP is measured by the square yard (m^2).

The measured width is from outside to outside of completed pavement including integral curb, not exceeding the specified width or the width ordered by the Project Manager.

The length is measured along the centerline of the pavement surface.

Fillets for widened sections or at drainage structures and similar locations placed monolithic with the pavement are measured as pavement.

Areas constructed other than as pavement are deducted from the pavement area. No deduction is made for any fixture located within the pavement limits that has a surface area in the plane of the pavement surface of 1 square yard (0.80 m^2) or less.

Integral curb included in the completed pavement is not measured separately for payment.

501.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Cement Concrete Pavement	Square Yard (m^2)

Payment at the contract unit price is full compensation for resources necessary to complete the item of work in accordance with the contract.

SECTION 551
HYDRAULIC CEMENT CONCRETE

551.01 DESCRIPTION

These are the general requirements for designing hydraulic cement concrete mixtures, the ingredients, mixing, transporting, placing, curing, testing and acceptance for all classes and uses of hydraulic cement concrete.

551.02 MATERIALS

Provide cementitious materials and admixtures from sources listed on the QPL.

551.02.1 Cement

Furnish low-alkali hydraulic cements meeting the following requirements as specified in the contract:

- **A.** Furnish low-alkali portland cement in accordance with AASHTO M 85, Type I, II, III, or V.
- **B.** Furnish low-alkali hydraulic blended cement in accordance with AASHTO M 240, Type IP or IS. When fly ash or ground granulated blast furnace slag (GGBFS) is used in blended cement, limit the replacement amount to the maximums specified in Subsections 551.02.2 and 551.02.3 respectively.
- **C.** Furnish low-alkali hydraulic cement in accordance with ASTM C1157, Type GU, HE, MS, HS, MH, or LH.
- **D.** Meet the following requirements for all types of cement:
  - **1.** The total alkali content does not exceed 0.6%, calculated as the percentage of sodium oxide (NaO) plus 0.658 times the percentage of potassium oxide (K_2O).
  - **2.** Use only 1 brand of any 1 type of cement on the contract except by written approval from the Project Manager. Different brands or grades, if approved, cannot be used alternately in any 1 pour.
  - **3.** Do not use air-entraining cements.

551.02.2 Fly Ash

When included in the mix design, furnish fly ash in accordance AASHTO M 295, Class C or F, including optional chemical requirements as set forth in Table 2.

551.02.3 Ground Granulated Blast Furnace Slag (GGBFS)

When included in the mix design, furnish GGBFS in accordance with AASHTO M 302, Grade 100 or Grade 120.

551.02.4 Microsilica Fume (Silica Fume)

When included in the mix design, furnish microsilica in accordance with AASHTO M 307.

551.02.5 Admixtures

When included in the mix design, furnish admixtures in accordance with AASHTO M 194. Ensure that the total contribution of chloride ions from all admixtures and air-entraining agents does not exceed 50 parts per million chloride ions (Cl-) by weight of cementitious material. All admixtures must be compatible with other constituents including cement, silica fume, GGBFS, fly ash, and other admixtures. Dose all chemical admixtures according to manufacturer's recommendations unless trial batches provide adequate information for different dosage rates.

551.02.6 Air-entraining Agents

Include an air-entraining agent in the mix design unless otherwise specified. Furnish an air-entraining agent in accordance with AASHTO M 154.

551.02.7 Water

All water used for concrete other than a potable municipal source must be tested according to ASSHTO T 26 for acidity, alkalinity, and solids. Water must also be tested for chloride content according to ASTM D512 and sulfate content according to ASTM D516. Furnish test results with the mix design submittal. Ensure the water does not contain oil, acid, alkali, vegetative matter, and is not brackish or salty. Any water source not in accordance with Table 551-1 will be rejected.

TABLE 551-1
WATER REQUIREMENTS

Requirement	Limit
Acidity, maximum amount of 0.1N NaOH to neutralize 200 mL of water	2 mL
Alkalinity, maximum amount of 0.1N HCL to neutralize 200 mL of water	10mL
Maximum sulfate ($S0_4$)	0.05%
Maximum chloride	0.06%
Maximum solids organic	0.04%
Maximum solids inorganic	0.15%
pH level between 4.5 and 8.5 (note 1)	

Note 1: Water outside pH range may be used if there is no indication of unsoundness, no significant change in the time of setting, and cubes vary no more than 10% in compressive strength against those of concrete cubes made with water of known quality. The concrete cubes must be cast, cured, and tested for compressive strength in accordance with AASHTO T 106.

551.02.8 Aggregate

Furnish aggregates in accordance with Subsection 701.01.

551.02.9 Storage of Materials

A. **Cementitious Materials.** Store all bulk cementitious materials in metal silos, bins, or other approved storage. Provide storage facilities that permit convenient sampling and inspection. Store all sacked cementitious materials in weatherproof buildings or, if approved, in the open on raised platforms with waterproof covering. Partially set, caked or lumpy cementitious material will be rejected.

B. **Aggregates.** Store aggregates in compartmented bins, or other methods that separate the different aggregate sizes to prevent contamination and segregation. Suspend work until aggregate contamination or segregation is corrected.

Build up aggregate stockpiles in a manner that avoids contamination and segregation. Re-mix segregated aggregate to the grading requirements at Contractor expense.

When ready-mixed concrete is furnished, the ready-mix producer's stockpiled aggregates must meet all aggregate specifications. Establish separate stockpiles for Department work if existing stockpiles do not meet specifications.

Do not use contaminated or segregated aggregate removed from stockpiles in the work.

Handle all aggregates to prevent segregation and to obtain uniformity of materials. Pile separated aggregates and aggregates secured from different sources in separate stockpiles. Provide sites which are level, firm and free of all foreign materials for the stockpiles. If aggregates are placed directly on the ground, do not use material within 6 inches (150 mm) of the ground level. Leave this material undisturbed to avoid contaminating the aggregate being used with the foreign material.

551.03 CONSTRUCTION REQUIREMENTS

551.03.1 Classification

Design and produce concrete using the classifications defined in Table 551-2.

TABLE 551-2
CONCRETE CLASSIFICATION

Class	Use
General	General use concrete. Used for sidewalks, curbs, and slope protectors. Also used in precast products.
Structure	Used for structural concrete. (Use for all sub-structural work.)
Deck	Used for all superstructure concrete, deck slabs and barriers.
Overlay	Used on bridge deck overlays.
Pave	Used for concrete pavement, streets and highways.
PRE	Used in all prestressed items.
Controlled Low Strength Material (CLSM)	Used for bedding, encasement, and general backfill. (flowable fill, density fill, flowable mortar, slurry cement backfill.)
Drilled Shaft	Used for drilled shafts and piles.
SCC	(Self-consolidating concrete) Used for precast, drilled shafts, and aesthetic structural components.

551.03.2 Composition of Concrete

Design and produce concrete in accordance with Table 551-3.

TABLE 551-3
CONCRETE REQUIREMENTS

Class	Nominal Maximum Aggregate Size inches (mm)[11]	Maximum Cementitious Materials Content, lbs./yd^3 (kg/m^3) [13]	Indicated Compressive Strength, 7-Day, PSI (MPa)	Minimum Required Compressive Strength, 28-Day, PSI (MPa)[7]	Maximum Water / Cement Ratio (W/C)[7]	Maximum Target Value for Slump, inches (mm)[3]	Slump Tolerance, inches (mm)	Required Air Content, (%)[9]
General[10]	1½ (37.5) - ¾ (19)	658 (390)	—	4000 (28)	0.45	5 (130)	± 1 (25)	5.5-8.5
Pave[1]	1½ (37.5) - ¾ (19)	658 (390)	Note 5	4000 (28)	0.45	3 (75)	± 1 (25)	5.5-8.5
Pre[2]	¾ (19)	—	—	Note 2	0.40	—	—	—
SCC	¾ (19)	—	—	Note 6	0.42	See Special Requirements for SCC Concrete		5.5-8.5
Deck	¾ (19)	564 (334)	Note 4	4000 (28)	0.42	5 (130)	+1½ (37) to -2 (50)	5.5-8.5
Overlay-SF	½ (12.5)	580 (344)	Note 12	4000 (28)	0.42	5 (130)		5.5-8.5
Overlay-LM	½ (12.5)	660 (392) min	Note 12	4000 (28)	0.30 - 0.40	5 (130)		3.0-6.5
Structure	1½ (37.5) - ¾ (19)	580 (344)	Note 4	4000 (28)	0.42	6 (150)	± 1 (25)	5.5-8.5
Drilled Shaft	¾ (19)	—	Note 4	4000 (28)	0.45	See Special Requirements for Drilled Shaft Concrete		—

Notes:

1. For concrete pavement, the 28-day flexural strength requirement is 500 psi (3.5 MPa) minimum, determined by AASHTO T 97.
2. The strength for transfer of pre-stress and the 28-day strength requirement vary with beam length and design. Check plans and specifications for eac project.
3. The designed target value for slump may be changed, within requirements, when necessary to facilitate proper placement.
4. Compressive strength must be 80% of the design strength before form removal.
5. For full-depth concrete pavement, the flexural strength requirement to open to traffic is 350 psi (3.5 MPa) minimum determined by AASHTO T 97 or 3500 psi (24 MPa) compressive strength.
6. For self-consolidating concrete, the 28-day strength may vary with the class of concrete specified. Check plans and specifications for each project.
7. Maximum water cement ratios and minimum 28-day design strength requirements do not relieve the contractor of supplying concrete producing adequate freeze-thaw protection.
8. Mix designs with other nominal maximum aggregate sizes may be requested based on certain placement and design scenarios.
9. If 1½-inch (37.5 mm) nominal maximum aggregate is used in the design, the air content requirement is reduced to 4.5% - 7.5%.
10. When class General is specified for seal concrete, air entrainment is not required.
11. Nominal Maximum aggregate size is defined as one sieve size larger than the first size to retain more than 10%.
12. Compressive strength must reach a minimum of 3,000 psi (21 MPa) before opening to traffic.
13. When high-early strength concrete is required by contract, higher cement contents may be submitted for approval.

Furnish the names of proposed suppliers and locations of proposed aggregate sources upon notice of award. Sources must be sampled, tested, and approved annually.

Coordinate with the Project Manager for submitting samples for testing.

A. Design. Design the concrete mix as follows:

1. Submit a concrete mix design for each class of concrete to be used on a project. Meet all the requirements of MT 100.
2. Design the concrete mix to meet Table 551-3 requirements or the requirements stated below for specific classes of concrete. State the design proportions in terms of aggregates in a saturated, surface dry condition. Submit the proposed aggregate source and proportion computations. Submit a final mix design for approval at least 15 business days before intended use on form MTPCC-1.
3. Furnish materials meeting the requirements of Subsection 551.02.
4. Submit a new design when proposing any change in material sources.
5. The following supplementary cementitious materials (SCMs) may be used as partial replacement for hydraulic cement in the mix design.
   - **a.** Fly ash may be included in the mix design for up to 30% by weight of the total cementitious material. Combinations of various classes of fly ash may not exceed 30% by weight of the total cementitious material.
   - **b.** Microsilica Fume may be included in the mix design for up to 10% by weight of the total cementitious material when a minimum of 15% fly ash or GGBFS is also included in the mix design or when the mix design incorporates acceptable blended cement.
   - **c.** Metakaolin may be included in the mix design for up to 20% by weight of the total cementitious material.
   - **d.** Ground granulated blast furnace slag may be included in the mix design for up to 50% by weight of the total cementitious material.

   When multiple SCMs are used in a design, the total replacement rate may not exceed 50% by weight of the total cementitious material.

   Calculate the W/C ratio as the total weight of water divided by the total weight of cementitious material.
6. Blended cements in accordance with Subsection 551.02 may be used in the mix design.
7. When Type V cement is specified for sulfate resistance, other cementitious material mixtures tested in accordance with ASTM C1012 may be submitted for approval. Acceptance will be based on expansion less than 0.10% at 18 months.
8. The mix design may include provisions that address special conditions of the project that would otherwise not be allowed. The following provisions may be included in the mix design:
   - **a. Delayed Initial Set.** The mix may be designed for delayed set time to allow for long haul or other project conditions. When delayed set is included in the mix design, the time requirements for placing the concrete in final position in accordance with Subsection 551.03.4 may be replaced by time to final placement requirements included in the mix design. Include in the mix design information on the delayed set provisions of the design and specific time to final placement requirements. Support the time to final placement with test results from trial batches.
   - **b. Slow Strength Gain.** The mix design may include cementitious materials or other admixtures that result in slow strength gain. When a slow strength gain is included in the mix design, include a recommendation for the age in days at which the

strength will be obtained. The recommended age must be no less than 28 days and no more than 56 days. Support this recommendation with test results from trial batches. Upon acceptance, the recommended age will be used in all provisions that refer to 28-day strength.

B. Class Deck and Overlay-SF. Design and produce class Deck and Overlay-SF concrete in accordance with Table 551-3 and the following:

- Include silica fume and fly ash or GGBFS as SCMs in combination with compatible air entraining, water reducing and/or super-plasticizing admixtures. SCMs replacement quantities must meet the requirements of Subsection 551.02.
- Mix requires trial batch rapid chloride permeability test results in accordance with AASHTO T 277 less than 1500 coulombs at 28 days or surface resistivity test results in accordance with AASHTO TP 95 greater than 35 kilohm-centimeters at 28 days.
- Submit a batching sequence procedure with the mix design including the amount of material charged and the time before the next material will be added. Include approximate mixer revolutions for each stage of the sequence.

Alternative mix designs not in accordance with Table 551-3 may be accepted provided the following requirements are met:

1. Include in the design compressive strength test results according to AASHTO T 22 for 3, 7, and 28 days. The design must produce strengths in accordance with Table 551-3 by the specified age.

2. Include in the mix design shrinkage test results according to AASHTO T 160. The maximum allowed shrinkage for mix design acceptance is .0300% at 28 days.

3. Include in the mix design rapid chloride permeability (RCP) test results according to AASHTO T 277. The design must demonstrate a maximum of 1500 coulombs at 28 days. Alternatively, include in the mix design test results according to AASHTO TP 95, surface resistivity indication of concrete's ability to resist chloride ion penetration. The design must demonstrate a minimum of 35 Kilohms-centimeters at 28 days.

4. Include in the mix design creep test results at 28 days according to ASTM C512.

5. Include in the mix design modulus of elasticity (MOE) results according to ASTM C469.

6. Include in the mix design air-void spacing results according to ASTM C457 modified point-count method at 100x magnification. The average of all tests must not exceed 0.009 inches (0.230 mm) with no single test greater than 0.010 inches (0.260 mm). The total air content must exceed 5.5%.

7. Design and produce concrete maintaining a plastic air content of 5.5% - 8.5%.

8. Submit a batching sequence procedure with the mix design including the amount of material charged and the time before the next material will be added. Include approximate mixer revolutions for each stage of the sequence.

C. Class Drilled Shaft. Drilled shaft concrete is a highly workable concrete that can flow through dense reinforcement and adequately fill voids without segregation or excessive bleeding without the need for vibration. Drilled shaft concrete should not begin initial set until the placement is complete. Design and produce Class Drilled Shaft concrete in accordance with Table 551-3 and the following:

1. Set a target slump that meets the needs of the project. Set the target slump no lower than 8 inches (200 mm). Do not place drilled shaft concrete having a slump of less than 7 inches (175 mm).

2. Include with the mix design an estimate of the maximum time from producing the 1st batch of concrete for a shaft to the anticipated completion of that shaft. All concrete

used for the drilled shaft must maintain a minimum of a 6-inch (150 mm) slump until 2 hours after the estimated completion.

3. Air entrainment may be used in drilled shaft concrete if needed to reduce bleed water or achieve certain placement properties
4. Self-consolidating concrete may be used for drilled shaft mix designs. When used, meet the above requirements and those of Subsection 551.03.2(F).

D. Latex-Modified Overlay Concrete (Overlay-LM). Design and produce overlay-LM concrete in accordance with the following requirements:

1. Use only Type I or Type II hydraulic cement.
2. Furnish concrete with a latex emulsion admixture rate of 25 gallons per cubic yard (123.8 L/m^3). Use a latex admixture containing a polymer of 66% ± 5% styrene and 34% ± 5% butadiene, with the polymer comprising between 46% and 49% of the total emulsion. The emulsion must have a sodium alkyl sulfate stabilizer acting as an anionic surfactant, polymer average particle size between 1,900 and 2,500 angstroms, a weight of 8.43 to 8.52 pounds per gallon (1.01 - 1.02 kg/L) at 75 °F (24 °C), and a pH between 9.5 and 11.0.
3. Protect the latex admixture from temperatures below 32 °F (0 °C) and above 85 °F (29 °C) at all times. Provide a thermometer capable of storing minimum and maximum temperatures and place it with any admixture stored on site. Replace admixture subjected to temperatures outside the range above at no expense to the Department.

E. Controlled Low Strength Material (CLSM). CLSM is a mixture of hydraulic cement, SCMs, aggregate, natural sands, silty sands, air entraining admixture and water. CLSM contains a low cementitious content for reduced strength development. Submit a mix design for approval including aggregate gradations, cement and SCM mill certifications, proportioning, and trial batch information.

1. **Excavatable.** Design and produce excavatable CLSM in accordance with the following requirements:
   - **a.** Unconfined compressive strength between 35 psi and 150 psi (0.24 - 1 MPa) determined by ASTM D4832.
   - **b.** Air content between 5% and 40% determined by ASTM D6023.
   - **c.** Unit weight of 80 – 110 lbs/ft^3 (1,280 – 1,760 kg/m^3) determined by ASTM D6023.
   - **d.** Consistent flow producing a self-leveling product free of segregation determined by ASTM D6103
   - **e.** Do not use coarse aggregate in excavatable CLSM. (Maximum ⅜-inch (9.5 mm) nominal maximum aggregate size designs.)
2. **Non-Excavatable.** Design and produce non-excavatable CLSM in accordance with the following requirements:
   - **a.** Unconfined compressive strength greater than 150 psi (1 MPa) determined by ASTM D4832
   - **b.** Air content between 5% and 30% determined by ASTM D6023.
   - **c.** Unit weight of 100-130 lbs/ft^3 (1,600 – 2,080 kg/m^3) determined by ASTM D6023.
   - **d.** Consistent flow producing a self-leveling product free of segregation determined by ASTM D6103.

   Do not use materials in CLSM with a plasticity index over 4 according to MT 208. Furnish aggregates in accordance with Table 551-4.

TABLE 551-4
CLSM GRADATIONS

Percentage By Weight Passing Square Mesh Sieves	
Sieve Size	**Percent Passing**
¾-inch (19 mm)	100
No. 4 (4.75 mm)	65 - 100
No. 30 (0.600 mm)	40 - 80
No. 200 (0.075 mm)	10 - 30

High air generators or foaming agents may be used in lieu of conventional air entraining admixtures and may be added at the jobsite and mixed in accordance with the manufacturer's recommendation. The requirements for percent air and unit weight are for laboratory mix designs only and are not intended for jobsite acceptance requirements.

Produce a consistent mix that results in a flowable product at the time of placement which does not require manual means to move it into place.

Secure tanks, pipes and other members to be encased in CLSM to prevent displacement during placement.

Protect CLSM from traffic until sufficient strength has been achieved for further construction operations.

The CLSM may be mixed onsite, or at a ready-mix plant and transported to the site. Keep the mix homogeneous and in a suspended condition to prevent settling of the materials prior to placement. Characteristics of CLSM include, consistency, workability, and plasticity such that the material is flowable, self-compacting and self-consolidating during placement.

F. Self- Consolidating Concrete (SCC). SCC is a highly workable concrete that can flow through densely reinforced or complex structural elements under its own weight and adequately fill voids without segregation or excessive bleeding without the need for vibration.

SCC may be used for Classes General (in precast or aesthetic placements only), Structure, and Drilled Shaft concrete. Design and produce SCC in accordance with Table 551-3 and the following:

1. 28 day compressive strength meeting the requirements of the class of concrete specified or established in the contract (e.g. Class Drilled Shaft = 4000 psi (28 MPa)). Many precast designs requiring Class General concrete have varying design strengths.

2. Provide a slump-flow within ± 2 inches (± 50 mm) of the target value, and within the overall range of 18 to 28 inches (450 to 710 mm). Test in accordance with MT 116. When used for a drilled shaft design, include in the design, hourly slump-flow retention testing up to the desired placement time of the shaft.

3. Provide a maximum visual stability index (VSI) of 1 in accordance with AASHTO TP 80.

4. Provide a maximum J-ring value of 2 inches (50 mm) in accordance with AASHTO T 345. When used for a drilled shaft, include in the design, hourly J-ring testing up to the desired placement time of the shaft.

Include the above test results in the mix design submittal. If SCC is used in the production of precast items, meet the testing requirements in Section 554.03.6.

G. Class Structure Concrete. Design and produce Class Structure concrete in accordance with Table 551-3.

Alternative mix designs not in accordance with Table 551-3 may be accepted provided the following requirements are met.

1. Include in the design compressive strength test results according to AASHTO T 22 for 3, 7, and 28 days. The 28-day results must exceed specified strength.
2. Include in the mix design shrinkage test results according to AASHTO T 160. The maximum allowed shrinkage for mix design acceptance is .0350% at 28 days.
3. Include in the mix design creep test results at 28 days according to ASTM C512.
4. Include in the mix design MOE results according to ASTM C469.
5. Include in the mix design air-void spacing results according to ASTM C457 modified point-count method at 100x magnification. The average of all tests must not exceed 0.009-inch (230 µm) with no single test greater than 0.010-inch (260 µm). The total air content must exceed 5.5%.
6. Design and produce concrete maintaining a plastic air content of 5.5% - 8.5%.

H. Class Pre Concrete. Design and produce Class Pre concrete in accordance with Table 551-3. Include the following in the mix design.

1. Include in the design compressive strength test results according to AASHTO T 22 for 3, 7, and 28 days. Also include strength tests at intended de-tensioning/release times (e.g. 12 hrs, 16 hrs, 24 hrs, etc.) The 28-day results must exceed specified strength.
2. Include in the mix design shrinkage test results according to AASHTO T 160. The maximum allowed shrinkage for mix design acceptance is .0350% at 28 days.
3. Include in the mix design creep test results at 28 days according to ASTM C512.
4. Include in the mix design MOE results according to ASTM C469.

I. Prepackaged Concrete. Prepackaged concrete or rapid set patching material must contain a product data sheet proving the product will meet the specifications required for its intended use. Prepackaged concrete is subject to Project Manager approval.

551.03.3 Batching, Mixing, Handling and Sampling

Produce each class of specified concrete from approved material batched in the proportions specified in the approved mix design.

Correct for moisture content variations. All concrete aggregates are sampled using methods described in MT 201 using sample sizes used in MT 202. MT 224 will be used to calculate combined gradations.

The water may be proportioned by weight or volume. Proportion the cement and aggregates by weight.

The temperature of the combined material must be less than 130 °F (54 °C) before the addition of cementitious materials.

Concrete batch plants and operations must meet the requirements of ASTM C94 prior to producing concrete for any work, including concrete for any field trial batches, and shall meet the requirements throughout the production of concrete including the following:

A. Quality Control. When requested, furnish documentation for all the plant's equipment including each plants quality control procedures, calibration records, maintenance records, and any other information pertinent to proper concrete production. All measuring devices, batching equipment, trucks, and mixers are subject to approval.

B. Water.

1. **Weigh Measurement.** Ensure the weigh equipment measurements are not effected by pressure variations in the water supply lines. The Project Manager may require an auxiliary tank for filling the weighing tank.

2. **Metering.** Measure water volume by metering through a recording water-meter device, accurate to within plus or minus 1.0% of the required volume or plus or minus 1 gallon (3.8 L), whichever is less.

   Completely discharge wash water from the mixer before starting any batching operation.

C. **Cementitious Materials.**

1. Proportion cementitious materials by weight on all projects for all classes of concrete.
2. Ensure equipment for weighing cementitious material is accurate to within 0.5% of the true weight.
3. Weigh cementitious material to within 1.0% of the total cementitious material batch weight.
4. Weigh each cementitious material separately.

D. **Admixtures.** If using 2 or more admixtures in a single concrete batch, add each admixture separately to prevent interaction of the different admixtures before mixing with other batch materials. Agitate admixtures to ensure homogeneous concentrations in accordance with the manufacturer's recommendations.

If using a mechanical dispenser for proportioning admixtures, provide a site gauge or meter. Ensure unobstructed flow and accurate dosing of admixtures.

Batch admixtures in accordance with ASTM C94.

E. **Aggregate.** Proportion aggregate by weight on all projects for all classes of concrete.

Ensure equipment for weighing aggregates is accurate to within 0.5% of the true weight.

Weigh aggregates to within 1.5% of the total aggregate batch weight.

Weigh each size of aggregate separately.

F. **Batch Ticket.** Furnish the Project Manager a printed record of each batch in accordance with ASTM C94. Include on the ticket any water or admixture added after the record is printed and the initials of the person making the additions. Approval is required before any addition to the mix after batching and initial mixing has been completed.

G. **Mixers.** Use mixers that combine cementitious materials, aggregates, water, and admixtures within the specified time to form a uniformly mixed mass.

Meet the requirements of ASTM C94.

Operate mixers following the manufacturer's recommendations.

The Department may require uniformity testing. When required, meet the requirements of Subsection 106.04.

Do not place concrete improperly or inadequately mixed in the work. If incorporated, remove the concrete at no cost to the Department.

Do not mix, transport, or place concrete using equipment with aluminum or aluminum parts that contact the concrete.

Produce concrete in such quantity and at such a rate as proper placement and finishing will permit. Do not re-temper partially set concrete.

Do not use mixed concrete that has remained in the truck mixer drum longer than 10 minutes without agitation.

When silica fume is incorporated in the mix design, the maximum mixer revolutions will be waived. Ensure a minimum of 50 revolutions at mixing speed when the concrete is in a low-slump stage [2 to 3 inches (50 to 75 mm)] to properly disperse silica fume particles.

H. **Job-Site Additions.** Do not make any additions to the plastic concrete without the approval of the Project Manager. On-site dosing of water or admixture in no way relieves the contractor of producing passing plastic and hardened concrete test results.

1. **Water.** Do not exceed the approved W/C ratio.

   The addition of water is allowed only 1 time and a minimum of 30 revolutions at mixing speed are required before discharge of concrete.

   Do not add water if part of the batch has been discharged as a W/C ratio cannot be determined.

   Do not add water if the slump is within specified range.
2. **Admixture.** Do not exceed manufacturer's recommended dosage rates unless otherwise approved in the mix design stage.

   Only admixtures included in the approved mix design may be dosed on-site. A minimum of 30 revolutions at mixing speed are required before discharge of concrete.

   Do not add admixtures if any concrete has been discharged from the mixer other than the minimal amount for initial testing.

When the measured plastic air content or slump exceeds the upper test limit and there is time available within the discharge time limit specified, rotate the load at agitation speed and re-test the air content and/or slump. Do not use additives to reduce the air content and/or slump.

No other materials may be added to the concrete mixture.

551.03.4 Transporting Concrete

Ensure that the capacity of the plant and transportation equipment provides a delivery rate to permit handling, placing, and finishing of the work.

Time the delivery of loads to prevent the in-place concrete from taking initial set before succeeding layers or lifts are placed. Do not permit any layer or lift of concrete to remain exposed in excess of 20 minutes before being covered by fresh concrete.

Document the method and time of delivery by batch tickets issued to the driver and signed by the Inspector at the plant if present. Deliver the ticket to the Inspector upon arriving at the project.

Place concrete with a temperature between 50 and 85 °F (10 and 29 °C).

Meet the requirements of ASTM C94 and the following:

A. **Revolving Drum Mixers.** Discharge the concrete at the job and place it in final position within 1½ hours after introducing the mixing water and cement. If long hauls or other project conditions are expected, meet the requirements of Subsection 551.03.2(A)(7)(a).

   When the ambient temperature is 85 °F (29 °C) or above, place the concrete in final position within 1 hour after the water and cement are introduced.

B. **Non-agitating Transportation Equipment.** Do not use non-agitating transport equipment to transport concrete except when placing concrete pavement in accordance with Section 501.

551.03.5 Placing Concrete

Place concrete in accordance with Sections 501, 552, and 553.

Always place concrete as near as possible to its final position.

Do not place concrete that has taken initial set.

Do not place concrete:

1. On frozen or ice-coated ground or subgrade;
2. Against or on ice-coated forms, reinforcing steel, structural steel, conduits, precast members, or construction joints;
3. Under rainy conditions; stop the placement of concrete before the quantity of surface water is sufficient to effect or damage surface mortar quality, cause a flow, or wash the concrete surface;
4. In any foundation until the Project Manager has approved its depth and character;

5. In any form until the Project Manager has approved it and the placement of any reinforcing in it; or
6. In any work area when vibrations from nearby work may harm the concrete's initial set or strength.

Ensure all reinforcement and other embedded items are clean and free from dried mortar, rust, scale, oil, or foreign matter before placing concrete.

Remove all sawdust, chips, other construction debris and extraneous matter from the interior of forms before placing concrete.

Treat the forms interior surfaces to prevent mortar adhesion.

Moisten all foundations, forms, and contacting concrete surfaces with water just before the concrete is placed. Remove any standing water on surfaces which will contact with the concrete.

Provide a method of concrete placement that has a consistent, minimal impact on the concrete properties. All equipment proposed for use in mixing, conveying, placing and compacting the concrete is subject to Project Manager approval prior to its use. All the necessary equipment for any particular pour must be on site and proven to be in working condition before the pour commences. Ensure the equipment is well maintained, suitable in kind and adequate in capacity for the work.

Support bars to maintain their position as shown in the contract.

Place and secure all reinforcing, dowels, and other embedded items as specified.

Deposit concrete in small quantities at many points and then work or run it along the forms. Carefully fill each part of the forms, depositing the concrete as close as possible to its final position, working the coarse aggregates back from the face and forcing the concrete under and around the reinforcing bars.

Deposit concrete around steel shapes and closely spaced reinforcing bars, on 1 side of the steel, uniformly working it until the concrete flushes under the steel to the opposite side before any concrete is placed on the opposite side or over the steel.

Place concrete with means as to avoid segregation of the materials and the displacement of the reinforcement. Remove and discard any concrete that is segregated, is too wet for use, or is not of uniform consistency. Deposit concrete through an approved means when placement operations involve a free drop of concrete by more than 5 feet (1.5 m) to prevent segregation.

Place concrete in a continuous operation between expansion or construction joints.

Thoroughly clean all chutes, troughs, and pipes after each run.

Discharge any flushing water away from the forms and in place concrete.

Once the concrete has taken initial set, avoid jarring the forms or straining the projecting reinforcement ends.

A. **Placement Methods.** All placement methods are subject to approval.
   1. **Truck Chute.** Use metal or metal-lined troughs and chutes that extend to the point of deposit. Regulate the discharge.
   2. **Pumping Concrete.** When concrete pumps are used for placement, prior to use on the first placement of each day, visually inspect the pumps water chamber for water leakage. Do not use a pump that allows free water to flow past the piston.

      If a concrete pump is used as the placing system, discard the pump priming slurry before placement. Eliminating the priming slurry from the concrete may require that several cubic yards of concrete are discharged through the pumping system and discarded.

      Use of a concrete pump requires a written plan to place the remaining concrete if the pump breaks down.

      Provide a pump that produces a continuous flow of concrete without air pockets. Arrange equipment so that the impact on the plastic air content of the concrete is

affected as little as possible, and that the freshly placed concrete is not damaged by any form of vibration. If boom angles will vary significantly, furnish means to control air content variation.

3. **Conveying Concrete.** When a conveyor is used for placement, prior to use on the 1st placement of each day, visually inspect the conveyor to ensure proper operation. Provide a belt free of tears and holes and operates smooth and free of bouncing and jarring to prevent segregation of the concrete. Protect the concrete while on the conveyor to prevent the concrete's plastic properties from changing.

   Do not use a conveyor exceeding 200 feet (60 m).

   Equip all conveyors with a drop-chute and scraper to prevent segregation and mortar loss respectively.

   Once concrete placement begins, ensure that there is proper and equal edge-distance between the edge of the belt and windrow of concrete.

4. **Bucketing Concrete.** When a bucket is used for concrete placement, prior to use on the first placement of each day, visually inspect the bucket for proper working condition and contaminants. The bucket should be clean and free of hardened concrete and excess of release agent.

   Once concrete has been discharged into the bucket, do not place concrete back into a mixer to be altered or remixed.

B. Consolidation. Thoroughly consolidate concrete, except SCC, during and immediately after depositing into the work. Consolidate the concrete by mechanical vibration subject to the following:

1. Apply the vibration internally unless otherwise approved or as provided herein.
2. Vibrate the concrete at a minimum 4,500 impulses per minute or as recommended by the vibrator manufacturer.
3. The vibration must visibly affect the concrete mass, producing a 1-inch (25 mm) slump over a minimum 18-inch (455 mm) radius.
4. Use enough vibrators to consolidate each batch immediately after it's placed.
5. Vibrate the concrete around the reinforcement and imbedded fixtures and into the form corners and angles.
6. Vibrate at the point of deposit in areas of freshly deposited concrete. Slowly insert and remove the vibrators from the concrete. Vibrate to thoroughly consolidate the concrete without causing segregation or forming localized grout areas.
7. Vibrate at uniformly spaced points and no farther apart than twice the radius over which the vibration is visible.
8. Do not apply vibration directly to or through the reinforcement or to non-plastic sections or layers of concrete. Do not use vibrators to transport concrete in the forms. Use plastic or rubber tipped vibrator heads when placing concrete near epoxy coated reinforcing steel.
9. Supplement vibration by spading and tamping to produce smooth surfaces and dense concrete along form surfaces, in corners and locations impractical to reach with the vibrators.

Refer to Section 501 for consolidation requirements for concrete paving.

551.03.6 Weather and Temperature Limitations

Concreting during hot or cold weather requires an approved written plan to be implemented upon abrupt changes in weather conditions or equipment failures**.**

A. Hot Weather Concreting. Defined as job-site conditions that accelerate the rate of moisture loss or rate of cement hydration of freshly mixed concrete. Do not place Classes

Deck or Overlay concrete in temperatures exceeding 95 °F (35 °C). Other classes of concrete may be placed in temperatures exceeding 95 °F (35 °C) with Project Manager approval.

When hot weather concreting is anticipated, submit a hot weather concreting plan for review and approval. Include detailed procedures, including production, placement, finishing, curing and protection of concrete during hot weather concreting.

Do not place concrete when the ambient temperature is 85 °F (29 °C) and rising and/or the evaporation rate is greater than 0.2 lb/ft^2/hr. (1 kg/m^2/h) without an approved hot weather concreting plan. Do not place Classes Deck or Overlay without an approved plan when the ambient temperature is greater than 80 °F (27 °C) and/or when the evaporation rate is greater than 0.15 lb/ft^2/hr. (0.75 kg/m^2/h).

When hot weather as defined above exists, monitor site conditions (air temperature, humidity, wind speed) to assess the need for evaporation control measures beginning no later than 1 hour before the start of concrete placing operations. Continue to monitor site conditions at intervals of 30 minutes or less until specified curing procedures have been applied.

1. **Materials.** Produce concrete at a temperature such that its maximum temperature at discharge will not exceed the specified maximum allowable concrete temperature. Acceptable production methods to reduce the temperature of the concrete include: shading aggregate stockpiles, sprinkling water on coarse aggregate stockpiles; using chilled water for concrete production; substituting chipped or shaved iced for portions of the mixing water; and cooling concrete materials using liquid nitrogen.

   Include in the submittals for hot weather concreting which methods will be used and in what order they will be initiated when multiple methods are to be used. The substitution of other cooling methods will be considered by the Department when requested in the submittal and accompanied by satisfactory supporting data.
2. **Construction.** Include in the plan methods that will be used to maintain surfaces that will come in contact with the plastic concrete below 85 °F (29 °C). Include methods and equipment that will be used to keep the plastic concrete from cracking (e.g. fogging equipment, burlap, plastic, curing compounds, etc.). Describe devices or procedures that will be used to monitor wind speed, temperature, humidity, and other weather variables determining evaporation rate. Also include a detailed description of curing practices that will be used to supplement standard requirements in hot weather placements.

Protect the concrete against thermal shrinkage cracking due to rapid drops in concrete temperature greater than 40 °F (22 °C) during the first 48 hours unless otherwise specified.

Under hot weather conditions, scheduling placements at other-than-normal hours may be advisable. Concrete showing evidence of plastic shrinkage cracking or thermal cracking will be removed and replaced at no cost to the Department.

B. Cold Weather Concreting. Defined as when the weather forecast predicts air temperatures below 35 °F (2 °C) at any time during the specified curing and protection period following concrete placement. Assume all risk for placing concrete during cold weather. Replace frozen or damaged concrete at Contractor expense.

Remove ice, snow, and frost from the forms, subgrade, adjacent concrete, and reinforcing bars before placing concrete. Do not place concrete on frozen base or subgrade.

When cold weather concreting is anticipated, submit a cold weather concreting plan for review and approval. Include detailed procedures for production, transportation,

placement, curing, and temperature monitoring of the concrete during cold weather. Submit the plan a minimum of 15 calendar days prior to any concrete which is scheduled to be placed during cold weather. Prepare and submit a separate cold weather concreting plan for each concrete component which requires different methods of protection from cold weather. Clearly indicate which concrete components are covered by each submittal.

1. **Cold Weather Plan.** Include, as a minimum, the following items in the cold weather concreting plans:
   - **a.** Materials, details, and locations for insulating blankets, enclosures, or other methods to be used to protect concrete from cold weather.
   - **b.** Method for verifying the minimum concrete compressive strength has been reached to allow formwork and cold weather protection removal. Indicate whether cylinder testing or maturity method will be used.
   - **c.** Recording thermometer information and location. Provide product data including type, manufacturer, model number, and temperature range. Include proposed number and location of thermometers in the concrete.
   - **d.** Heating equipment and locations, if used. Provide product information on heating equipment and equipment placement.
2. **Fresh Concrete Temperatures.** Place fresh concrete with a temperature between 50 and 85 °F (15 and 32 °C).

   Eliminate frozen lumps, ice, and snow before aggregates are used in production.

   The Contractor may warm stockpiled aggregates with dry heat or steam, but not by applying flame directly or under sheet metal. If the aggregates are in bins, steam or water coils or other heating methods may be used if aggregate quality is not affected. Live steam heating is not permitted on or through aggregates in bins. If using dry heat, increase mixing times enough to permit the dry aggregates to absorb moisture.

   Use equipment and methods that heat the materials evenly.

   Do not add chlorides, chemical admixtures, or other ingredients to the concrete to prevent freezing.
3. **Protection of Concrete.** Enclose the structure in such a way that the concrete and air within the enclosure can be kept above 60 °F (15 °C) for a period of 7 calendar days or the specified curing period after placing the concrete. Ensure that the relative humidity remains above 80% within the enclosure.

   Before placing concrete, provide adequate preheat to raise the temperature of the formwork, reinforcing steel, adjacent concrete, and subgrade to at least 35 °F (2 °C).

   Submit documentation for a temperature recording device for approval. The device must be capable of recording temperatures a minimum of once per hour, 24 hours a day, for the entire curing period. Furnish and place enough temperature probes within the concrete to ensure the temperature of the concrete is adequately monitored. Install a minimum of 3 temperature probes within each concrete element. Ensure that the temperature probes cannot be dislodged by the placement of concrete, vibration, or workers. Include at least 1 additional temperature probe to record ambient outside air temperature. Where heated enclosures are used, include a temperature recording device inside the heated enclosure. Temperature probe locations are subject to approval. Submit the temperature recording device data to the Project Manager daily.
4. **End of Curing Period.** The conclusion of the curing period is defined when field cured cylinders meet design strength, maturity meter readings are satisfactory, or the

specified curing days are reached and all temperature recording data has been submitted.

a. **Field Cured Specimens.** Mold a minimum of 6 field cured cylinders per lot. Cast field-cured cylinders in accordance with MT 101. Place the cylinders at locations designated by the Project Manager and expose them to the same conditions as the concrete being placed until they are removed for testing.

Test field-cured cylinders within 24 hours after removal from cold weather protection according to AASHTO T 22, except that the moist cure period is omitted. Perform tests using a certified testing laboratory. Furnish the Project Manager certified copies of the test results.

Cast enough cylinders to guarantee the required strength has been met for protection removal.

The Department reserves the right to witness selected tests and testing procedures.

Two cylinders constitute a test with the test value being the average of the 2 compressive strengths. The average of all sets must meet the specified strength. Continue curing and protection until the tests indicate the specified compressive strength is reached.

b. **Removing Protection.** When the curing period has ended and the design strength is met, withdraw protection and heating in such a manner so as not to induce thermal shock stresses in the concrete.

Gradually reduce the temperature of the concrete at a rate not exceeding 15 °F (9 °C) per hour. Do not exceed a temperature differential of 40 °F (4 °C) between the core of the element and the surface of the element. In addition the temperature differential between the surface of the element and the ambient air shall not exceed 15 °F (9 °C). Ambient air temperature is defined as the temperature at mid-height of the element and 12 inches (305 mm) from the surface of the element.

All concrete must achieve a minimum of 4000 psi (28 MPa) before being exposed to freeze/thaw cycles.

The Contractor is solely responsible for protecting concrete from inclement weather during the entire curing period. Permission given by the Project Manager to place concrete during cold weather in no way ensures acceptance of the work by the Department. Should the concrete placed under such conditions prove unsatisfactory in any way, the Project Manager has the right to reject the work although the plan and the work were carried out with the Project Manager's permission.

551.03.7 Curing Concrete

Continuously water cure any class of concrete used for bridge deck construction for 14 calendar days as specified below.

Continuously water cure class Overlay-SF for 7 calendar days as specified below.

Continuously water cure class Overlay-LM for 72 hours as specified below, followed by a dry cure. Begin the dry cure at the end of the 72-hour wet cure period by removing the burlap and the polyethylene. Allow the concrete to undergo 48 hours of dry cure. Keep the bridge closed to traffic an additional 48 hours if the air temperature falls below 50 °F (10 °C) during the cure. Allow no traffic on the overlay surface until the end of the dry cure and the transverse deck grooving has been completed.

Continuously cure all other concrete surfaces for 7 calendar days by either water curing or liquid membrane-forming curing compound as specified below. Design strength must be verified by field-cured cylinders in accordance with AASHTO T 22.

Do not place curing compounds on concrete that is still bleeding.

Protect freshly placed concrete from freezing, high temperatures, large temperature differentials, premature drying, excessive moisture, and moisture loss for the period of time necessary to develop the desired concrete properties.

Protect exposed concrete surfaces from premature drying by covering with canvas, plastic sheets with sealed joints, burlap, or other approved materials. Keep the concrete moist. Continually moisten uncovered surfaces by fogging. Do not allow water to drip, flow, or puddle on the concrete surface during fog misting, when placing the burlap, or at any time before the concrete has achieved final set.

The concrete surfaces against forms may be cured by leaving the forms in place for at least 7 calendar days.

Keep the concrete surfaces moist after removing forms until surface repair is completed and one of the final cure methods described below is used. Surface repair includes removal of irregularities and repair of all depressions, voids, and air holes.

After placement, cure concrete surfaces as follows:

A. Water Cure. Keep all finished top surface concrete moist with a fine water mist until the burlap is placed.

Place wet burlap in accordance with Subsection 717.01.2 immediately behind concreting operations no later than 15 minutes after finishing. Do not use products having a laminated moisture barrier. Soak burlap for a minimum of 24 hours before use. Keep the burlap wet until concrete reaches sufficient strength to place soaker hoses or other effective means of providing moisture without marring the surface. Once a watering system is placed, place an approved reflective type sheeting or blanket over the watering system in accordance with Subsection 717.01.1 and cover to reduce evaporation. The entire concrete surface must remain moist throughout the full cure period. Ensure the temperature of all water used in the water cure is within 20 °F (11 °C) of the in-place concrete temperature. Secure covers and sheeting to prevent them from being lifted or displaced.

If an intermediate monomolecular film curing agent (evaporation retarder) is used, apply the monomolecular film in a light-fog application, using a pressure spray tank with an adjustable nozzle. Use a water-to-curing agent ratio and rate of application, both according to the manufacturer's recommendations. Agitate the solution before each application.

Apply the monomolecular film immediately after the final finishing operation is completed on any area. Do not perform finishing after application of the curing agent.

Use of an evaporation retarder must be approved before use by the Project Manager. Furnish a product data sheet to the Project Manager before approval.

B. Liquid Membrane-Forming Curing Compound. Furnish and uniformly apply a liquid membrane-forming curing compound in accordance with Subsection 717.01.3 over exposed surfaces.

Deliver membrane-curing compound to the job in the manufacturer's original container, clearly labeled with the manufacturer's name and contents.

The compound must be ready to use as shipped by the manufacturer. Do not dilute the compound.

Do not use curing compound without providing the Project Manager a manufacturer's product data sheet.

Use white-pigmented compound for pavements.

Use a clear compound containing a fugitive dye on curbs, sidewalks, barrier rail, substructure components, and superstructure components other than those requiring a

water cure. The clear compound must contain a fugitive dye that makes the film visible on the concrete for at least 4 hours after application but does not affect the concrete surfaces natural color after curing.

Thoroughly mix and apply the compound following the manufacturer's instructions or apply at a rate exceeding 1 gallon per 150 square feet (0.27 L/m^2) and ensure complete coverage with no transparent areas showing obvious color differential.

Apply the curing compound immediately after the finishing operation using a mechanical pressure distribution system to provide uniform coverage. During windy conditions, equip the spray nozzles with hoods.

When concrete is placed in forms, immediately apply the curing compound after form removal if the concrete has not reached its design strength.

A hand-operated sprayer providing uniform coverage may be used to apply liquid curing compound to areas where a mechanical sprayer is impractical.

If the curing membrane is damaged from any cause during the curing period, re-coat the damaged areas immediately.

Do not apply membrane-curing compound to construction joint surfaces. Protect exposed steel during application of curing compounds.

C. Steam-Cure for Precast Concrete Items. Completely enclose or cover the casting beds for steam-cured members using curing blankets or other approved flexible coverings. Provide a minimum 6 inches (150 mm) of free air space between the enclosure or coverings and all concrete surfaces.

Secure flexible coverings to prevent moisture loss. Provide moisture before the cure cycle to aid hydration and prevent surface cracks caused by rapid water loss from the concrete.

Steam may be introduced before starting the cure cycle if the enclosure temperatures are maintained between 50 and 70 °F (10 and 21 °C). Fog-spray or cover the top surfaces of the members with wet blankets within 15 minutes after placing concrete to prevent moisture loss for a 3 hour period before the cure cycle.

Begin the steam-cure cycle after the concrete has been in place at least 3 hours. Maintain steam at 100% relative humidity, applied so it does not damage the surface of the concrete, forms, or tendons.

Raise the ambient temperature within the enclosures no faster than 40 °F (22 °C) per hour to a maximum temperature between 120 and 160 °F (49 and 71 °C). Maintain the temperature until the concrete has reached strength for transfer of prestress or design strength.

Once the cure cycle is complete, cool the precast items by decreasing the temperature within the enclosures no faster than 40 °F (22 °C) per hour until the temperature difference between the inside and outside air is within 25 °F (14 °C), unless otherwise approved.

Keep a curing time-temperature record for each concrete pour in the casting bed. Provide 1 automatic temperature-recording thermometer for each 200 feet (61 m), or fraction thereof, of continuous bed length used. Record curing temperatures continuously for the full curing cycle. Place the temperature sensors at approved locations. Supplement automatic recording thermometers with standard bulb-type thermometers placed at approved locations. Certify the accuracy of automatic recorders once each year or when the recorder accuracy is in question. Steam curing is not permitted without automatic recorders.

The sideforms may be removed at the Contractor's discretion. Assume all responsibility removing forms before breaking the release cylinders. Concrete members damaged from early form removal will be rejected.

The cure cycle may be interrupted a maximum 20 minutes for form removal.

Do not expose the members to below-freezing temperatures within 6 calendar days of casting. In place of the 6-day requirement, the cure time may be based on the concrete strength. The concrete strength is determined by the average strengths of 3 standard 6 x 12-inch (152 x 305 mm) or 4 x 8-inch (102 x 203 mm) cylinders cast from different batches of concrete used in each casting. Expose these cylinders to the same cure and temperature conditions as the precast items. Immediately test the cylinders according to AASHTO T 22 without further curing, once they are removed from the cure area.

Curing may be discontinued if the average strengths of the 3 cylinders equals or exceeds specified strengths. Protect the member from freezing temperatures for the 6-day period if the average compressive strength fails to meet specified strength. Cool all members as specified in this Subsection.

Cast compression cylinders for field tests of the 28-day strengths following MT 101. Cast the number of test cylinders as required in Subsection 551.03.8(C) and MT 111.

The Contractor may submit in writing, alternate curing methods, for approval.

551.03.8 Testing and Acceptance of Concrete

A. Sampling and Testing. Furnish an adequate and representative sample of concrete in accordance with MT 105 from the point of placement to an area designated by the Project Manager for testing of concrete properties and molding of test specimens. The Department will take possession of the sample and begin the following applicable tests.

1. **Compressive Strength Testing.** Furnish samples for determining compressive strength following MT 105. Test cylinders will be cast and cured following MT 101 and tested in accordance with AASHTO T 22 at a frequency determined by MT 601**.** Test cylinders for SCC will be cast and cured in accordance with MT 117. Compressive strength tests may be molded at any time if inconsistency between batches is identified or suspected. A compressive strength set consists of 4 test cylinders made at the same time from the same batch of concrete. Tests for plastic properties will also be run from the same sample used for compressive strength tests.

   The Contractor may make additional cylinders to determine strength gain and to maintain job control. Make additional cylinders anytime strengths must be determined before 7 days for cure times, form removal, post-tensioning, or any other scenario requiring field-cured strength tests.

   Standard compressive strength tests will be made at 7 and 28 days, except as specified below for concrete used in prestressed members.

   The compressive strength results of the cylinders tested will determine if the concrete meets the required compressive strength in Table 551-3 or specified in the contract.

2. **Testing of Plastic Concrete.** Perform quality control sampling/testing during the concrete placement, including air content, temperature, and slump to maintain job control.

   Furnish samples for determining slump, air, and temperature in accordance with MT 105. Slump will be tested in accordance with MT 104. Air content will be determined in accordance with MT 102. Temperature will be tested in accordance with ASTM C1064 at a frequency determined in accordance with MT 601. Plastic

properties tests may be run at any time if inconsistency between batches is identified or suspected.

Slump flow and air content for SCC will be evaluated in accordance with MT 116 and MT 119.

Plastic concrete will also be subjected to a visual test for segregation. If segregation is identified by a “halo”, bleeding, aggregate agglomerations, or aggregate settlement (identified by a high sheen or bubbling) during the slump test, do not place the concrete. Take immediate steps to resolve the problem. Remove and replace any concrete placed showing signs of segregation at no expense to the department.

3. **Flexural Strength Testing.** In addition to the compressive strength requirements, Class Pave hydraulic cement concrete pavements require beam tests to determine the concretes flexural strength.

   The number of flexural strength tests required for acceptance is determined by the Department on a random basis. The flexural strength results from 1 or a combination of the beams tested will be used to determine whether the concrete meets the required flexural strength specified in Table 551-3.

   Flexural beams made in the field will be cast and cured in accordance with MT 101 and tested in accordance with AASHTO T 97.

4. **Durability Testing.** When applicable, furnish samples for determining permeability following MT 105. Test cylinders will be cast and cured following MT 101 and tested in accordance with AASHTO T 277 or AASHTO TP 95.

   The Department may test hardened air content in accordance with ASTM C457 for acceptance.

5. **Gradations.** Samples for determining gradations of aggregates for concrete will be sampled in accordance with MT 201 and tested in accordance with MT 202. Combined gradations are determined in accordance with MT 215.

B. **Acceptance of Concrete.** The concrete must meet all contract specifications and the following:

1. **Classes General, Deck, Pave, Structure, Overlay and Drilled Shaft Concrete.** These classes of concrete are evaluated for acceptance on a lot-by-lot basis.

   An individual lot is defined as a single days pour or every 200 yd^3 (150 m^3) of concrete poured (i.e. 200 yd^3 = 1 lot, 400 yd^3 = 2 lots, etc.) whichever is less, excluding Class Pave. An individual lot of Class Pave concrete is defined as a single day’s pour or every 1,000 yd^3 (750 m^3) of concrete poured, whichever is less. Partial lots may be created or added to the preceding lot at the Project Manager’s discretion. Each lot is accepted or rejected based on the lot acceptance air tests, strength tests, gradation tests and when applicable, permeability tests. The pay factors for each lot accepted are determined from Table 551-5, 551-6, 551-7 and 551-8.

   a. **Strength.** A minimum of 2 standard compressive strength sets will be made for each lot. Each set will be made from concrete taken from a separate batch or load randomly selected from all loads or batches in the lot. For a lot less than 30 cubic yards (23 m^3), the Project Manager may elect to make 1 set of compressive strength cylinders to represent that lot.

      Three cylinders from each set of cylinders are tested for compressive strength at 28 days and the fourth is tested at 7 days. The test result is the average of the strengths of the 3 individual 28 day cylinder specimens unless an outlier is identified. An outlier is defined here as 1 compressive strength specimen with a result differing from the average of the 2 closest compressive strength specimens

by greater than or equal to 10% of the averaged value. If an outlier is identified, that specimen will be removed and, the average strength will be determined using the remaining 2 specimens.

The lot acceptance strength is the average of the test results for the lot.

TABLE 551-5
CONCRETE STRENGTH PAY FACTORS

Strength Pay Factors **Classes Deck, Overlay, Structure, General, Pave, and Drilled Shaft Concrete** lot acceptance strength, x psi (1 psi = 6.9 kPa)	
strength, x (psi)	**strength pay factor, PF_S**
x ≥ 4,000	$PF_S = 1.0$
4,000 > x ≥ 3,500	$PF_S = 1.0 - \frac{0.15 - (4000 - x)}{500}$
3,500 > x ≥ 2,800	$PF_S = 0.85 - \frac{0.85 - (3500 - x)}{700}$
2,800 > x	PF_S = 0, remove and replace

The pay factors shown will be used when the department determines the concrete is acceptable at less than the specified strength. The Department may require removal and replacement or corrective action for any concrete not in accordance with the required strength.

b. Air Content. Concrete air content will be determined in accordance with MT 102 or ASTM C457. The lot acceptance air content is the average of all the test results for the lot. In cases where the measured air content within a lot varies by more than 2.5 percentage points, a separate air content pay factor will be computed for each test result and the lot air content pay factor will be the average of the individual test result pay factors. The pay factor for each lot based on air content is determined from the following table:

TABLE 551-6
AIR CONTENT PAY FACTORS

Lot Acceptance, Air Content			
Classes General, Pave, Deck, Overlay, and Structure Concrete		**Used when mix design incorporates ≥ 1½-inch nominal maximum aggregate gradation**	
Air content, x (%)	**Air content pay factor, PF_{AC}**	**Air content, x (%)**	**Air content pay factor, PF_{AC}**
x ≥ 5.5%	$PF_{AC} = 1.0$	x ≥ 4.5%	$PF_{AC} = 1.0$
5.5% > x ≥ 4.5%	$PF_{AC} = 1.0 - 0.25(5.5 - x)$	4.5% > x ≥ 4.0%	$PF_{AC} = 1.0 - \frac{0.20(4.5 - x)}{0.5}$
4.5% > x ≥ 3.5%	$PF_{AC} = 0.75 - 0.75(4.5 - x)$	4.0% > x ≥ 3.0%	$PF_{AC} = 0.80 - \frac{0.80(4.0 - x)}{1.0}$
3.5% > x	Remove and Replace	3.0% > x	Remove and Replace

The pay factors shown will be used when the department determines the air content of the in-place concrete is acceptable at percentages less than specified. The Department may require removal and replacement or corrective action for any concrete not in accordance with the required air contents.

In addition to the air content pay factor, coating concrete with an approved penetrating epoxy sealer at no cost to the Department will be required any time concrete having an air content less than 4.0% (3.5% for concrete containing 1½-inch nominal aggregate) for Classes Deck, Overlay, and Structure concrete allowed to remain in place.

Air content pay factors will not be used on Class Drilled Shaft concrete.

c. Permeability. Concrete permeability will be determined at 28 days in accordance with either AASHTO T 277 (Table 551-7) or AASHTO TP 95 (Table 551-8). The lot acceptance permeability is the average of the test results for the lot. The pay factor for each lot based on permeability is determined from Table 551-7 or 551-8.

TABLE 551-7
CONCRETE PERMEABILITY PAY FACTORS (COULOMBS)

Lot Acceptance, Permeability, x (coulomb) Classes Deck and Overlay[1]	
lot chloride permeability test result, x (coulombs)	**permeability pay factor, PF_P**
1,500 ≥ x	$PF_P = 1.05$
2,000 ≥ x > 1,500	$PF_P = 1.05 - \frac{0.05(x - 1500)}{500}$
3,000 ≥ x > 2,000	$PF_P = 1.00 - \frac{0.30(x - 2000)}{1000}$
x > 3,000	0.70

Note 1: If Class Structure is specified for a bridge deck, the incentive may be paid, but no deduction will occur for permeability results.

TABLE 551-8
CONCRETE PERMEABILITY PAY FACTORS (KΩ-CM)

Lot Acceptance, Permeability, x (kΩ-cm) Classes Deck and Overlay[1]	
lot chloride permeability test result, x (kω-cm)	**permeability pay factor, PF_p**
x ≥ 35	$PF_P = 1.05$
35 > x ≥ 30	$PF_P = 1.05 - \frac{0.05(35-x)}{5}$
30 > x ≥ 20	$PF_P = 1.00 - \frac{0.30(30-x)}{10}$
20 > x	0.70

Note 1: If Class Structure is specified for a bridge deck, the incentive may be paid, but no deduction will occur for permeability results.

The pay factors shown will be used when the department determines the permeability of the in-place concrete is acceptable with results less than specified. The Department may require removal and replacement or corrective action for any concrete not in accordance with the required permeability.

d. Gradation. Concrete aggregate gradations will be determined in accordance with MT 202 or MT 215, if applicable. The lot acceptance gradation is the average of the test results for each lot of concrete placed.

1) Conventional Gradations. For concrete designed with conventional gradations not in accordance with the required range for an individual aggregate fraction in accordance with Section 701, the Project Manager will make determinations regarding the disposition, payment, or removal of the material. The Department will adjust the contract unit price for the concrete item in accordance with the following formula. When there is not a separate contract unit price for an item of work or the concrete is a minor component of the contract unit price, the Department will reduce payment based on the Contractor-provided invoice amount for the concrete in question.

$$PF_G = 1.0 - \frac{0.25(x)}{25}$$

Where:
x = The sum of the individual percentages out of range on each aggregate fraction.
PF = Pay Factor

2) Optimized Gradations. For concrete designed with optimized gradations not in accordance with the specified tolerances in Section 701, the Project Manager will make determinations regarding the disposition, payment, or removal of the material. The Department will adjust the contract unit price for the concrete contract item in accordance with the following formulas. When there is not a separate contract unit price for an item of work or the concrete is a minor component of the contract unit price, the Department will reduce payment based on the Contractor-provided invoice amount for the concrete in question. The following pay factor will be used when all gradation tests in the

lot produce passing results with no individual aggregate fraction out of tolerance.

$$PF_G = 1.05$$

The following formula will be used when any gradation test produces a failing result or an individual aggregate fraction is out of tolerance.

$$PF_G = 1.0 - \frac{0.25(x) + 2(y)}{25}$$

Where:
x = The sum of percentages out of tolerance on each individual aggregate fraction (reported to the whole number).
y = Percentage out of tolerance on the No. 200 (0.075 mm) sieve fraction (reported to the tenth of a percent).
PF = Pay Factor

The following formulas are used to calculate the OLPF and unit price adjustment ADJ. All pay factors (PF_S, PF_P, PF_{AC}, and PF_G) must be 1.00 or greater for the production lot to be eligible for positive ADJ (incentive). If any individually calculated pay factor (PF_S, PF_P, PF_{AC}, and PF_G) is less than 1.00, the maximum value for its companion pay factor (PF_S, PF_P, PF_{AC}, and PF_G) to be used in the OLPF calculation for the respective production lot will not exceed 1.00. No OLPF can exceed 1.07.

$$OLPF = PF_S \times PF_{AC} \times PF_P \times PF_G$$
$$ADJ = (OLPF - 1) \times Price$$

Where
ADJ = Price adjustment per pay unit to be applied to the production lot quantity
Price = Contract unit price for the pay item

If a pay factor is not applicable to a specific class of concrete, the pay factor (PF) will be 1.00. Use Table 551-9 to determine pay factors applicable to specific classes of concrete.

TABLE 551-9
PAY FACTORS FOR CONCRETE

PF Type	Deck	Overlay	Structure	General	Drilled Shaft	Pave
PF_S	X	X	X	X	X	X
PF_{AC}	X	X	X	X		X
PF_P	X	X				
PF_G	X	X	X	X	X	X

2. **Class Pre Concrete.** Class Pre concrete is evaluated for acceptance on a lot-by-lot basis based on the average of the 28-day compressive strength cylinders and variation in test results as measured by the standard deviation.

Each lot will be judged against the formula:

F'c + 0.35S

Where:
S is the standard deviation of the strengths for the three 28-day cylinders.
F'c is the concrete strength required for final acceptance as specified in the contract.

A lot is defined as all the concrete that is placed in a single pre-cast prestressed member.

Lots with any actual average cylinder strengths less than that calculated from the above formula will be rejected.

Three 28-day compressive test cylinders will be made for each lot, and each 28-day test cylinder sample will be randomly selected from all batches or loads.

The strengths of other cylinders made from a sample and tested at an earlier age will not be considered for acceptance purposes.

The cylinders for acceptance will be cast in accordance with MT 101, sampled in accordance with MT 111 and tested in accordance with AASHTO T 22.

The cylinders will be cured within the curing enclosure under the exact conditions and methods used to cure the prestressed member until transfer of pre-stress. After transfer of pre-stress, the cylinders will be transported and continue curing in accordance with MT 101.

3. **Controlled Low Strength Material.** CLSM is evaluated for acceptance on a lot by lot basis. A lot is defined as a single days pour or every 100 yd^3 or $100m^3$ of CLSM placed whichever is less. A minimum of 1 set of 6 x 12-inch (152 x 305 mm) or 4 x 8-inch (102 x 203 mm) compressive test cylinders will be made for each lot in accordance with ASTM D4832. Do not apply additional loads until CLSM has reached its design strength.
4. **Small Concrete Quantities.** The Project Manager may accept 7 cubic yards (5.4 m^3) or less of concrete without a formal mix design. Submit a batch proportion sheet to the Project Manager for approval before use. Classes Deck, Overlay, and Structure concrete are excluded from this exception.

551.04 METHOD OF MEASUREMENT

Concrete is measured by the cubic yard (m^3) in accordance with Subsection 552.04, unless otherwise specified.

Class Pave concrete is measured for payment in accordance with Subsection 501.04.

Class Pre concrete is measured for payment in accordance with Subsection 553.04.

Concrete used in pre-cast concrete products is measured for payment in accordance with Subsection 554.04.

551.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Concrete	Cubic Yard (m^3)

Class Pave concrete is paid for in accordance with Subsection 501.05.

Class Pre concrete used in prestressed concrete members is paid for in accordance with Subsection 553.05.

Concrete used in pre-cast concrete products is paid for in accordance with Subsection 554.05.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 552
CONCRETE STRUCTURES

552.01 DESCRIPTION

This work is constructing concrete structures, and portions of prestressed concrete, steel, timber, stone masonry, and composite structures.

552.02 MATERIALS

Furnish materials in accordance with the following section and subsection:

Bearing Devices	565
Compression Joint Seals	711.15
Concrete	551
Concrete Sealants	717
Expansion Joint Filler	707.01
Reinforcing Steel and Structural Steel	711
Water Stops	707.03

552.03 CONSTRUCTION REQUIREMENTS

552.03.1 Foundations

Construct foundations in accordance with Section 209.

Place concrete only after the foundations are inspected and approved.

552.03.2 Falsework

Construct falsework that supports the concrete work without detrimental deformation or settlement and to the plan lines and grades.

Use piling to support falsework not on solid footings.

Temporary camber all spans allowing for shrinkage and settlement. The contract specifies those bridges that require a permanent camber.

Provide “tattletales” or other approved devices at locations to indicate form settlement or deflection. Adjust falsework as required to maintain plan line and grade.

Stop the work if detrimental settlement occurs in the falsework that cannot be adjusted. Remove and replace all concrete work affected by detrimental settlement at Contractor expense.

The Contractor is responsible for the adequacy and execution of the falsework plans. Furnish a Contractor approved copy of the falsework plans to the Project Manager upon request. The Contractor approval must be shown on the drawings.

552.03.3 Forms

Construct forms so their removal does not damage the concrete.

Remove all forms and form members not designated to remain in place.

The term “exposed surfaces” means those concrete surfaces that are above the finished ground line.

Use metal or plywood forms for exposed surfaces, and countersink all bolt and rivet holes. Ensure the forms are mortar-tight providing a smooth finished concrete surface meeting the specified shape. Rough lumber, tongue-and-groove lumber, and steel-framed wooden panel forms may be used for surfaces not exposed in the finished structure that do not adversely affect the strength or appearance of the finished structure.

Use only 1 type of material in any form or group of forms for exposed concrete surfaces on similar parts of a structure.

Use filleted forms for re-entrant angles. Chamfer forms ¾-inch (19 mm) for all exposed corners and edges with an enclosed angle of less than 120°.

Design the forms and falsework to withstand the vertical loads and horizontal pressure of the plastic concrete. Include in the design allowances for temporary construction loads.

Do not place concrete exceeding the designed form pressure.

Use forms for completed structures that are removable without disturbing adjacent forms.

Form marks must conform to the general lines of the structure. Column form marks may be horizontal or vertical or both, being as symmetrical as practical.

Provide form openings that permit ready access for form cleanout, inspection, placement, and compaction of the concrete. Provide cleanout ports at the top surface of the concrete where placing is stopped in narrow forms for walls or columns or where the bottom of the form is inaccessible.

Remove all extraneous material within the forms before placing concrete.

Treat the forms interior surfaces to prevent mortar adhesion.

Water soak wooden forms to close shrinkage cracks.

Set and maintain forms to the specified alignment, grade, and section and leave in place after concrete is placed for the specified time in Subsection 552.03.10.

Form defects are cause to stop work until corrected.

Fit metal tie rods or anchorages within the forms with cones or other devices that permit the rod and anchorage to be removed to 1-inch (25 mm) below the surface without damaging the concrete.

Use metal tie fittings that leave the smallest possible size cavities. Dry pack cavities with cement mortar to produce a sound, smooth, even finished surface closely matching that of the adjacent concrete after form removal.

Use deck slab forms that permit vertical adjustment of the bottom of the slab form.

552.03.4 Placing Concrete

A. General. Transport and place concrete in accordance with Subsections 551.03.4 and 551.03.5 respectively.

Do not allow concrete to drop from a height exceeding 5 feet (1.5 m) unless it is within a conduit.

Support bars to maintain their position as shown in the contract.

Deposit concrete in small quantities at many points and then work or run it along the forms. Carefully fill each part of the forms, depositing the concrete as close as possible to its final position, working the coarse aggregates back from the face and forcing the concrete under and around the reinforcing bars. Do not allow concrete to segregate by falling through or over reinforcing steel, tie rods, or similar items.

Deposit concrete around steel shapes and closely spaced reinforcing bars, on one side of the steel, uniformly working it until the concrete flushes under the steel to the opposite side before any concrete is placed on the opposite side or over the steel.

Once the concrete has taken initial set, avoid jarring the forms or straining the projecting reinforcement ends.

Thoroughly consolidate all concrete, except seal concrete, during and immediately after depositing using mechanical vibration as follows:

1. Apply the vibration internally unless otherwise approved or as provided herein.

2. Vibrate the concrete at a minimum 4,500 impulses per minute or as recommended by the vibrator manufacturer.

3. The vibration must visibly affect the concrete mass, producing a 1-inch (25 mm) slump over a minimum 18-inch (455 mm) radius.

4. Use enough vibrators to compact each batch immediately after it’s placed.

5. Vibrate the concrete around the reinforcement and imbedded fixtures and into the form corners and angles.

Vibrate at the point of deposit in areas of freshly deposited concrete. Slowly insert and remove the vibrators from the concrete. Vibrate to thoroughly consolidate the concrete without causing segregation or forming localized grout areas.

Vibrate at uniformly spaced points and no farther apart than twice the radius over which the vibration is visible.

6. Do not apply vibration directly to or through the reinforcement or to non-plastic sections or layers of concrete. Do not use vibrators to transport concrete in the forms. Use plastic or rubber tipped vibrator heads when placing concrete near epoxy coated reinforcing steel.

7. Supplement vibration by spading and tamping to produce smooth surfaces and dense concrete along form surfaces, in corners and locations impractical to reach with the vibrators.

These requirements apply to precast piling, concrete cribbing, and other precast members unless the manufacturer's vibration methods are approved.

Place and secure all reinforcing, dowels, and other embedded items as specified. Clean rust, scale, oil, dried mortar deposits or foreign material from all embedded materials before placing the concrete.

Continuously place concrete in each section of the work in horizontal layers, working continuously if necessary, to prevent stoppage planes.

Place the concrete in layers to thoroughly consolidate them with the concrete beneath. Place the succeeding layer before the previous layer has reached initial set.

Compact each layer to prevent separation planes between the preceding layer and the layer being placed.

The Project Manager may require an emergency bulkhead if concrete placement in a section is delayed longer than 20 minutes.

A construction joint is any place where concrete placement has stopped and the concrete has taken initial set. Make construction joints in accordance with Subsection 552.03.6.

Inset construction joints where a "feather edge" might be produced in the succeeding layer. Provide a minimum thickness of 6 inches (150 mm) in all succeeding layers.

Place concrete so all construction joints are across low shear stress regions and out of view to the greatest extent possible.

Place deck slab concrete a minimum of 7 calendar days after placing diaphragm concrete or when standard compressive strength test results verify that the diaphragm concrete has attained a compressive strength of 1,360 psi (9.5 MPa).

B. Pumping Concrete. Pump concrete in accordance with Subsection 551.03.5(A).

C. Concrete Columns. Place concrete in one continuous operation, unless otherwise specified.

Allow columns to set at least 12 hours before placing the caps.

Place concrete in the superstructure after the column forms have been stripped and the column is inspected by the Project Manager.

The superstructure load may be placed on the columns when the column concrete reaches 80% of the required 28-day compressive strength, determined by testing standard 6 x 12-inch (152 x 305 mm) or 4 x 8-inch (102 x 203 mm) test cylinders.

D. Reserved.

E. Concrete Slab and Girder Spans. Place slabs and girders having spans less than 30 feet (9.1 m) in one continuous operation.

Concrete slabs with girders spanning 30 feet (9.1 m) or more may be placed in two operations, first placing the girder stems to the bottom of the slab haunches, and then placing the slab.

Use shear keys made of beveled timber blocks inserted at least 1½ inches (38 mm) in the fresh concrete at the top of each girder stem. Place the blocks to uniformly cover about ½ of the girder stem top surface. Remove the blocks when the concrete has set enough to retain its shape.

Do not place the slab until the girders have been in place for at least 24 hours.

Check all falsework for shrinkage, settlement, and tighten all wedges to ensure minimum deflection of the stems caused by the slab weight before placing the slab.

Place concrete in girder haunches less than 3 feet (915 mm) high at the same time as the girder stem.

When any haunch or filler has a vertical height of 3 feet (915 mm) or more, place the abutment or columns, the haunch, and the girder in 3 successive stages:

- First, up to the lower side of the haunch.
- Second, to the lower side of the girder.
- Third, to completion.

F. Concrete Slip-forming. Concrete barrier rails on bridges may be slip-formed.

Hand-finish the traffic face and top of the barrier to remove air holes and other blemishes, followed by a light broomed finish.

Sections with concrete slumps or bulges causing barrier rail misalignment or inadequate concrete cover for reinforcing steel will be rejected.

552.03.5 Depositing Concrete Underwater

Use Class General or Drilled Shaft concrete for seals specified in the contract.

All costs for concrete placed outside of the plan dimensions and any change in the seal mix design for the Contractor's convenience is at Contractor expense.

Do not place concrete underwater without Project Manager approval.

When it is impractical or inadvisable to de-water an excavation before placing concrete, place a seal course underwater to seal the cofferdam. Place the entire seal in one continuous operation, in accordance with the following:

- Use a tremie system;
- Pump directly into a tremie hopper; or
- Pump directly to the deposit point.

Use tremie systems made of rigid, watertight steel tube having a minimum diameter of 10 inches (255 mm) with a hopper at the top. Keep the tremie's discharge end submerged in the deposited concrete, and the tremie tube full to the hopper bottom at all times during the concrete placement. When a load is dumped into the hopper, raise the tremie to start the flow of concrete until the load discharges to the hopper bottom. Use a tremie support that allows free movement of the discharge end and permits rapid lowering of the tremie to retard or stop the flow.

Pump seal concrete in accordance with Subsection 551.03.5(A).

Have a backup concrete pump or tremie available at the site to ensure uninterrupted placing of the entire foundation seal.

Pump concrete into a tremie meeting the placing requirements for tremie-placed concrete.

When concrete is pumped directly, the discharge tube must be a rigid pipe extending at least 5 feet (1.5 m) above the water level during placement. The discharge line from the top of the rigid pipe to the concrete pump may be flexible.

Prevent water from entering the tube while placing concrete. Fill the tubes without washing the concrete.

Place concrete in a consolidated mass without disturbing it once deposited.

Do not place concrete in running water or expose it to the action of water before it has reached final set. Keep water still at the point of deposit.

Do not pump from the cofferdam while depositing concrete underwater.

Make all formwork retaining concrete underwater practically watertight.

Deposit concrete to produce horizontal surfaces.

After the seal concrete has cured and can withstand the hydrostatic pressure, de-water the cofferdam and place the remaining concrete in the dry.

Prepare the top surface of the foundation seal in accordance with Subsection 552.03.6 before joining fresh concrete to the seal concrete. Remove high spots to provide the clearances for reinforcing steel or projection of embedded piling.

552.03.6 Construction Joints

Obtain the Project Managers approval for construction joint locations.

If the concrete develops initial set due to placement delays, the stopping point is considered a construction joint.

Place concrete continuously from joint to joint. Make the joints perpendicular to the principal lines of stress and locate them at points of minimum shear.

Place a gauge strip, at least 2 inches (50 mm) thick, at all horizontal construction joints and at other directed locations inside the forms along all exposed faces to provide a straight line for the joints.

Before placing fresh concrete against set concrete, draw the forms tightly against the set concrete face and remove all gage strips and key forms. Remove all latence, loose and foreign materials from the surface by sandblasting, high-pressure water cutting, or light bushhammering. Keep the surface moist until resuming concrete placement. Apply a thin coat of neat cement to the surface or coat as specified just before resuming concrete placement.

Bond the successive courses by keying or doweling, as shown in the contract, at the top layer of each day's work and at other points where work is interrupted.

552.03.7 Joints for Bridge Approach Slabs

Construct and seal joints between concrete approach slabs and structures or concrete pavement as specified.

Use forms for joints that are removable without damaging the concrete.

Protect the joint from damage and prevent debris and foreign material from entering the joint before installing the seal.

Limit construction equipment and other vehicles operated directly across the joint to rubber-tired equipment, unless approved joint protection is used.

Repair all spalls, fractures, breaks, or voids in the concrete joint surfaces as approved.

Before placing the seal, clean the joints by abrasive blast or other similar methods, followed with high-pressure air jets to remove all residue and foreign material. Protect expansion joint filler from the blast.

Make joint surfaces surface-dry when placing the seal.

552.03.8 Cold Weather Concreting

Perform cold weather concreting in accordance with Subsection 551.03.6.

552.03.9 Curing Concrete

Cure concrete in accordance with Subsections 551.03.6 and 551.03.7.

552.03.10 Removal of Forms and Falsework

Do not release, loosen, or remove forms or falsework without the Project Manager's approval. This approval does not relieve the Contractor of responsibility for the safety of work.

Remove all forms, blocks and bracing. Remove mortar lips and all irregularities caused by form joints.

The presence of honeycombed areas may cause rejection of the work, and upon written notice, require removal and rebuilding of the work in whole or part at Contractor expense.

After the forms are removed, cut back and repair all projecting wires, tie bolts, and other metal form ties passing through the concrete in accordance with Subsection 552.03.3.

Repair honeycombed concrete in all parts of the work and voids and depressions in exposed portions of the work as follows:

1. Chip back all coarse and broken material to a dense, uniform concrete surface with exposed solid coarse aggregate.
2. Cut back feather edges to form faces perpendicular to the surface being patched.
3. Saturate all cavity surfaces with water, and apply a thin layer of neat cement.
4. Fill the cavity with a thick mortar mixed in the same proportions as the concrete used in the work and at the same temperature as the surface against which the mortar is placed.

Use a blend of hydraulic cement, white hydraulic cement and sand, proportioned to match the color of the concrete being repaired. Tamp the mortar into place, and float the surface using a wooden float before initial set takes place. Cure the patch in accordance with Subsection 551.03.7.

For patching large or deep areas, add coarse aggregate to the patching material to provide a dense, well-bonded, and cured patch.

Pull or remove all falsework piling 1-foot (305 mm) below the finished ground line or streambed unless otherwise specified.

552.03.11 Concrete Finish

A. **Broomed Finish.** Finish the surface of concrete curbs and sidewalks to the lines and grades in the contract. Work the concrete until the coarse aggregate is forced into the body of the concrete and no coarse aggregate is exposed. Float the surface with a wooden float producing a smooth and uniform surface.

   Apply a broom finish to curbs or sidewalks. The texturing broom may be any medium-stiff bristled broom. Broom at right angles to the curb face or sidewalk and produce a uniform close spaced texture not exceeding ⅛-inch (3 mm) deep.

B. **Bridge Decks.** Finish deck slabs by the machine method, excluding small or irregularly shaped areas where a machine is impractical.

   1. **Machine Method.** Use a self-propelled transverse finishing machine to strike off and finish the surface of deck-slab concrete. Furnish the Project Manager information on the location and method of rail support, size of rail members, and a description of the machine.

      Trial-run the finishing machine over the entire deck area to be finished before placing any concrete. Make the trial run with the machine and rails set to the specified grade and section. Attach a spacer to the bottom of the strike-off ⅛-inch (3 mm) in thickness less than the concrete cover shown in the contract. Adjust the support rails to compensate for dead-load deflections in the bridge girders. Adjust transverse strike-off support rails to match any changes in the deck section. Make transverse rail adjustments to maintain the specified surface tolerances. Record trial run transverse rail adjustments for use during the deck finishing operations. Make all adjustments to maintain proper grade, section, concrete cover over slab reinforcement, and slab thickness before any concrete is placed.

      While placing the concrete, make enough strike-off passes to produce the required profile and section.

Maintain the heading of concrete placement nearly parallel to and not more than 10 feet (3 m) ahead of the strike-off. The concrete carried ahead of the strike-off must not cause wheel slippage or other unsatisfactory operation.

Orient the transverse axis of the finishing machine parallel to centerline of bearing on all pre-stress and steel girder spans skewed more than 15°. Make the concrete placement heading parallel to the strike-off heading to produce equal loads on each girder.

2. **Hand Finishing.** Obtain the Project Manager's approval for hand finishing on deck slabs.

   Strike off concrete using a template or vibrating screed and finish to a smooth, even surface meeting the required profile and section using longitudinal and transverse floating. Power trowels are not allowed.

3. **Straight-edging.** Test the plastic concrete surface for surface smoothness behind the finishing machine with a 10-foot (3 m) straightedge. Ensure the straightedge contacts the surface in successive positions parallel to the centerline of roadway across the entire slab width. Make longitudinal advances in maximum 5-foot (1.5 m) increments.

   Immediately fill depressions with fresh concrete, consolidate, strike off, and finish. Remove high areas with a 10-foot (3 m) cutting straightedge and refinish. Correct all other surface defects using a 10-foot (3 m) float or combination float and cutting straightedge.

   Provide footbridge(s) that clear span the fresh concrete for complete finishing, texturing, curing, straightedge testing, and surface correction.

   Continue straightedge testing and surface correction until the entire surface meets the specified surface-smoothness requirements.

   Limited hand floating may be used to correct defects left by the finishing machine. Hand floating is not required if the machine-finished surface meets surface-smoothness requirements and is free of defects.

4. **Bridge Deck Surface Texture.** Perform transverse deck grooving prior to allowing traffic on the new deck. After the Project Manager has approved the finished deck surface and concrete has cured for the specified cure period, saw cut transverse grooves into the finished deck. Use grooving equipment capable of saw cutting ⅛ ± $^{1}/_{16}$-inch (3 ± 2 mm) wide and $^{3}/_{16}$ ± $^{1}/_{16}$-inch (5 ± 2 mm) deep at 1¼ ± $^{1}/_{16}$-inch (30 ± 2 mm) center-to-center spacing. Do not overlap grooves during succeeding passes. Terminate grooves 1-foot (305 mm) from the face of rail or face of barriers and 4 inches (100 mm) from the paving notch, guard angles or expansion joints.

5. **Broom Texture.** Hand-finish the traffic surface of curbs, sidewalks, and other horizontal surfaces to receive a broom finish in accordance with Subsection 552.03.11(A).

6. **Surface Smoothness.** The finished surface must not vary more than $^{3}/_{16}$-inch (5 mm) from a 10-foot (3 m) straightedge placed parallel to the roadway centerline.

   High spots are measured as ½ the distance between the end of the straightedge and the pavement surface with the straightedge centered on the apex and the opposite end held in contact with the surface. Low spot variations are measured as the distance from the straightedge to the surface with the straightedge centered on the low point. Correct unacceptable surface variations by grinding off high spots and patching or filling low areas.

   Subsequent surface sealing will not be required where the grooved surface is produced using a diamond-faced saw-type cutter for grinding.

Perform surface sealing as follows for areas ground using conventional star-wheel-type cutters.

Seal all areas where removal exceeds ¼-inch (6 mm) in depth with an approved, concrete-colored, low-viscosity epoxy-resin adhesive. Produce a non-skid texture using a steel-tine broom or by applying medium-coarse silica sand to the plastic epoxy surface. Meet the surface smoothness requirements.

7. **Protective, Remedial, and Corrective Work on Deck Slab Concrete.** Do not place concrete for deck slabs and stop work when rain appears imminent. Take immediate action to strike off all concrete in place to promote drainage and prevent ponding.

Do not perform placing or finishing work that manipulates the concrete during precipitation.

Deck slabs areas where precipitation has been incorporated into the concrete may be rejected. Make a maximum 3 light passes with a straightedge float to remove excess water after the precipitation stops.

Protective work is that work necessary to protect unhardened concrete from damage by hail and rain. This includes covering the concrete with a protective covering when conditions warrant.

Remedial work is that work to restore a surface profile and texture on unhardened, rain-damaged concrete. Concrete damaged by rain to the extent the texture is obliterated and has a sandy appearance may be repaired by removing excess water and restoring it to the specified surface smoothness and texture.

Hardened concrete is concrete that is non-plastic and does not allow the vibrator to penetrate under its own weight.

Corrective work is work to provide an acceptable profile and texture on hardened, rain-damaged concrete.

Do not place fresh concrete against hardened concrete until a construction joint is placed in accordance with Subsection 552.03.6.

Correct areas exceeding the specified surface-smoothness tolerance and areas where the specified texture cannot be produced by grinding and grooving using concrete grinding machines.

Use a diamond saw type grooving machine.

Grooves may be either longitudinal or transverse. Space grooves at ¾-inch (19 mm) centers and be ⅛-inch (3 mm) wide by ⅛ to $^{3}/_{16}$-inch deep (3 to 5 mm).

Grooving is not required on areas that measure 10 feet (3.0 m) or less in length parallel to centerline of roadway.

Do not grind or groove so that concrete cover is reduced over the top reinforcing bars to less than 2 inches (50 mm).

Remove, replace, or overlay areas that cannot be corrected to the required surface smoothness and texture by grinding and grooving. Submit proposed overlay methods in writing to the Project Manager for approval before use.

Remove all latence and hardened, excess concrete from construction joints before placing curbs, barriers, or other concrete.

Furnish all protective, remedial, and corrective work to provide an approved deck slab at Contractor expense.

C. **Bridge Seats and Tops of Walls.** Bring the concrete at bridge seats and tops of walls up to the required grade elevation, strike off with a straightedge, and float to a smooth, uniform texture.

Slope the concrete surfaces in areas of bridge bearing assemblies to drain water away from the bearing devices as specified.

Bushhammering is permitted only for leveling the concrete surface under the bearing plate and removing latence and loose and foreign material. Bushhammer to produce full, level bearing.

When necessary, place shims in accordance with Subsection 565.03.2.

D. Ordinary Finish. An ordinary finish is the concrete surface left once the forms are removed and all holes caused by form ties, trapped air, and all other defects are repaired. The finished surface must be true and even, free from stone pockets, depressions, or projections beyond the surface.

Ordinary finish is produced as follows:

- Soak the concrete surface with water, and use the patching mortar specified in Subsection 552.03.10, working it into the small air holes and other voids in the concrete face with a sponge float or wooden float.
- Rub off excess mortar after the mortar is partially set using burlap or carpet.
- Remove uneven mortar surfaces that have set too hard by rubbing the entire surface with a carborundum stone and water.
- Produce a finished surface that is uniform in texture and color.

Rub-finish all surfaces not repairable by the ordinary finish method in accordance with Subsection 552.03.11(E).

The ordinary finish may not be required for exposed vertical concrete surfaces listed below, if the forming produces a true and uniform surface and minor defects are repaired as specified:

- Interior surfaces of box type concrete structures such as culverts, stockpasses, and minor grade separations; or
- Concrete diaphragms for prestress girders; or
- Pier shafts, abutment walls, columns, struts, crossbeams, or other substructure components located where they are not readily subject to public access or view. In general, substructure elements on bridges in undeveloped rural areas and more than 25 feet (7.6 m) from the edge of the public road, located in or over streams not used extensively for recreation, or exclusively over railway property are not considered subject to public access and view.

Good forming practice is considered as:

- Using materials with a smooth surface free from holes, tears, dents, and gouges;
- Using the largest practical pieces to minimize joints;
- Arranging joints to be vertically or horizontally symmetrical; and
- Using bracing to prevent bulges, offsets, and other major defects in the concrete surface.

Repair major surface defects, and finish the substructure unit surface or other structural components to a uniform appearance.

Major surface defects are large rock pockets, offsets at form joints exceeding ¼-inch (6 mm), bulges, projections and depressions that deviate from the surface plane by more than ¼-inch (6 mm) in any 4-foot (1.2 m) length, and all other defects that reduce plan reinforcing bar cover by more than ¼-inch (6 mm).

Minor surface defects may be corrected without finishing the surrounding surface. Remove mortar fins even with the surrounding surface. Fill air holes exceeding ¾-inch (19 mm) in the longest dimension with mortar and strike off even with the surrounding surface. Patch minor rock pockets, tie holes, and the like as specified in Subsection 552.03.10.

E. Rubbed Finish. After concrete has hardened, saturate the surface with water and rub using a medium-coarse carborundum stone with a small quantity of mortar on its face. Approved bonding agents may be used.

Use mortar consisting of cement and fine sand in the same proportions used in the concrete being rubbed.

When forms are removed while the concrete is “green”, wet the surface and rub it with a wooden float. If approved the thin mortar described above may be used for rubbing.

Continue rubbing until all form marks, projections, and irregularities are removed, all voids filled, and a uniform surface is obtained. Keep the paste produced by rubbing moist and allow it to set for at least 5 days. Smooth the surface by rubbing with a fine carborundum stone and water. Rub to produce a smooth texture and uniform color over the entire surface. After the final rubbing is complete and the surface has dried, rub the entire surface with burlap to remove loose mortar. The finished surface cannot have unsound patches, paste, powder, or objectionable marks.

F. Special Tooled Finish. Produce special tooled finishes using a bushhammer, a pick, a crandall, or other approved tool. Use air tools unless otherwise directed. Do not begin tooling until the concrete has set for at least 7 days, or longer if necessary, to prevent “picking” the aggregate out of the surface. Produce a finished surface showing broken aggregate in a matrix of mortar, each aggregate particle being in slight relief.

552.03.12 Installation of Expansion and Contraction Joints

Construct expansion and contraction joints in accordance with the contract.

A. Open Joints. Construct open joints by inserting and removing a template made of wood, metal, or other approved material. Remove the template without chipping or breaking the concrete corners.

Do not extend reinforcement across an open joint unless specified.

B. Filled Joints. Construct poured expansion joints similar to open joints. Use filler material listed on the QPL and in accordance with Subsection 707.01.

When pre-molded expansion joints are specified, the thickness of installed filler is specified in the contract. Match the joint filler to the shape and size of the surfaces to be joined and fix it firmly against the existing surface. Do not displace the joint filler while placing concrete.

Where more than one piece of filler is used to cover any joint surface, place the abutting pieces in close contact and join them together with a layer of asphalt-saturated roofing felt. Use a minimum 20-pound (1 kg/m^2) grade roofing felt having one side covered with hot asphalt.

The filled joints will be inspected immediately after the forms are removed. Neatly cut and remove all concrete or mortar that has sealed across the joint. Fill openings in deck slab joints during construction with an approved tar or asphalt as directed.

Place the necessary dowels, load-transfer devices, and other devices as specified.

C. Steel Joints. Fabricate and paint the joints as specified. Ensure that the surface in the finished plane is true and free of warping.

Hold joints in the correct position during concrete placement.

Use the openings at expansion joints shown in the contract, correcting for installation temperature. Maintain the required clearance.

D. Water Stops. Place water stops as specified.

552.03.13 Placing Anchor Bolts

Install anchor bolts and dowel bars by one of the following methods:

- Securing in position prior to casting concrete;

- Drilling and grouting; or
- Forming holes and grouting.

Determine the final bolt and dowel locations, making allowance for thermal effects on the superstructure at the time of grouting.

Ensure that all anchor bolts for shoe assemblies project above the plane of the substructure concrete to provide full anchor bolt and nut engagement after the final placement of the shoe assemblies.

Form holes by inserting treated wood plugs or metal pipe sleeves into the plastic concrete and withdrawing the devices after the concrete has partially set. Form holes at least 3 inches (75 mm) in diameter to allow for horizontal adjustment.

Drill holes at least 1-inch (25 mm) larger than the diameter of the anchor bolts. Verify diameter and depth before setting the beams.

Use an approved non-shrink or epoxy grout and fill holes ⅔ full. Force bolts and dowels down using uniform, even pressure or light blows with a hammer until the grout rises to the top of each hole and the bolts and dowels are inserted to the correct depth. Remove all excess grout, and clean the metal surfaces for painting. If below freezing temperatures are expected, a non-shrink or epoxy grout product formulated specifically for use at temperatures below freezing must be submitted for approval prior to grouting.

Protect holes against damage from ice by filling with a non-evaporating antifreeze solution. Before grouting, remove the antifreeze and thoroughly flush the holes with clean water.

Install the anchor bolt nuts as shown in the contract. Tighten the upper nut against the lower nut so neither nut can be turned by hand.

Correct all inaccuracies in bolt and dowel locations using approved methods at Contractor expense.

552.03.14 Setting Shoes and Bearing Plates

Set shoes and bearing plates in accordance with Subsection 565.03.2.

552.03.15 Drainage Holes and Weep Holes

Construct drainage holes and weep holes as specified. Place ports and vents for equalizing hydrostatic pressure where required.

Forms for weep holes through concrete may be wood, clay pipe, PVC pipe, concrete drain pipe, wooden boxes, or metal. Remove wooden forms, if used, after the concrete is placed. Paint or galvanize exposed metal drain surfaces as specified.

552.03.16 Pipes, Conduits, and Ducts

Install and rigidly brace pipes, conduits, and ducts encased in concrete before the concrete is placed.

Furnish and install 3-inch (75 mm) length plastic, PVC pipe or approved equal in the bottom slab at the low point of each box girder cell to provide drainage for each cell. Extend the pipe ¼-inch (6 mm) below the bottom of the slab and flush with the slab's top surface.

552.03.17 Loading of Piers and Abutments

Do not place any superstructure load on finished bents, piers, or abutments until approved. The minimum time before any superstructure load is placed on the substructure is 7 days, unless otherwise approved.

552.03.18 Silane Sealer

Apply Silane sealer after the deck has been cast for at least 28 days and after transverse deck grooving is completed.

Remove any grease, oil or other contaminants on the deck surface by sandblasting the contaminated areas. Sandblast all area of the deck surface where vehicular traffic has been present.

Power wash the entire deck surface to remove concrete swarf, dirt, dust and other debris. Allow the deck to dry until it is visibly dry with no ponding or dark areas indicating moisture in the concrete surface.

Temporarily plug any deck drains and take any other precautions as necessary to ensure that the sealer is not allowed to drip off the deck.

Apply sealer in accordance with manufacturer's recommendations until refusal. Refusal means that additional applications remain on the surface of the concrete and does not soak in. Provide the Project Manager with the manufacturer's recommendations for application and storage.

552.03.19 Bridge Deck Crack Sealing

A. Submittals. Submit 2 copies of the following to the Project Manager for review prior to beginning work:

1. A MSDS for each shipment of the crack sealant components.
2. If high molecular weight methacrylate (HMWM) is supplied, provide certification from an independent testing laboratory that the materials meet the contract requirements**.**
3. The dates of manufacture of the deck sealant materials, their lot numbers and date of shelf-life expiration for each lot number.
4. A table showing the likely cure time in minutes for the allowable ambient temperature range, in increments of 10 °F (6 °C).
5. A work plan for each structure that includes estimated times for surface preparation and sealant application.

B. Material Delivery and Storage. Store sufficient quantities of sealant materials at the site to perform the entire application. Store these materials in their original containers and according to the manufacturer's direction. These containers must bear the manufacturer's label. The label must show the manufacture date, the batch number, the trade name brand, and quantity. Store containers of promoters and initiators in a manner that prevents leakage or spillage.

C. Surface Preparation. Clean all concrete surfaces for bridge deck crack sealant according to the manufacturer's recommendations. Remove curing compound, laitance, grease, dirt, dust, salt, oil, asphalt, coating, and other foreign materials. Select the size of shot or sand, and travel speed of the equipment to provide a uniformly clean surface with a uniform profile. Sand blast areas that are not cleaned with the shot blast equipment. Remove striping to the maximum extent determined to be practical by the Project Manager using up to 3 passes with shot blasting, sandblasting or other approved equipment.

D. Application. Follow the manufacturer's recommendations. The deck surface must appear dry to a visual inspection at the time of bridge deck crack sealant operations. The application rates may vary depending on field conditions. Pretreat visible cracks if required. Fill the cracks and keep them full. Continue the pretreating process until refusal of the crack to accept the material.

Apply the resin to the deck within 5 minutes of complete mixing. Redistribute excess material continuously, using squeegees or brooms, and stop before resin gels.

For HMWM applications, provide a manufacturer's representative on site for the duration of the work, to provide expert assistance on storage, mixing, application, clean-

up and disposal of materials. The manufacturer's representative is required to assist the Contractor in determining the application rates.

Broadcast sand mechanically over the entire treated area of the bridge deck to obtain a visually uniform coverage of 2.5 pounds per square yard (1.3 kg/m^2). Spot sand as necessary to ensure complete coverage. Apply the sand prior to deck sealant cure to ensure adequate bonding. Remove excess sand as required.

E. Limitations. Do not use material after the shelf life date. Cover membrane and elastomeric material in deck joints, plug deck drain scuppers, seal cracks on underside of deck, and use other protective measures to protect waterways and bridge components. Replace or repair bridge components if materials or solvents harm their appearance or function, at no cost to the Department.

The following conditions govern work on each individual portion of a structure unless otherwise approved by the Project Manager in writing.

1. Do not apply deck sealant materials within 48 hours after a rain or when more than 10% probability of rain is forecast within 4 hours following the application.
2. Conduct the work in a continuous operation with the bridge deck crack sealant application immediately following surface preparation.
3. Apply HMWM treatment only if the deck surface temperature and the air temperatures are between 50 and 90 °F (10 and 32 °C) and the weather forecast shows air temperatures will remain within that range for at least 12 hours after the end of the application. Apply Epoxy treatment at temperature requirements in accordance with manufacturer recommendations.

Do not permit traffic on the treated surface until the sand cover adheres sufficiently so that no tracking will occur.

F. New Bridge Slab Construction. Upon completion of the water cure and prior to transverse grooving and Silane treatment, treat all visible cracks with crack sealer. In areas where crack sealer has puddled, spread sand on the surface in an amount to ensure adequate skid resistance. Visible cracks are cracks that can be seen unaided from about 4 feet (1.2 m) above the deck. The Project Manager will determine the locations where crack sealing is required.

552.03.20 Opening to Traffic

Open concrete deck bridges to traffic only with the Project Manager's approval.

Do not open concrete bridge decks to traffic when the air temperature during the cure period is 50 °F (10 °C) or higher, until one of the following is met:

1. Twenty-one days after placing concrete unless standard strength test results indicate more time is required; or
2. Test results on field-cured test cylinders indicate that at least 90% of the required minimum strength has been attained. Two cylinders constitute a test, with the test strength being the average of the strengths of the 2 individual cylinders.

The Project Manager will determine the opening date when the ambient temperature during the cure period has been lower than 50 °F (10 °C).

552.03.21 Acceptance

Repair or replace all defective work at Contractor expense. Remove and replace the entire section at Contractor expense when the Project Manager determines the repair is not adequate.

Acceptance of the bridge deck concrete placement and water cure is based on meeting the following requirements:

1. Proper use of fogging;
2. Proper water cure; and

3. Application of silane sealer.

The Project Manager will determine if these items meet this specification. The Project Manager may apply a 10% deduct on each separate pour, for each item that does not meet specifications.

No incentive will be awarded for pay factors calculated from Subsection 551.03.8, if any deductions are applied. The Department may require corrective action for any concrete not in accordance with the contract at Contractor expense.

552.04 METHOD OF MEASUREMENT

Concrete is measured in cubic yards (m^3) from the plan dimensions. Plan quantities will not be re-measured except as specified in Subsection 552.05.

Fillets, scorings, and chamfers 2 inches (50 mm) or less in the greatest dimension are omitted from the quantity calculations.

No deductions are made for the concrete volume displaced by reinforcing steel, structural steel, prestressed beams, anchor bolts, drains, weep holes, joint fillers, conduits, or junction boxes.

Deductions are made for the concrete volume displaced by steel and concrete piles.

When ordered in writing by the Project Manager, concrete quantities placed outside neat lines, are calculated and added for payment.

No measurement is made for forms, falsework, cofferdams, bracing, and the like.

Crack sealing is measured by the square yard (m^2) of deck surface area treated. When required as part of new bridge construction, crack sealing will be measured in accordance with Subsection 109.04.

Fogging, water cure and Silane sealer are not measured for payment.

Transverse deck grooving is measured in square yards (m^2) for the actual area grooved.

552.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made in accordance with the following:

A. The calculated quantities involved in changes ordered in writing by the Project Manager are added or deducted from the contract quantities.

B. A re-calculation will be made and the corrected quantity included for payment, in lieu of the contract quantity, when the contract quantity of any complete structure element is in error by 2% or more. A complete structure element is the smallest portion of a total structure for which a quantity is included in the Estimated Plan Quantities Table shown in the contract. The party to the contract requesting an adjustment in quantity must present to the other party 3 copies of the description and location and recalculated quantities of the structure element that has the quantity error.

C. All Classes of concrete placed in bridges are subject to a payment reduction based on lot payment factors in accordance with Subsection 551.03.8(B)(1).

Partial payments for structure elements will be made based on the contract quantities as follows:

1. 40% of superstructure concrete when deck forms are complete in place.

2. 80% when all types of concrete are placed.

3. 85% when curing is complete.

4. 95% when all finishing is complete.

5. 100% when the structure element area is cleaned up to the Project Manager's satisfaction.

Pay Item	**Pay Unit**
Bridge Deck Crack Seal	Square Yard (m^2)
Concrete	Cubic Yard (m^3)
Transverse Deck Grooving	Square Yard (m^2)

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract.

SECTION 553
PRESTRESSED CONCRETE
MEMBERS

553.01 DESCRIPTION

This work is the furnishing and placing of precast, prestressed concrete beams, slabs, piling, and other structural members.

553.02 MATERIALS

553.02.1 Concrete

Furnish concrete in accordance with Section 551.

553.02.2 Reinforcing Steel

Furnish reinforcing steel in accordance with Subsection 711.01.1. Obtain the Project Manager's written approval for reinforcing steel substitutions.

State on the fabrication drawings showing reinforcing steel details the following or similar words: "All dimensions are out-to-out".

553.02.3 Steel Rods and Bolts

Furnish rods used as dowels and bolts in accordance with Subsection 711.07.

553.02.4 Prestress Steel

Furnish high tensile strength steel wire in accordance with Subsection 711.11.

Furnish the typical load-elongation curves for all shipments of prestress steel to the fabrication plant.

Ensure all prestress steel used in the work is free of rust, corrosion, dirt, oil, spatter from welding or flame cutting, kinks, bends, nicks, broken wires, or other defects.

Prestress steel is sampled in accordance with MT 111.

553.02.5 Enclosures

Use metallic enclosures, excluding aluminum, or forms using removable cores or ducts made of rubber or other approved material. Remove cores and ducts before installing the prestress steel.

Use enclosures that are mortar tight and maintain their shape when subjected to loading.

Use enclosures that are ¼-inch (6 mm) larger in internal diameter than the bar, cable, strand, or group of wires being enclosed.

Equip cores or ducts with pipes or other connections for grout injection when pressure grouting is specified.

553.02.6 Structural Steel

Furnish structural steel in accordance with Subsection 711.02.

553.02.7 Elastomeric Bearing Devices

Furnish elastomeric bearing devices in accordance with Subsection 711.14.

553.02.8 Fiber Reinforced Pads for Bearing Plates

Furnish fiber reinforced pads in accordance with Subsection 711.16.

553.02.9 Deck Sealer

Furnish deck sealer for precast prestressed deck sections which is listed on the QPL and in accordance with Subsection 717.02.

553.02.10 Leveling Inserts

Furnish Leveling inserts for precast prestressed deck sections designed for a minimum working tension of 5,500 lbs. (24.4 kN) and have machine threaded ferrules. Use ¾-inch (19 mm) minimum diameter structural connection type leveling inserts.

553.03 CONSTRUCTION REQUIREMENTS

553.03.1 Fabrication

Fabricate all prestressed concrete members using a manufacturing plant currently certified by the Prestressed Concrete Institute or the National Precast Concrete Association in the category applicable to the member being fabricated. The Department will make an exemption for new manufacturing plants that are of the same ownership as an existing certified plant, provided the new manufacturing plant operates under the same quality assurance and control programs as the certified plants, modified to address any production differences, and all fabrication is performed under the direct supervision of a quality assurance and control manager provided by an existing pre-qualified plant. Direct supervision means that the quality assurance and control manager is on site during all fabrication performed in the new fabrication plant and is responsible for the quality assurance and control activities.

Furnish a copy of the plant's current certification in the applicable category along with the fabrication drawings for the elements to be fabricated. For new manufacturing plants, submit and receive approval of any proposed modifications to the parent plant's quality assurance and control program prior to beginning production. Allow 30 business days from the date submitted for Department review and approval.

The fabricator may prestress by pretension or post-tensioning the member, subject to the contract requirements.

Obtain written approval before changing the prestressing details.

553.03.2 Fabrication Drawings

Before casting members, submit fabrication drawings and designs calculations to the Project Manager. Show complete details of the method, materials, and equipment proposed for use in prestressing.

Include in the fabrication drawings the following information:

1. An erection layout of the members placed in the structure or structures with each prestress member assigned a production number. Mark each completed member with an assigned number;
2. A tentative fabrication schedule;
3. The proposed mix design, including admixtures;
4. The prestress steel manufacturer's name and the applicable specifications;
5. Details of the method and sequence of stressing including the numbered or lettered layout to be followed to stress the member. Show complete details of the proposed method for tensioning the draped strands. Include in the details gauge and elongation readings for initial, intermediate, and final tensioning, as well as the deflection sequence, where applicable;
6. Complete details, including anticipated camber, tensioning forces (initial and final), and required concrete strengths (transfer and 28-day);
7. A complete detensioning procedure for the castings;
8. Details of items to be incorporated into the beam, such as chairs, inserts, hold-downs, etc., listed by source, type, size or capacity, and supplier;

9. Show all items incidental to the beams, such as bearing plates, rocker assemblies, anchor bolts, etc., if supplied by the beam fabricator. Include the specification and grade of all steel items;

10. All information and data required for fabrication;

11. Show the tack welding procedures;

12. Detail the use of all external weights or hold-downs if used. If weights are not required, note it on the fabrication drawings;

13. Show the finish for all steel members incorporated in the beams. For galvanized items, identify the applicable specification. For painted items specify paint type, manufacturer and recommended dried film thickness for each coat applied in the shop. Also identify surface preparation for each item to be painted. For paint requirements, refer to Section 612;

14. Submit welder certifications and welding procedure specifications for all welding done to any member incorporated into the beam. For welding requirements see Subsections 556.03.1 and 556.03.10; and

15. For precast prestressed deck sections:

a) Show the location of the leveling inserts; and

b) Drawings of the proposed leveling system.

Show all changes from the prestressed details in the contract.

Submit 5 copies of shop drawings on 11" x 17" or larger sheets and 5 copies of welding procedures and design calculations on 8½" x 11" or larger sheets to the Project Manager. Shop drawings, design calculations, and welding procedures may be furnished in Adobe Acrobat Reader (.pdf) format in lieu of the hard copies. Ensure the submittal includes all information required to check the structural accuracy and fabrication procedures for the structure.

Structural shop drawings must be designed, and stamped by a professional engineer registered and licensed to conduct engineering in the State of Montana.

Do not begin fabrication until the Department approved drawings are received by both the plant and the Department Inspector. Coordinate the fabrication schedule with the Department Inspector.

553.03.3 Design of Concrete Mixtures

The prestressed girder concrete must have a minimum ultimate compressive strength of 4,000 psi (27.6 MPa) at transfer of prestress and 5,000 psi (34.5 MPa) at 28 days. The actual required strengths are specified in the contract.

Furnish a concrete mix design that produces concrete meeting the specified compressive strengths before use. Approved changes to the mix design may be permitted during fabrication.

Use a concrete design of between 6.5 to 8.0 sacks of cement per cubic yard (350 - 450 kg/m^3) of concrete.

Establish the Class Pre concrete slump range between 1 and 4½ inches (25 and 115 mm). The high and low limits of the range may not exceed 1½ inches (38 mm). The range may be changed with the Engineer's approval.

553.03.4 Forms

Use steel side and bottom forms. End bulkhead forms may be steel or plywood.

Form joints and strand exits through bulkhead forms that are mortar tight.

Check the grade and alignment of side forms before casting. Check the beam bed alignment for displacement while placing the concrete.

Construct beam bed forms to limit movement to not exceed ¼-inch (6 mm) from a straight line in any 50-foot (15.25 m) length of the bed.

Use clean forms that are free from warp, bulge, and other defects.

Do not exceed a maximum offset of $^{1}/_{16}$-inch (2 mm) where form sections are joined.

Treat the form facing with a bond breaker before each casting. Form treating materials that stain or react with concrete are not permitted. Apply form oil or other bond breaker materials without contaminating the prestress strand and reinforcing steel. Clean soiled strand or reinforcing with a non-contaminating solvent.

Chamfer all exposed concrete edges, excluding the beam top, with an enclosed angle of less than 120°. Use chamfer strips having no irregularities, and maintain smooth joints with the chamfer tightly fitted against abutting forms.

Fit forms with a grade strip or other positive control to establish the nominal depth of the beam.

Use forms that can be removed from the member without damaging the concrete.

Identify production form dimensions that vary from the contract beam dimensions on the fabrication drawings.

553.03.5 Placing Reinforcing Steel

Place and secure all reinforcing steel as shown in the contract before placing concrete.

Fasten all bars at all intersections with adjacent bars.

Do not tack weld reinforcing steel if the reinforcing bar is a stress-carrying member. Welding non-stress reinforcing bars may be permitted with the Engineer's approval. Reinforcing steel welds not shown on the approved tacking detail or fabrication drawings are prohibited.

For convenience, additional reinforcing steel may be tied in for securing inserts, void ducts, etc., or may be secured by tack welding.

Protect the tensioning strand from weld spatter using wet burlap or other protective covering. Replace all strands with weld spatter at Contractor expense.

Provide the distance between the reinforcing and side forms using approved stays, ties, or chairs. Do not use precast mortar blocks, pebbles, pieces of broken stone or brick, metal pipe, or wooden blocks.

Provide clearance between the beam stirrups and the beam bed using metal chair supports with stainless steel or other approved, corrosion-resistant legs.

Use reinforcing steel in the ends of prestressed beams to provide clearance for the paving notch block out, void ducts, embed plates and anchorages, and inserts without interfering with the reinforcement spacing.

Reinforcement in the prestressed member will be inspected in place and approved by the Inspector before the concrete is placed. Concrete placed before inspection may be rejected.

553.03.6 Prestressing Equipment

Use approved jacking equipment for prestressing.

Equip hydraulic jacks with pressure gauges. Have a certified testing laboratory calibrate each jack and gauge combination as a unit with the cylinder extension in the approximate position that it will be in at the final jacking force. Have a certified calibration chart for each jack.

Other types of jacks may be used with proving rings or other approved devices calibrated by a qualified testing laboratory.

Calibrate jacking equipment once each year and after each repair. Re-calibration may be required if any jack or gauge gives erratic results or if the difference between the gauge reading and elongations exceed allowable limits.

Equip tensioning systems with hydraulic gauges that prevent the gauge pointer from fluctuating until the jacking load is released from the tendon. The gauge must read loads directly in pounds (Newtons) or have a chart to convert the dial reading into pounds (Newtons). Ensure the gauge readings are accurate to within ± 2%.

Locate the gauges to provide the operator and Inspector a clear view of elongation measurements and gauge readings. Use gauge dials graduated in increments not exceeding 100 pounds (700 kPa) pressure. The gauge range or load cells must not use the lower 10% of the manufacturer's rated capacity in determining the jacking stress, unless calibration data establishes accuracy within the 2% requirement at the lower range.

Ensure the end anchorages and prestressed member stressing blocks can maintain the required tension in all prestressed tendons until the concrete has been placed and reached transfer strength. Equip the end anchorages and stressing blocks to detect deflection while prestressing. The Inspector will check for deflection.

Provide the equipment to determine concrete compressive strengths at the location the prestressed members are manufactured. The test equipment may be mechanical or hydraulic, capable of applying and measuring the required load. Error for loads within the loading range of the test equipment may not exceed an error of ± 1.5%. Have a certified calibration diagram covering the entire use range with the equipment at all times. The indicated load of the testing equipment does not have to be corrected by calculation or by the calibration diagram to obtain values when the values are within the required variation of + 1.5%.

Certify the concrete strength testing equipment every 2 years; after each repair or adjustment of the equipment; when a non-portable machine has been moved; and whenever accuracy is in question.

553.03.7 Pretensioning

Hold the prestressing elements in position using jacks when stressing. Keep a record of the jacking force and the elongations.

Multiple units may be cast in a continuous line and stressed at one time. Leave a space between the ends of the units to permit cutting of the strands.

Furnish strand in coils, reel-less packs, or on reels. Stringing may be performed by pulling single or multiple strands. Pull to gradually relieve strand rotation on coil or reel-less packs.

Strand with gripped points are not permitted within the lengths to be stressed.

Bring all prestress tendons to the uniform initial tension on the approved fabrication drawings. Initial tension is the minimum force required to equalize stresses and eliminate slack in the strand. Submit alternate initial loading proposals for approval.

The initial load may be applied by the jack used for single strand tensioning or by any other approved method that provides a definite, uniform load. Regardless of the method used, measure the initial load within ± 100 pounds (450 N). Compute elongation measurements for initial tensioning but do not use as a measurement of the initial force.

Once initial tensioning is complete, reference mark the strand as directed. The mark must provide an accurate measurement of elongation by final tensioning.

Measure the induced stress by gauge and check it by elongation, load cell, or both. The results must agree within 5%. Do not permit jacking stress to exceed 75% of the specified minimum ultimate tensile strength of the prestressing steel. Measure the strand elongation to within 1% of the theoretical elongation or ⅛-inch (3 mm), whichever is smaller. If a discrepancy between measured elongations and gauge readings exceeds 5%, check and correct the entire operation before proceeding with the work.

All uplift devices, hold-down devices, and strand openings in end bulkheads must have rounded, smooth surfaces at all contact points with the strand.

Take gauge readings, elongation measurements, and make calculations for elongation and include allowances for operational losses for the tensioning system used. These allowances must include losses for strand slippage, anchor movement, friction, strand rotation, and other forces acting on the strand.

If the temperature difference between the strand at the time of tensioning and the concrete at the time of pouring exceeds 30 °F (16 °C), correct the computed elongation measurements for the temperature differences.

Provide copies of the elongation calculations to fabrication and inspection personnel at the beginning of production to ensure all allowances for the method of tensioning have been considered.

553.03.8 Final Tensioning

A. Single Strand Tensioning. After the initial load is applied and the reference marks are established, individually pull the strands to the final load. Tension each strand to the load required by the gauge reading.

The elongation measurement must be within ± 5% of the load indicated by the gauge reading. If the load indicated by gauge reading doesn't agree with the measured elongation within the required tolerance, discontinue tensioning and inspect the bed for restrictions that could affect the accuracy of the applied load.

If the measurements agree, three more strands may be tensioned. If elongation measurement and gauge readings are within the required tolerance, the remaining strands may be tensioned.

As some variation in the modulus of elasticity and the cross-sectional area of a strand does exist, the strand tensioning may be accepted, if the difference between the load determined by elongation and that indicated by the gauge does not exceed 5%. A maximum 10% of the total number of straight strands for any one line of casting will be accepted on this basis.

If the difference between the elongation load and gauge readings exceed the limits, discontinue tensioning and correct the problem.

B. Multiple Strand Tensioning. Mark each strand, once pre-loaded and seated in the anchorage, at both end anchorages to determine elongation and slippage. The Inspector will establish references to verify parallel movement.

Measure the stressing force by the gauge system and check it by the elongation measurement.

Use 2 load cells to verify the applied design load and check the uniformity of pull. Place one load cell on each side of the line of pull, preferably on the outermost strands of an upper row of straight strands.

If the hydraulic gauge and the load cells agree with the elongation measurements within ± 5%, the strands are acceptably tensioned. If the gauge reading is within 5% but either or both of the load cells exceed that limit, re-tension the strands including pre-loading. Locate and place the load cells on the strands nearest to those previously gauged.

If, upon re-tensioning, the load cells are within the 5% tolerance, no excess strand slippage has occurred, and the movable anchorage has traveled the required distance, the tensioning may be accepted.

If the difference between the gauge readings, load cell readings, and elongation measurements exceed the tolerance limit, stop tensioning and correct the problem.

Lubricate the jacking ram or rams, guide rods, and movable anchorage rails to minimize friction and run the ram through its length of travel at least four times before tensioning the strand.

C. Tensioning Draped Strands. Draped, pre-tensioned strands may be tensioned by partial jacking at the stressing block and subsequent depressing or uplifting to the deflected position or by tensioning to the initial and final loads with the tendons held in

the final design position using pins, rollers, or other devices. Use low-friction devices at all points of slope change of the draped strand.

When draped strands are partially tensioned in the straight condition and then depressed to the final design position, determination of the final load is made as follows:

1. Before starting the tensioning operation, place a load cell at the dead end anchorage on one of the strands to be deflected in each line of beams.
2. The Inspector will select the strand to which the load cell will be placed.
3. Once tensioning is complete, the load cell reading must be within ± 6% of the final design load.

Should the load cell reading exceed the allowable tolerance, use additional deflecting jacks to distribute friction and restraint at the deflection points or, if necessary, revise the entire method for applying the final design load within tolerances.

If the tensioning of draped strands indicates readings within the tolerances, the Inspector may require load cells for occasional checks.

If tensioning of the draped strands is performed by partial tensioning and uplift or, by tensioning in the draped position, submit the method for approval before use.

Strand splicing using approved devices is permitted. One splice is allowed on any one strand between anchorages. Splices must not fall within a beam. For single strand tensioning, the number of strands spliced is not restricted. When multiple strand tensioning is used, the number of strands spliced may not exceed 10% of the total number of strands in the casting line, or all the strands must be spliced.

Use only one manufacturer's strand in any one tensioning operation.

Use the same direction of twist of strand wires in all spliced strands.

One wire failure in 7 wire strands may remain in the casting, subject to the following: For beams with:

a. Less than 20 strands ..... No wire breaks permitted
b. 20 to 39 strands..... 1 wire break permitted
c. 40 to 59 strands..... 2 wire breaks permitted
d. 60 or more strands ..... 3 wire breaks permitted

Should wire breaks exceed these limits, or more than one wire break in any individual strand, remove and replace that strand or strands.

Locate all wire breaks allowed to remain in the casting, and securely wrap the broken ends with tie wire to prevent unraveling.

The Fabricator may be ordered to check the prestressing steel in a tensioned member for loss of prestress before placing concrete. The Project Manager will approve the checking method for loss of prestress. Re-tension all strands showing a loss of prestress exceeding 3% of the original computed jacking stress.

Except as permitted in Subsection 553.03.5, do not weld, flame-cut, or ground welding equipment to the bed or forms after the prestress strand has been tensioned.

553.03.9 Placing Concrete

A. General. Batch and mix concrete in accordance with Subsection 551.03.3, except as provided below:

1. Provide master batch sheets to the Project Manager for review before production.
2. A timing device that locks the discharge gates of a stationary mixer is not required, however, the mixer must not be emptied until the materials have been mixed the specified time.
3. Ready-mix delivery slips are not required unless specifically requested.

The batching operation and equipment may be inspected at any time. The work will be stopped for failure to use approved procedures or equipment.

B. Method and Manner. Place concrete in accordance with Subsection 552.03.4 and the following.

Obtain the Project Manager's approval before placing concrete in large members. Concrete may be placed in the member in a single lift if satisfactory results are obtained, or in multiple horizontal lifts provided cold joints are not formed. Remove and replace concrete containing cold joints. When concrete is placed in layers, place the first lift to fill the form slightly above the juncture of the bottom flange and the beam web.

Compact the concrete immediately after pouring with high-frequency mechanical vibrators operating at a minimum 4,500 impulses per minute. Apply vibration internally, externally, or a combination of both methods to flush the mortar to the surface of the forms. Vibrate succeeding concrete layers to extend into the previously placed layer. Use vibrators to thoroughly consolidate the concrete to a plastic mass without causing segregation. Do not permit vibrator heads to contact reinforcing steel, prestressing steel, or other embedded items to aid consolidation. Slowly insert and remove internal vibrators from the concrete.

Have one additional vibrator available at the site at all times during concrete pours.

C. Concreting in Adverse Weather Conditions. Perform concrete work in accordance with Subsection 551.03.6 when the ambient air temperature falls below 40 °F (4 °C), except that the placement temperature for steam-cured Class Pre concrete must be between 50 and 90 °F (10 and 32 °C) at placement.

When the ambient temperature before concrete is placed is 35 °F (2 °C) or less, pre-heat forms to a minimum 50 °F (10 °C) removing all frost, snow, and ice from the forms and components to be embedded in the concrete.

Do not permit the concrete temperature to exceed 90 °F (32 °C).

Cover open buckets of concrete with wet burlap mats or other approved coverings, when necessary, to prevent slump loss or premature drying.

553.03.10 Curing

Water-cure or steam-cure prestressed concrete members in accordance with Subsection 551.03.7.

553.03.11 Transfer of Prestress

Prestressed strands may be released when the concrete has:

1. Reached the minimum compressive strength for transfer of prestress;
2. The cure cycle is complete; and
3. Restrictive forms are removed.

If delays are anticipated, maintain the temperature in the curing enclosure at a minimum 50 °F (10 °C) until transfer of prestress.

Use positive, external hold-downs or weights to offset the uplifting forces in the member when the hold-down strands are released, when required.

Use a method of harped and straight strands release to hold the lateral eccentricity of prestress to a minimum. Detail the bed release and the strand-cutting pattern on the fabrication drawings. Changes to the release procedures shown on the approved drawings are not permitted except by written request and the Engineer's written approval.

Cast cylinders to determine prestressed transfer strengths using MT 101 and MT 111 as modified below:

- Cast and cure the release cylinders under the exact conditions the prestressed members were cured.

- The concrete sample for each cylinder will be selected at random from different batches.

Once the cure cycle is complete, test the release cylinders in accordance with AASHTO T 22. Test 3 cylinders to determine the prestressed transfer strengths for each round of beam castings. The average strengths of the 3 cylinders must equal or exceed:

F'r + 0.35S

Where:

S = the standard deviation of the strengths for the 3 cylinders

F'r = the required concrete transfer strength as specified in the contract

Test all 3 cylinders within 30 minutes.

Furnish the number of release cylinders required to perform these tests.

The Contractor may cast additional back-up test cylinders.

Should the release strengths not be reached and all back-up cylinders are broken, put the casting through at least one additional complete cure cycle. The Project Manager may direct other tests to determine release strengths.

Test compression specimens using AASHTO T 22. While testing, apply the last ½ of the load at a rate between 1,200 to 3,000 psi (8.28 - 20.7 MPa) per minute.

The Inspector will witness the Fabricator's casting and testing of release cylinders.

553.03.12 Post-tensioning

Begin tensioning of the prestress reinforcing steel when the concrete cylinders representing the member to be prestressed reach the compressive strength shown on the approved fabrication drawings.

Stress the prestress reinforcing steel, using jacks, to the specified tension with the stress transferred to the end anchorage.

Measure the tension and elongation at all times.

Make a record of gauge pressures and elongation while post tensioning and submit it for review.

553.03.13 Bonding Steel

Bond post-tensioned steel to the concrete unless otherwise specified.

Clean all dirt, loose rust, grease, or other deleterious material from all pre-stress reinforcing steel.

Flush all conduits with water and blow them out with compressed air after post-tensioning.

Remove rubber sheaths used as enclosures, then flush and blow out the voids as described above.

Once cleaned, pressure-grout the conduit or void using a pressure not exceeding 100 psi (690 kPa). Continue grouting until a steady flow of grout exits from the pipe outlet. Close the outlet, then the inlet with the grout under pressure. Maintain the final grout pressure at between 50 to 100 psi (345 - 690 kPa).

553.03.14 Concrete Surface Finish

Perform the concrete finish work immediately after de-tensioning. Give the exterior surfaces of exterior members and the entire bottom flange of all girders to the juncture with the beam web an ordinary finish as specified in Subsection 552.03.11(D).

All other beam surfaces may be left with the surface created by the forms, if the surfaces are true, even, and free of stone pockets, depressions, or surface projections. Point with mortar and strike off even with the surrounding surface, all air holes in the concrete measuring ½-inch (13 mm) or more in any direction. Repair rough, uneven, and non-uniform concrete surfaces

using power grinders, carborundum stones, brushhammers, or other approved equipment and then apply an ordinary finish.

Match the appearance of the surface adjacent to the repair. Apply an ordinary finish to the entire adjoining surface of the member if a match is not possible.

Repair rock pockets identified for repair. Chip rock pockets back to sound concrete, clean, and permit inspection before patching. Rock pockets affecting the member's strength will be further evaluated before repair.

Notify the Inspector of all members having the prestress strand exposed for 8 inches (200 mm) or more on any one strand or any exposure of multiple strands before repair.

Provide an ordinary finish on beam ends not embedded in concrete. The Contractor may use approved epoxy or quick-setting grout products, provided the colors blend with the surrounding surface. Before finishing the beam ends, cut the strands back a minimum of ½-inch (13 mm) and fill the depressions with an approved epoxy.

When beam ends are to be embedded in concrete, the ends may be left rough and strands cut back to extend a maximum 1-inch (25 mm) beyond the surface of the concrete. Cut the strands in the area of the paving notch flush with the concrete surface.

Screed and rough-float the top surface of prestressed girders to the required depth of the member, bringing grout to the surface, and covering all aggregate.

Clean all projecting reinforcing stirrups of mortar and other foreign materials before starting the cure cycle.

553.03.15 Workmanship and Tolerances

All tolerances are applied to the theoretical positions and dimensions shown in the contract and approved fabrication drawings.

The tolerances from the plan and theoretical dimensions listed in Table 553-1 are the maximum acceptable cumulative deviations. The Project Manager will verify that the girders are within the allowable tolerances when the girders alignment is not influenced by temporary temperature differences between the girders surfaces. Tolerances in other manufacturing sequences cannot accumulate to supersede any individual tolerance. Members having dimensions outside the tolerance limits may be rejected.

TABLE 553-1
TOLERANCES FOR PRESTRESSED CONCRETE MEMBERS

Element	Tolerance
Length of beam, end-to-end, measured at centerline of beam, top or bottom flange	± ¾-inch (19 mm)
Centerline-to-centerline of end bearing plates	⅛-inch per 10 feet (3 mm per 3 m), but no greater than ½-inch (13 mm)
Depth of flanges, fillets, and web	± ¼-inch (5 mm)
Depth overall	+ ½ to ¼-inch (13 to 5 mm)
Width of flanges, fillets, and web	+ ⅜ to ¼-inch (10 to 5 mm)
Beam ends - deviation from square or specified skew	horizontal ± ¼-inch (5 mm), vertical ⅛-inch per foot (3 mm per 300 mm) of beam height or ½-inch (13 mm), whichever is less
Side insert, center-to-center and center to beam end	± ½-inch (13 mm)
Horizontal alignment (deviation from a straight line parallel to centerline of the member)	⅛-inch per 10 feet (3 mm per 3 m) of beam length but not greater than 1-inch (25 mm)
Camber differential between adjacent beams measured at release of prestress (to be applied only to identical members cast in same line)	⅛-inch per 10 feet (3 mm per 3 m) of span to a maximum of 1-inch (25 mm)
Stirrup bars (specified projection above beam top)	± ½-inch (13 mm)
Tendon position	± ¼-inch (5 mm) in center of gravity of strand group and individual tendons
Position of deflection points for deflected strands	± 6-inch (150 mm)
Position of handling devices along centerline of beam	± 6-inch (150 mm)
Centerline of bearing plates to end of beam	± ¼-inch (5 mm)
Bearing plates (deviation from a plane perpendicular to the vertical axis of the beam)	± $^{1}/_{16}$-inch (2 mm)
Stirrup bars (longitudinal spacing)	± 1-inch (25 mm)
Position of post-tensioning ducts	± ¼-inch (5 mm)

553.03.16 Storage and Transportation

Exercise care during transporting, storing, hoisting, and handling of the precast units to prevent cracking or damage.

Transport precast girders and slabs in an upright position, with the points of support and directions of the reactions with respect to the members being approximately the same during transport and storage as when the members are in the final planned position.

Lift the beams using the lifting eyes. During lifts, use spreaders between slings to eliminate the horizontal component of the lifting force from being applied to the beam. A spreader is not required when the angle between the sling and the top of the beam exceeds 45°.

Do not move prestressed members from the casting yard until the concrete has reached the 28 day strength and the Project Manager has been notified of the intent to transport the beams.

Replace units damaged by improper storing, handling, or transporting at Contractor expense.

553.03.17 Placing

Place precast, prestressed structural members as specified. Place piling in accordance with Section 559.

553.03.18 Bearing and Anchorage

Place masonry bearing plates in accordance with Subsection 565.03.2.

Place anchor bolts in accordance with Subsection 552.03.13.

553.03.19 Precast Prestressed Deck Sections

A. Fabrication Control. Schedule fabrication so that camber differences between adjacent deck sections are minimized. Measure camber on each deck section immediately after transfer of prestress forces. At transfer of prestress, the difference in camber between adjacent deck sections of the same design must not exceed ¼-inch (6 mm) per 10 feet (3 meters) of span length or a maximum difference of ¾-inch (19 mm), whichever is less.

B. General. Locate the leveling inserts so that the specified camber corrections are achieved. Center the leveling inserts over the beams web, install a minimum of ⅛-inch (3 mm) below the finished deck surface and cast into the member. Fill all insert holes with a non-shrink epoxy grout in accordance with Subsection 713.04.

C. Leveling. Make adjustments by use of a leveling beam and jack assembly. Attach the leveling beam to the inserts and jack the deck sections to within ⅜-inch (10 mm) at the center of the span prior to placement of the weld tie connections and diaphragms. More than one leveling beam and jack assembly may be necessary to adjust adjacent sections.

If the prescribed tolerance between deck sections cannot be attained by the approved leveling system, shim the bearings of the deck sections so that the required tolerance is met throughout the span.

D. Acceptance. Remove any grease, oil or other contaminants on the deck surface by sandblasting. After sandblasting, power-wash the entire deck surface to remove concrete swarf, dirt, dust and other debris. Allow the deck to dry until it is visibly dry with no ponding or dark areas indicating moisture in the concrete surface. Apply deck sealer by spray until refusal to the cleaned, dry deck. Refusal means that additional spray applications remain on the surface of the concrete and do not soak in. Ensure that a minimum of 28 calendar days have passed from the time the deck is cast to the application of the deck seal. Prevent chloride contamination of the deck during all stages of construction.

553.04 METHOD OF MEASUREMENT

Precast, prestressed concrete members, excluding piling, are measured by the foot (meter) for each specified type and/or size, installed and accepted.

Prestress beams are measured by the foot (meter) from centerline bearing to centerline bearing along the beam centerline.

Precast prestressed deck sections are measured by foot (meter) for each type installed and accepted.

553.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Precast Member	Foot (m)
Prestress Member	Foot (m)
Prestressed Beam – (Type)	Foot (m)

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract.

SECTION 554
PRECAST CONCRETE PRODUCTS

554.01 DESCRIPTION

This work is the furnishing and installing of reinforced precast concrete bridge members, precast curbs, barrier rails, cattle guard bases, guardrail posts, and other precast concrete products.

554.02 MATERIALS

554.02.1 Concrete

Furnish hydraulic cement concrete in accordance with Section 551.

554.02.2 Reinforcing Steel

Furnish reinforcing steel in accordance with Section 555 and Subsection 711.01.

554.02.3 Structural Steel

Furnish Structural steel in accordance with Subsection 711.02.

554.03 CONSTRUCTION REQUIREMENTS

554.03.1 Fabrication Drawings

Prior to casting members, submit fabrication drawings and design calculations to the Project Manager.

Include on/with the fabrication drawings the following information:

1. An erection layout with each member assigned a production number;
2. A tentative fabrication schedule;
3. The proposed mix design, including admixtures, and;
4. All other information necessary to fabricate and install the product.

Submit 5 copies of shop drawings on 11" x 17" or larger sheets and 5 copies of welding procedures and design calculations on 8½" x 11" or larger sheets to the Project Manager. Shop drawings, design calculations, and welding procedures may be furnished in Adobe Acrobat Reader (.pdf) format in lieu of the hard copies. Ensure the submittal includes all information required to check the structural accuracy and fabrication procedures for the structure.

Structural shop drawings must be designed, and stamped by a professional engineer registered and licensed to conduct engineering in the State of Montana.

Do not begin fabrication until the Department approved drawings are received by both the plant and the Department Inspector. Coordinate the fabrication schedule with the Department Inspector.

554.03.2 Design of Concrete Mixtures

Submit a proposed mix design with the shop drawings for approval.

The Contractor may request to change aggregate size and gradation to use aggregates in an established plant. Submit the request in writing and include sizes and gradation limits for each size aggregate. Furnish evidence of satisfactory performance of concrete produced from the aggregates. Do not make changes in the aggregates without approval.

554.03.3 Sampling, Handling, Batching, and Mixing

Sample, handle, batch, and mix materials for concrete in accordance with Subsection 551.03.3.

554.03.4 Forms and Forming

Meet the form requirements in Subsection 552.03.3.

554.03.5 Placing Concrete

Place concrete in accordance with Subsection 552.03.4.

554.03.6 Curing and Testing Concrete

Cure precast concrete products by water curing, impervious membrane curing, elevated temperature curing, or a combination of these methods.

Perform water curing and impervious membrane curing in accordance with Subsection 551.03.7.

Perform elevated-temperature steam process curing in accordance with Subsection 553.03.10.

Submit procedures for curing by the elevated-temperature electric coil process or a combination of methods in writing for approval before use.

Perform at least 1 test per 50 cubic yards (35 m^3) or per each day's production if less than 50 cubic yards (35 m^3) to verify reaching the compressive strength required to discontinue curing.

A test is the average strengths of 3 cylinders, each cast from different batches of concrete used in the day's production. Take the 3 samples from as many different batches as possible if more than 2 batches are used.

Sample and cast cylinders in accordance with MT 101.

Cure until the compressive strength of the standard 6 x 12-inch (152 x 305 mm) or 4 x 8-inch (102 x 203 mm) cylinders, cured under the same conditions as the concrete represented, reaches the required strength for the class of concrete or the specified strength.

Field-cure cylinders a maximum 28 days and test for compressive strength within 24 hours after removal from the field curing conditions. Perform strength testing in accordance with AASHTO T 22. Furnish the certified laboratory test results or arrange for the tests to be witnessed the Department.

Test results are acceptable if the average of the 3 cylinder strengths exceed the strength for the concrete class or the specified strength and no individual cylinder tested has a strength less than 90% of the specified strength.

Continue un-interrupted curing until test results are obtained. Should all cylinders be tested without reaching the specified strength, the concrete represented by the cylinders may be rejected.

554.03.7 Cold-weather Concreting

Furnish concrete at between 50 to 85 °F (15 and 32 °C) for placing when the air temperature is less than 35 °F (2 °C). Heat the concrete in accordance with Subsection 551.03.6(B).

Clear form work of snow, ice, and frost before placing concrete.

Protect the concrete from freezing for at least 48 hours after its placed or until it reaches the strength required to discontinue curing.

After 48 hours, provide freeze protection to develop the required strength.

Construct and protect bridge components in accordance with Subsection 551.03.6(B).

Assume all risk of concrete work during cold weather.

554.03.8 Form Removal

Remove lateral support forms only when it does not damage the concrete. Do not interrupt curing and protection in excess of 30 minutes for form removal.

554.03.9 Finish on Exposed Surfaces

Produce concrete surfaces free from rock pockets, depressions, or projections.

Scattered holes from surface trapped air are not considered defects. Point holes larger than ½-inch (13 mm) in any direction with mortar and strike off even with the surface. Apply an

ordinary finish to surfaces not smooth and uniform in texture and appearance in accordance with Subsection 552.03.11.

554.03.10 Handling, Transporting, and Storage

Do not remove, handle, or transport items designed to carry loads from the casting bed before they reach the required strength.

Other items may be moved from the casting bed to other curing locations when they have reached the strength to prevent damage.

Replace all cracked or broken items at Contractor expense.

Handle, transport, and store precast concrete items without damage. Replace or repair all damaged items at Contractor expense.

554.03.11 Placement

Place precast concrete members as specified.

554.04 METHOD OF MEASUREMENT

554.04.1 Precast Concrete Curb

Precast concrete curb is measured in accordance with Subsection 609.04.

554.04.2 Precast Concrete Barrier Rail

Precast concrete barrier rail is measured in accordance with Subsection 606.04.

554.04.3 Plain Reinforced Precast Concrete Bridge Members

Plain reinforced precast concrete bridge members are measured in accordance with Subsection 553.04.

554.04.4 Precast Concrete Cattle Guard Bases

Precast concrete cattle guard bases are not measured or paid for separately but are included in the payment for cattle guards in accordance with Subsection 611.05.

554.04.5 Precast Concrete Guardrail Posts

Precast concrete guardrail posts are not measured or paid for separately but are included in the payment for metal guardrail in accordance with Subsection 606.05.

554.04.6 Other Precast Concrete Products

Other specified precast concrete products are measured and paid for as specified in the contract.

554.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Precast Concrete Curb	See Subsection 609.05
Precast Concrete Bridge Members	See Subsection 553.05
Precast Concrete Median Barrier Rail	See Subsection 606.05

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract.

SECTION 555
REINFORCING STEEL

555.01 DESCRIPTION

This work is furnishing, protecting and placing reinforcing steel and wire fabric.

555.02 MATERIALS

Furnish materials in accordance with the following subsection requirements:

Epoxy-coated Reinforcing Bars 711.01.2
Reinforcing Steel..... 711.01.1
Wire and Wire mesh..... 711.01.3

Use reinforcement listed on the QPL and in accordance with Section 711.

555.03 CONSTRUCTION REQUIREMENTS

555.03.1 Protection of Material

Protect new and existing reinforcing steel from damage. The Project Manager will reject damaged material or allow a repair in accordance with ASTM A775 at Contractor expense.

Handle epoxy-coated steel reinforcing with padded or nonmetallic slings and padded straps to prevent damage to the epoxy coating.

Store reinforcing and supports on wooden blocks. Cover all reinforcing steel from weather exposure using an opaque moisture resistant covering that permits air circulation. Do not permit epoxy coated reinforcing steel to be exposed to sunlight in excess of 60 calendar days.

555.03.2 Fabrication

Bend reinforcing bar as specified in the contract.

Bend all bars cold. Do not field bend bars partially imbedded in concrete unless otherwise specified.

Meet Table 555-1 bend radii for standard hooks and all other bars other than stirrups and ties. Provide a minimum inside radii of 2 bar diameters for stirrups and ties.

TABLE 555-1
MINIMUM BENDING RADII

Bar Size	Minimum Inside Radii
3 thru 8 (#10 thru #25)	3 bar diameters
9 thru 11 (#30 thru #35)	4 bar diameters
14 or 18 (#45 or #55)	5 bar diameters

Obtain approval for special fabrication or bends exceeding 90° for No's. 14S and 18S reinforcing steel.

Ship reinforcing bar in bundles tagged and marked in accordance with the *Concrete Reinforcement Steel Institute Code of Standard Practice*.

Submit fabrication drawings when specified or requested.

555.03.3 Placing and Fastening

Place the reinforcing steel as shown in the contract and hold in place during concrete work. Submit a written request for approval to weld reinforcing steel to hold in place or fasten. Include in the request ANSI/AWS procedures to be used.

Ensure steel reinforcing is free of loose rust and scale, dirt, paint, oil, or other foreign material.

Verify the anchor bolt clearances before placing reinforcing steel.

Tie bars at all intersections unless bar spacing is less than 1-foot (305 mm) in each direction, which requires alternate intersections be tied.

Provide the minimum cover for reinforcing bars shown in Table 555-2.

TABLE 555-2
MINIMUM BAR EMBEDMENT

Bar Location	Embedment
Top of Slab	2⅜ inches (60 mm)
Bottom of Slab	1-inch (25 mm)
Stirrups and Ties	1½ inches (38 mm)
Footing and Pier Shafts	3 inches (75 mm)

Separate forms using stays, ties, hangers, metal chairs, blocks, or other approved supports.

Precast mortar blocks may be used at locations approved by the Project Manager, excluding supports for bridge deck slab reinforcing steel. Use blocks precast from concrete used on the project and water cured for 7 days before use. Use blocks of the size specified having an embedded wire for fastening to the reinforcing bar. Separate bar layers using precast mortar blocks, upper continuous metal chairs, or other approved devices.

Separate the upper and lower mats of reinforcing steel for deck slabs, depending upon the vertical distance between the mats, using “Upper Continuous High Chair” or “Slab Bolsters with Runners”. Place Continuous bar supports at right angles to structure centerline for “Flat Slab” structures and parallel to structure centerline for all other deck slabs. Do not use pebbles, pieces of broken stone, concrete rubble, broken brick or building blocks, metal pipe, or wooden blocks.

Use metal chairs and supports contacting epoxy-coated bars that are epoxy coated or coated with another inert approved coating.

Use plastic-coated tie wires or tie wires coated with another inert coating approved by the Project Manager to tie the coated bars in place.

Space deck slab reinforcing supports a maximum 4 feet (1.2 m). Space supports closer if necessary to prevent deflection during placement of concrete.

Obtain approval of reinforcing placement before placing concrete. Remove concrete placed before inspection.

Flatten rolled reinforcing fabric into sheets before placing.

555.03.4 Splicing

Furnish all reinforcing steel in the specified lengths. Splice as shown in the contract or as directed.

555.03.5 Reinforcing Steel - Material Guaranty and Random Sampling

Furnish for each shipment of reinforcing steel delivered to the project, duplicate copies of the following:

1. Shipping invoice showing the weight and price per pound (kg) of all of the steel in the shipment;
2. Certified mill test reports showing physical and chemical analysis on each heat of reinforcing steel;
3. A statement from the fabricator certifying that the mill tests furnished are representative of the reinforcing steel furnished and that it meets Subsection 106.09 requirements; and
4. For epoxy-coated reinforcing bars, the coating applicator must furnish with each shipment a certificate of compliance confirming that the coated reinforcing bars were cleaned, coated, and tested in accordance with ASTM A775 and Subsection 106.09. Additionally,

the certification must include for each bar size the preheat temperatures, cure times, thickness checks, holidays detected, and bend test results.

A shipment is the quantity of reinforcing steel in each truckload delivered to the project. When delivery is by railroad car, each 20 tons (18.1 MT), or fraction thereof, is a shipment.

Furnish the samples as requested for testing.

Do not place concrete until the steel test results are known. If a reinforcing steel sample fails, 2 additional samples representing the failed sample will be tested. If either of the check samples fails, the steel in the shipment represented by the failing sample may be rejected; or if the Project Manager determines that the steel is usable, a price reduction will be assessed as follows:

$$P = A \times B$$

Where:

A = Total invoice price of reinforcing steel in the lot[1]

B = 10%, 20%, or 30%, dependent upon departure from specifications; the value to be used will be determined by the Project Manager

P = Price reduction for the lot

Notes:

1. A lot is defined as all the bars of one bar number and pattern of deformation contained in an individual shipment.

The amount of reduction calculated above will be deducted from monies due the Contractor on the final estimate.

Remove and replace all rejected steel at Contractor expense. Furnish invoice statements, mill reports, and fabrication certificates for replacement steel. Replacement steel is subject to the tests specified above.

No reinforcing steel in a shipment will be final accepted until the test results are known. The Contractor may proceed with the work at its own risk before testing.

555.04 METHOD OF MEASUREMENT

The reinforcing steel quantity in the contract is the calculated theoretical weight of the steel in pounds (kg), measured as shown in the contract or ordered in writing, complete in place and accepted.

Plan quantities will not be re-measured except as provided for in Subsection 555.05.

The weights of standard sizes of reinforcing bars in accordance with AASHTO M 31 are computed using Table 555-3.

TABLE 555-3
WEIGHTS OF STANDARD SIZES OF REINFORCING BARS

Bar Size English (metric)	Bar Diameter inch (mm)	Weight lb/ft (kg/m)
No. 3 (#10)	0.375 (9.5)	0.376 (0.560)
No. 4 (#13)	0.500 (12.7)	0.668 (0.994)
No. 5 (#16)	0.625 (15.9)	1.043 (1.552)
No. 6 (#19)	0.750 (19.1)	1.502 (2.235)
No. 7 (#22)	0.875 (22.2)	2.044 (3.042)
No. 8 (#25)	1.000 (25.4)	2.670 (3.973)
No. 9 (#29)	1.128 (28.7)	3.400 (5.060)
No. 10 (#32)	1.270 (32.3)	4.303 (6.404)
No. 11 (#36)	1.410 (35.8)	5.313 (7.907)
No. 14 (#43)	1.693 (43.0)	7.650 (11.38)
No. 18 (#57)	2.257 (57.3)	13.600 (20.24)

Non-standard reinforcing bars or wire fabric, when required, have the unit weight specified in the contract.

No allowance is made for clips, wires, separators, or other material used for fastening or supporting the reinforcing steel.

555.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Reinforcing Steel	Pound (kg)

Reinforcing steel is paid in place for the quantities shown in the contract, except as follows:

1. The calculated quantities involved in changes ordered in writing by the Project Manager are added or deducted from the plan quantities.

2. A recalculation will be made and the corrected quantity will be included for payment, in lieu of the plan quantity, when the plan quantity of reinforcing steel in any complete structure is in error by 5% or more. A complete structure is the smallest portion of a total structure for which a quantity is included in the contract. The party to the contract requesting an adjustment must present to the other party 3 copies of the description, location and recalculated quantities of the structure having the quantity error.

Partial payments for reinforcing steel will be made based on the contract quantity as follows:

1. 85% when the material is accepted, placed and tied.

2. 100% when covered with concrete.

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract.

SECTION 556
STEEL STRUCTURES

556.01 DESCRIPTION

This work is the furnishing, fabricating, painting, and erecting of steel structures and the steel structure portions of composite structures.

The Department uses 490 pounds per cubic foot (7,850 kg/m^3) to calculate the weight of structural steel.

The weights of rolled shapes and plates up to and including 36 inches (915 mm) in width are computed based on their nominal weights and dimensions as shown on the shop drawings. One-half of the allowed percentage of overrun in weight as tabulated in ASTM A6 will be added to the nominal weights of plates exceeding 36 inches (915 mm) in width. The weight is computed on the basis of rectangular dimensions for all plates and overall lengths for all structural shapes with no deductions for copes, slips, sheared edges, punching, borings, milling, or planing. When parts can be economically cut in multiples from materials of larger dimension, the calculated weight is that of the material from which the parts are cut.

Bolts, nuts, and washer weights are the calculated weight in the AISC *Manual of Steel Construction*.

Weld metal weight is not computed.

556.02 MATERIALS

Furnish materials in accordance with the following subsection requirements:

Bearing Assembly Anchor Bolts for Bridges	711.13
Bolts and Nuts	711.07
Castings	711.12
Compression Joint Seals	711.15
Elastomeric Bearing Devices	711.14
Fiber-reinforced Pads for Bearing Plates	711.16
Galvanized Metal	711.08
High Strength Bolts	711.06
Pins and Rollers	711.04
Structural Steel	711.02
Structural Steel Tubing	711.03
Welding Electrodes	711.05
Welded Stud Shear Connectors	711.09

556.03 CONSTRUCTION REQUIREMENTS

For the fabrication of steel structures, follow AASHTO *LRFD Bridge Construction Specifications,* unless otherwise specified in the contract.

556.03.1 Pre-Qualification for Steel Fabricators

Use metal fabricators that are pre-qualified under the AISC Quality Certification Program for the items listed below. The Department will make an exemption for new manufacturing plants that are of the same ownership as an existing certified plant, provided the new manufacturing plant operates under the same quality assurance and control programs as the certified plants, modified to address any production differences, and all fabrication is performed under the direct supervision of a quality assurance and control manager provided by an existing pre-qualified plant. Direct supervision means that the quality assurance and control manager is on site during all fabrication performed in the new fabrication plant and is responsible for the quality assurance and control activities. For new manufacturing plants, submit and receive approval of any

proposed modifications to the parent plant's quality assurance and control program prior to beginning production. Allow 30 business days from the date submitted for Department review and approval. Items not listed may be fabricated by non-certified shops. Use metal fabricators having the following AISC quality certification categories:

1. Use fabricators having Advanced Bridge certification to fabricate the following:
   - **a.** Fracture critical members and attachments. Fabricators must have the Fracture Critical Endorsement (F).
   - **b.** Main members, (including spliced rolled beams).
   - **c.** Welded floor beams.
   - **d.** Diaphragms for horizontally curved girders.
2. Use fabricators having Intermediate Bridge certification to fabricate the following:
   - **a.** Non-spliced rolled beams.
   - **b.** Non-spliced floor beams.
   - **c.** Diaphragms for straight girders (does not include diaphragms used for concrete beams).
3. Use fabricators having a Simple, Intermediate, or Advanced Bridge certification to fabricate the following:
   - **a.** Modular expansion joints.
   - **b.** Steel grid decking.
   - **c.** Overhead sign bridge and cantilever sign structures.
   - **d.** Lighting poles and anchor bases.

556.03.2 Submittals

A. **Fabrication Drawings.** Prior to fabricating members, submit fabrication drawings to the Project Manager. Include the following information:
   1. An erection layout with each member assigned a production number;
   2. A tentative fabrication schedule;
   3. Denote any changes from the details in the contract;
   4. All dimensions, geometrical information, details and other data required for fabrication. Include camber information, blocking diagrams and shop splices;
   5. Denote specification, grade, finish, required toughness testing and required surface preparation for all steel plates, shapes, pipes, tubes, bars and all miscellaneous hardware such as shear studs, bolts, stud bolts, threaded rods, nuts and washers;
   6. For galvanized items, identify the applicable specification. For painted items, specify paint type, manufacturer and recommended dried film thickness for each coat applied in the shop. Also identify surface preparation for each item to be painted. For paint requirements see Sections 612 and 710;
   7. A list of field bolts and other items furnished by the fabricator:
   8. Appropriate weld sizes, symbols, requirements for non-destructive testing, heat cambering and bending procedures. Provide welding certifications and welding procedure specifications and any supporting documentation for all welding required for fabrication. For welding requirements see Section 624; and
   9. Welding Procedure Specification (WPS) identification is required in the weld symbol tail for all weld symbols shown on the shop drawings.

Submit 5 copies of shop drawings on 11" x 17" or larger sheets and 5 copies of welding procedures and design calculations on 8½" x 11" or larger sheets to the Project Manager. Shop drawings, design calculations, and welding procedures may be furnished in Adobe Acrobat Reader (.pdf) format in lieu of the hard copies. Ensure the submittal includes all information required to check the structural accuracy and fabrication procedures for the structure.

Structural shop drawings must be designed, and stamped by a professional engineer registered and licensed to conduct engineering in the State of Montana.

Do not begin fabrication until the Department approved drawings are received by both the plant and the Department Inspector. Coordinate the fabrication schedule with the Department Inspector.

B. Certificate of Compliance. Furnish a manufacturer's Certificate of Compliance for all bolts, nuts, washers and load indicator washers. Include certified mill test reports and test reports performed on the finished bolt confirming that all of the materials provided meet the requirements of the applicable AASHTO or ASTM specification. The documentation must include the name and address of the test laboratory, the date of testing, lot identification and the sample sizes of bolts and nuts used for each test performed for the certification.

Submit the following items to the Project Manager before installation:

1. One copy of the certification from the supplier showing that all tests required by the AASHTO and ASTM specifications have been performed. Include the date and location of those tests, as well as the production lot numbers and the sample sizes used for each test performed with the certification.
2. One copy of the certification from the supplier, showing that the wedge tests and rotational capacity tests have been performed. Also show production lot numbers, dates, locations, and sample sizes of these tests and who performed them.
3. Three bolt, nut, and washer assemblies from each rotational capacity test lot for verification by the Department.

Do not install fasteners prior to receiving approval.

556.03.3 Mill and Shop Inspection

1. **Inspection of Work.** Do not begin manufacturing or shop fabrication until the Department's Inspector has inspected the shop.
2. **Facilities for Inspection.** Furnish facilities for inspecting the material and workmanship in the mill and shop. Allow the Inspector free access to the work at all times.
3. **Inspector's Authority.** The Inspector may reject material or work not in accordance with the specifications. In case of dispute, the Contractor may appeal the Inspector's decision to the Project Manager.
4. **Mill Test Reports.** Furnish the Project Manager a complete certified mill test report showing chemical analysis and physical tests for each heat of steel for all members. Identify each piece of steel with a mark number on the mill test report.
5. **Facilities for Testing.** Furnish, at Contractor expense, test specimens, labor, testing machines, and tools to make the specimens and tests.
6. **Rejections.** Material or finished members accepted by the Inspector may be rejected if the material is subsequently found defective. Replace or repair rejected material at Contractor expense.

556.03.4 Storage and Handling of Materials

Mark alloy and high-strength steels as required by the AASHTO *LRFD Bridge Construction Specifications*. Mark material required to meet a Charpy requirement for identification.

1. Store materials off the ground and keep them clean and dry.
2. Place and store girders upright.
3. Support long members, including but not limited to columns, chords, and girders on blocks spaced to prevent deflection.
4. Store high-strength fastener components in accordance with the manufacturer's recommendations.

5. Store the bolts and nuts in the original containers until used.
6. Protect from dirt and moisture.
7. Remove only as many fasteners from protected storage as can be tightened during a work shift and return unused fasteners to protected storage at the end of each work shift.

556.03.5 Quality Control

Prepare and follow a quality control (QC) plan for ensuring the quality of all work and conformance to specifications. Submit 1 copy of the QC plan to the Project Manager for review 30 calendar days prior to fabrication.

Ensure that all nondestructive testing (NDT) is performed by personnel qualified in conformance with the American Society for Nondestructive Testing (ASNT) *Recommended Practice No. SNT-TC-1A* to minimum Testing Level II for the individual methods. Ensure that the QC plan meets the following minimum requirements:

1. **NDT, Radiographic Inspection.** Inspect 100% of all complete joint penetration (CJP) groove welds.
2. **NDT, Ultrasonic Inspection.** Inspect 100% of all CJP groove welds on plates thicker than ¼-inch (6 mm).
3. **NDT, Magnetic Particle Inspection.** Randomly inspect 25% of all welding for each member throughout the entire structure in accordance with AWS D1.5 bridge welding code. The Project Manager reserves the right to select locations for testing.
4. **Personnel qualifications.** Include the qualifications of the specific individuals that will be performing the QC testing.
5. **Quality control manager.** Identify the QC manager that will be the primary contact person for all QC communication. Ensure that this person is in charge of all QC work.

Provide reports of all QC testing as the testing is completed. Identify in the reports any deviations from specifications, standards, or the QC plan and a discussion of why the deviation occurred.

At the completion of fabrication, and before shipment, provide a certification signed by the quality control manager that contains the following statement and supporting information:

Required Statement: “This is to certify that the quality control plan was followed and that the results of the quality control program indicate that the materials and the construction operations controlled by the quality control plan are in conformity with the approved plans and specifications. Exceptions to the plans, specifications, and quality control plan are described below.”

556.03.6 Pilot and Driving Nuts.

Furnish 2 pilot nuts and 2 driving nuts for each size of pin unless otherwise specified. Pilot and driving nuts are not required when shoes are assembled at the fabrication plant.

556.03.7 Bolts and Bolted Connections

A. **General.** Make bolted connections in accordance with the contract requirements.
   1. Furnish bolts that are free of rust.
   2. When galvanized fasteners are specified, furnish assemblies manufactured with a visible dye, so a visual check verifies the lubricant’s presence at installation. Use black fasteners oily to the touch at installation.
   3. Use beveled washers to provide full bearing to the head or nut where bolts are used on beveled surfaces.

B. Definitions.

1. **Fastener Assembly.** An assembly of fastener components including bolt, nut, washer and DTI (when used) that are supplied, tested and installed as a unit. A fastener assembly represents one diameter and grade from the same lot.
2. **Snug-tight.** The condition that exists when all plies in a connection have been pulled into firm contact by the bolts in the joint and bolts have been tightened sufficiently to prevent removal of the nuts without the use of a wrench.
3. **Systematic Tightening.** The systematic assembly of the joint, progressing from the most rigid part of the joint until the connected piles are in firm contact and the subsequent systematic tightening of all bolts in the joint, progressing from the most rigid part of the joint in a manner that will minimize relaxation of previously tightened bolts.

C. Unfinished Bolts. Furnish standard unfinished bolts; with nuts having a bolt hole diameter 1/16-inch (2 mm) larger than the bolt diameter. Use threaded bolts, transferring shear, that have no more than one thread within the grip of the metal. Furnish bolts that extend through the nuts a maximum ¼-inch (6 mm).

556.03.8 Bolted Connections - High-Tensile-Strength Bolts

A. General. Make bolted connections as recommended by the Steel Structures Technology Center's *Structural Bolting Handbook (Bolting Handbook).*

1. **Bolt Lengths.** Use bolt lengths having the grip-length values in Table 556-1 plus the total thickness of connected material. The values in Table 556-1 consider nut, one flat washer, and bolt point.

   Adjust the length to the next ¼-inch (6 mm) increment up to a 5-inch (125 mm) bolt and to the next ½-inch (13 mm) increment for bolts over 5 inches (125 mm).

   Increase the bolt length ⅛-inch (3 mm) if direct tension indicator washers are used.

TABLE 556-1
BOLT LENGTH DETERMINATION

Bolt Diameter	Added Grip Length[1]
English	
½-inch	⅞-inch
⅝-inch	1-inch
¾-inch	1⅛-inch
⅞-inch	1⅜-inch
1-inch	1½-inch
1⅛-inch	1⅝-inch
1¼-inch	1¾-inch
Metric	
M16	25 mm
M20	30 mm
M22	35 mm
M24	40 mm

Note: 1. Add to total thickness of connected material.

Where beveled washers are used, adjust bolt lengths to account for the use of nonstandard or beveled washers.

2. **Bolted Parts.** Ensure bolted surfaces in contact with the bolt head and nut do not have a slope of more than 1V:20H to a plane normal to the bolt axis.

   Ensure bolted parts fit solidly when assembled.

   Provide a Class A finish, per AASHTO *LRFD Bridge Construction Specifications* for all faying surfaces.

3. **Washers.** Install fastener assemblies with hardened washer(s) in accordance with the *Bolting Handbook*.

B. Pre-Installation. Submit 1 of the following bolt methods for use:

- **a.** Turn of the nut,
- **b.** Calibrated wrench,
- **c.** Direct Tension Indicator (DTI), or
- **d.** Tension Control Bolts (twist-off)

1. **Pre-Installation Verification Testing.** Perform Pre-installation verification procedures in accordance with the *Bolting Handbook*. Retest when directed by the Project Manager.
2. **Reuse of bolts previously tightened.** Reuse of bolts previously tightened is not permissible except as described in the Bolting Handbook.

C. Production Bolting.

Tighten bolts in accordance to the pre-tensioning procedures given in the *Bolting Handbook.*

Fully erect continuously supported girder sections between expansion joints before production bolt tightening.

Tightening is dependent upon consistency of torque and is dependent on condition of the fastener assembly. Verify that the condition of assembly is similar to those used in the Pre-installation Verification test. Conditions of the assembly and the efficiency of the lubricant can be affected by the following:

1. Exposure to the elements during storage.
2. High temperatures during storage.
3. High temperatures during tightening.
4. Low temperatures during tightening.
5. Additional moisture from snow and rain during tightening.
6. Passing of time between the snugging operation and tightening.

If these condition changes occur, repeat the pre-installation verification test on a representative sample of fastener assemblies to be tightened.

Lubricate bolts in accordance to the *Bolting Handbook*. Re-lubricating of tension control bolts may only be performed by the manufacturer.

D. Metric Bolt Substitution. Allowable bolt substitutions are shown in Table 556-2.

TABLE 556-2
BOLT SUBSTITUTIONS

High Strength Bolt Substitution	
Specified Bolt ASTM A325M	Allowable Substitute ASTM A325
M16	5/8-inch
M20	7/8-inch
M22	7/8-inch
M24	1-inch
Standard Bolt Substitution	
Specified Bolt ASTM F568M Class 4.6	Allowable Substitute ASTM A307
M6	1/4-inch
M8	5/16-inch
M10	3/8-inch
M12	1/2-inch
M14	9/16-inch
M16	5/8-inch
M20	7/8-inch
M22	7/8-inch
M24	1-inch
Stud Bolt Substitution	
Specified Bolt ASTM F568M Class 8.8	Allowable Substitute ASTM A449
M12	1/2-inch
M14	9/16-inch
M16	5/8-inch
M20	7/8-inch
M22	7/8-inch
M24	1-inch

556.03.9 Welded Stud Shear Connectors

The type, size or diameter, and length of stud shear connectors are specified in the contract. Furnish fabrication material and perform welding in accordance with Section 624.

556.03.10 Field Welding

Do not weld temporary construction supports to beams, girders, or other main members. Any member with unauthorized field welds, tack welds, or arc strikes will be rejected. Perform welding in accordance with Section 624.

556.03.11 Assembling Steel

Field or shop assemble steel parts as follows:

A. Shop Work. Clean all contacting metal surfaces of deleterious materials before assembling, bolting, or welding. Paint may be applied to contact surfaces after bolting or welding.

Shop assemble and adjust to line and camber all bolted trusses, continuous plate girders, curved steel elements, box girders, I-beam spans, skew portals, skew connections, rigid frames, bents, and towers.

Drill and ream the field splice holes during assembly. Holes for other field connections may be shop drilled or reamed with the connecting parts assembled or drilled or reamed to metal templates with hardened bushings, without assembling.

Use an approved alternate procedure where shop space prevents complete shop assembly of continuous span girders or trusses. The procedure may require adjusting the line and camber of at least two abutting sections of girder for drilling or reaming of field splices if all girder lines for the complete structure are assembled consecutively.

Field butt joints for welded girders may be assembled with abutting members adjusted for line and camber and prepared to fit for welding, subject to Project Manager approval.

Bridge expansion devices must be initially shop assembled to establish the proper fit between the joint parts.

B. Field Work. Assemble the parts as specified in the contract, following the match-marks. Prevent damaging the material while handling. Clean all bearing and member surfaces in permanent contact before assembly.

Splices and field connections must have a minimum of ½ of the holes filled with bolts or erection pins before removing temporary supports or releasing the load from erecting equipment. Splices and connections carrying traffic during erection must have ¾ of the holes pinned or bolted.

Do not begin production bolt tightening of the field splice bolts until the complete girder line is aligned and erected matching the full camber line.

Use erection pins $^{1}/_{32}$-inch (1 mm) larger than the nominal diameter of the permanent bolts.

Erect truss spans on blocking, unless they are erected using the cantilever method, to provide truss camber. Leave the blocking in place until the tension cord splices are fully bolted and all other truss connections pinned and bolted. Do not tension bolts in butt joint splices of compression members and in railings until the span is swung.

C. Drifting of Holes. Only use drift pins during assembly to the extent necessary to bring the parts into position without enlarging or distorting the holes or metal. Do not ream holes during field fitting without approval from the Project Manager.

D. Match-marking. Match-mark parts assembled in the shop for reaming field connection holes and furnish the Project Manager a diagram showing the marks.

556.03.12 Marking and Shipping

Paint or mark each member with an erection mark, and furnish the Project Manager an erection diagram detailing the erection marks.

Furnish copies of material orders, shipping statements, and erection diagrams. Show the individual member weights on the statements.

A shipping statement must accompany the material and be marked to clearly identify it with the delivered material and mill test reports.

Mark the weight on members weighing 3 tons (2.7 MT) or more. Load and unload structural members on trucks or cars without stressing or causing damage.

Pack bolts, loose nuts or washers of each size separately. Ship pins, small parts, bolts, washers, and nuts in boxes, crates, kegs, or barrels, with the gross weight of each package not exceeding 300 pounds (136 kg). Plainly mark each shipping container, listing and describing the contents on the outside of each shipping container.

Keep structural material clean and free from damage.

556.03.13 Painting

Clean and paint all iron and steel surfaces in accordance with Section 612.

556.03.14 Erection

Furnish a steel erection plan and specifications that ensures safety, prevents overstressing of the steel, maintains stability, prevents damage to the work or surroundings, and achieves the proper final geometry. Furnish a complete erection plan and specifications for erection of the steel and for any falsework necessary, including temporary bracing, guy-wires, or other required items to the Project Manager a minimum of 14 calendar days prior to construction of the superstructure.

The erection plan and specifications must bear the signature and the professional seal of a professional engineer licensed to practice in Montana.

556.03.15 Falsework

Design, construct, and maintain falsework to support the maximum construction loadings. Check and approve falsework drawings before submitting. The Department has 20 business days to review and return the falsework drawings. The contract time will be extended day for day for any delay beyond the 20-day review period if the Department's delay affects the Contractor's operation as shown on the current work schedule.

556.03.16 Bearing and Anchorage

Place masonry bearing plates in accordance with Subsection 565.03.2.

556.03.17 Placing Anchor Bolts

Place anchor bolts in accordance with Subsection 552.03.13.

556.03.18 Straightening Bent Material

Straighten bent plates, angles or other shapes without damaging the material. The metal may be heated if approved. Do not exceed 1,000 °F (537 °C). Once heated, cool the metal slowly.

All straightened metal will be inspected for defects.

556.03.19 Pin Connections

Furnish the Project Manager the pilot and driving nuts provided with the steelwork once the work is complete. The members must take full bearing on the pins. Bring pin nuts up tight, and burr the threads at the nut face.

556.03.20 Misfits

Correct all misfits, errors, and injuries as a part of the assembly and erection work. Report to the Project Manager all shop work errors that prevent the assembly and fitting of parts with a minimum use of drift pins, reaming, slight chipping or cutting. Obtain Department approval for the correction method. Corrections must be inspected and approved.

556.03.21 Cleanup

Remove all falsework, excavated or unused materials, rubbish, and temporary buildings. Restore all public and private property damaged during construction to its original condition.

Pull, cut off or otherwise remove all falsework piling 1-foot (305 mm) below finished the ground line or streambed, unless otherwise directed. Perform all work affecting the stream channel in accordance with Subsection 208.03.4 before final acceptance.

556.03.22 Rejections

An Inspector's acceptance of material or finished members does not prevent later rejection if defects are found. Replace or repair rejected material and work at Contractor expense.

556.04 METHOD OF MEASUREMENT

Structural steel is measured by the lump sum.

556.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Structural Steel	Lump Sum

The weight of structural steel in the contract is an estimate only. No guarantee is made that the estimated weight is the correct weight to be furnished. No adjustment in the contract unit price is made if the weight furnished is more or less than the estimated weight.

If changes in the work ordered by the Project Manager vary the weight of steel to be furnished, the lump sum payment is adjusted as follows:

The value per pound (kg) of a decrease or increase in the weight of structural steel involved is determined by the following:

$$\text{Value per Pound (kilogram)} = \frac{\text{Contract Lump Sum Bid}}{\text{Estimated Contract Weight}}$$

The adjusted contract lump sum amount paid is the contract lump sum bid plus or minus the value of steel involved in the change.

Should the ordered change materially alter the character of the work and the unit cost, compensation for that work is made at an agreed price established before the work is performed. Detail in writing, the changes in procedures and the resulting costs for labor, equipment, and materials to support the agreed price.

Partial payments for structural steel will be made based on the lump sum contract unit price as follows:

1. 90% when erected.
2. 97% when bolted and spot painted.
3. 100% when painted in compliance with the plans and specifications.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 557
STEEL BRIDGE RAILING

557.01 DESCRIPTION

This work is the furnishing and installing of steel bridge railing.

557.02 MATERIALS

Furnish materials in accordance with the following subsection requirements:

Fiber-reinforced Pads for Rail Post Base Plates..... 711.16
Galvanized Metal 711.08
High Tensile Strength Anchor Bolts..... 711.06
Steel Beam Guardrail and Wood Blocks 705.01
Structural Steel 711.02
Structural Steel Tubing..... 711.03

557.03 CONSTRUCTION REQUIREMENTS

557.03.1 Fabrication Drawings

Furnish fabrication drawings for steel bridge railing in accordance with Subsection 556.03.2.

557.03.2 Fabrication

Fabricate steel bridge railing in accordance with Section 556.

557.03.3 Erection

Construct steel bridge railing as shown in the contract. Adjust the completed railing to compensate for any unevenness in the structure. Ensure all rail posts are vertical. Do not place railing on a span until centering or falsework is removed. Place rail post base plates on fiber-reinforced pads, sized and positioned to project a minimum ½-inch (13 mm) on all sides of the base plates.

557.03.4 Painting

Clean and paint steel bridge railing specified to be painted in accordance with Section 612.

557.04 METHOD OF MEASUREMENT

Steel bridge railing of the type or types specified is measured by the foot (m). Measurement is based on the computed horizontal distance between the centerlines of end base plates.

557.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Bridge Railing	Foot (m)

Partial payments of steel bridge railing will be made based on the total quantity as follows:

1. 90% when erected.
2. 95% when bolted and spot painted.
3. 100% when painted in compliance with the contract.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 558
DRILLED SHAFTS

558.01 DESCRIPTION

This work is constructing reinforced concrete shafts cast in cylindrically excavated holes that extend into soil or rock to support the structure and externally applied loads at the locations and to the lines and grades shown in the contract.

558.02 MATERIALS

558.02.1 Drilled Shaft Concrete

Use Drilled Shaft Concrete for all concrete placed between the bottom of the shaft and the top of the casing, unless otherwise shown in the contract. Obtain the Project Manager's approval before using a SCC mix design.

558.02.2 Permanent Drilled Shaft Casing

Furnish casing in accordance with the size and thickness requirements specified and casing material that meets the requirements of AASHTO M 270, Grade 36. Furnish, fabricate and inspect casing materials in accordance with Section 556.

558.03 CONSTRUCTION REQUIREMENTS

558.03.1 Submittals

Submit 4 copies of the following information to the Project Manager a minimum of 30 calendar days before start of drilling operations.

A. Drilled Shaft ASC and WN outlining:
  1. Bent and shaft construction sequence. If more than one shaft will be worked on at any time, include that information in the submittal.
  2. Method of shaft excavation.
  3. Method to clean shaft excavation.
  4. Temporary and permanent casing installation and removal methods. Include casing top and bottom elevations and diameters.
  5. The effects of hydrostatic pressure differentials that may occur during excavation and shaft construction. Include a description of procedures relating to hydrostatic effects that will be used to ensure that the stability of the excavation is not compromised.
  6. Method of concrete placement. State the planned initial elevation of the bottom of placement pipe. Provide descriptions of methods or devices used to prevent the injection of air or water into the drilled shaft concrete when starting concrete placement and in the event the placement is stopped and restarted. Include descriptions of methods or devices that will be used to control the rate of concrete discharge in order to minimize turbulence that could result in concrete washout or other detrimental effects.
  7. Time necessary for complete concrete placement.

B. Name and experience record of Contractor, and Superintendent and driller(s) to that will perform the drilled shaft work on this project. Include all experience in the last 10 years.

C. List of proposed drilling equipment to be used, including any cranes, drills, augers, bits, temporary casings and cleaning tools. Include diameter of augers and cleaning buckets.

D. Proposed size and location of all reinforcing steel used to support or maintain the shape of the reinforcing steel cage.

558.03.2 Shaft Pre-construction Meeting

Schedule a shaft pre-construction meeting with the Project Manager for a time 7 to 14 calendar days prior to drilling. The minimum required attendees are the superintendent, concrete supplier, and Project Manager. The purpose of the meeting is to review the requirements of this specification, discuss the drilled shaft installation plan, and to discuss logistical and contingency plans.

558.03.3 Geotechnical Logging

The Department may provide a geotechnical representative on-site during drilling and installation operations to log the excavation. Notify the Project Manager at least 7 calendar days prior to start of drilled shaft excavation so that the Project Manager may schedule the on-site representative.

558.03.4 Shaft Excavation

Use excavation methods that provide contact with firm, undisturbed soil or rock with the sides and bottom of the shaft concrete when the temporary casing is removed. Do not excavate holes larger than the outside diameter of permanent casings.

558.03.5 Shaft Locations, Alignment and Tolerances

Drill all shafts to the bottom elevations specified or as directed by the Project Manager. Construct the shaft so the vertical centerline axis of the finished shaft is within 3 inches (75 mm) of the plan location at the top of the shaft. Drill all shafts to within 2% of vertical the entire depth of the shaft excavation.

558.03.6 Sloughing and Caving

Use tools and tool withdrawal rates that will not cause suction effects that result in soil intrusion or instability of the excavation. Use construction methods that will ensure no sloughing or caving of the shaft side walls. In the event any sloughing or caving does occur, remove all sloughed material. Ensure that concrete completely fills the shaft. If caving occurs during placement of drilled shaft concrete, immediately stop the flow of concrete and undertake corrective measures to completely remove the sloughed materials from the shaft. If necessary to facilitate material removal, remove the concrete and reinforcing steel already placed in the shaft.

558.03.7 Permanent Casing

A. Furnish and install permanent casing when specified in the contract. Permanent casing remains in place and is included in the design of the drilled shaft. The permanent casing diameter may be oversized up to 3 inches (75 mm) if necessary to facilitate temporary casing installation.

B. If field welding, submit 4 copies of the weld procedures to the Project Manager for approval 30 calendar days prior to welding.

C. Provide corrosion protection for all permanent casing. Galvanize the permanent casing to AASHTO M 111 and ASTM A653 specifications or paint. If painting, meet the following requirements:

1. Furnish paint in accordance with Subsection 710.02(B)(3).

2. Prepare the casing surface following the paint manufacturer's recommendations.

3. Follow the paint manufacturer's recommendations for paint application. Apply paint to the casing before installation, starting 24 inches (610 mm) below ground surface, continuing to the top of exposed steel.

4. Apply the first two paint coats to produce a minimum 12 mil (0.300 mm) dry film thickness. Provide 2 copies of the painter's certification that the paint was applied following the manufacturer's recommendations and the paint coat thickness on the casing.

5. Repair paint damage caused by transport, handling and welding following the paint manufacturer's recommendations before applying the finish coat.

For the finish coat, use the same paint or paint compatible with the first 2 coats. Provide a finish coat with a minimum 3 mil (75 μm) dry film thickness. Provide the finish coat paint that meets Federal specification 595B, pigment code 36440 (concrete gray).

558.03.8 Temporary Casing

Do not use slurry construction methods as an alternative to or in conjunction with temporary casing unless specified in the contract. Use temporary casing to facilitate shaft construction and prevent sloughing and caving of the shaft sidewalls. Place temporary casing to a minimum elevation as shown in the contract. Place the temporary casing deeper if necessary to prevent material from entering the shaft excavation. Use casing with an outside diameter no less than the specified diameter of the shaft. Limit the excavation in advance of the casing tip to no more than 10 feet (3 m) unless synthetic slurry is being used. During casing extraction, maintain a sufficient level of fluid in the casing to counteract external hydrostatic pressures but no less than 5 feet (1.5 m) of positive head. Maintain an adequate level of concrete within the casing to ensure that fluid trapped behind the casing is displaced upward and discharged at the ground surface without contaminating or displacing the shaft concrete. Temporary casings that have become bound or fouled during shaft construction and cannot be removed are considered to be a defect in the drilled shaft. Correct defective shafts using approved methods at no cost to the Department. Corrective action may consist of, but is not limited to, the following:

1. Removing the drilled shaft concrete and extending the drilled shaft deeper to compensate for the loss of frictional capacity to the cased zone.
2. Providing straddle drilled shafts to compensate for capacity loss.
3. Providing a replacement drilled shaft.

558.03.9 Obstructions

An obstruction is defined as a specific object (including, but not limited to, boulders, logs, and man-made objects) encountered during the shaft excavation which prevents the advance of the shaft excavation. If an obstruction is encountered promptly notify the Project Manager. Submit 4 copies of a proposed obstruction removal method to the Project Manager for approval within 2 business days of encountering the obstruction.

558.03.10 Cleaning

Remove all loose or disturbed material from the bottom of the shaft excavation immediately prior to placing reinforcing steel and concrete. After cleaning, no more than 1-inch (25 mm) of loose or disturbed material permitted in the bottom of the shaft. Maintain a sufficient level of fluid to counteract external hydrostatic pressures but no less than 5 feet (1.5 m) of positive head.

558.03.11 Installation of Cross-hole Sonic Logging (CSL) Tubes

Install the CSL access tubes evenly spaced around the reinforcing cage and inside of all hoops and spiral reinforcing steel, as shown in the contract. Use 1½-inch (38 mm) nominal diameter schedule 40 PVC CSL access tubes. Provide an end plug at the lower end of the pipe and make all joints watertight. Ensure tubes extend to the shaft bottom. In the event that CSL access tubes are not installed to the shaft bottom, the Department may require coring of the shaft to verify shaft integrity at Contractor's expense. Fill the CSL access tubes with a 1:1 mixture of potable water and biodegradable antifreeze prior to or immediately after placing concrete in the drilled shaft. Temporarily cap the top of the tubes to prevent debris or concrete from entering the tubes. Clean any spilled antifreeze from the reinforcing steel and CSL tubes.

558.03.12 Reinforcing Steel

Tie bars at all intersections. After inspection and approval of the drilled shaft excavation by the Project Manager, place the reinforcing steel cage into the shaft as one unit. Support the steel cage from the top so that racking and distortion are prevented. Remove internal stiffeners as necessary as the steel cage is placed in the excavation to prevent interference with the placement of concrete. Use non-corrosive, roller-type spacers or other non-corrosive devices as approved by the Project Manager along the steel cage length and around the steel cage perimeter to align and maintain clearance from reinforcing cage to edge of casing during concrete placement. Begin placing the drilled shaft concrete immediately after the Project Manager has inspected and approved the location and alignment of the cage within the drilled shaft. Remove the steel cage and re-inspect the excavation if the concrete placement is not started within 3 hours of placing the steel cage in position.

558.03.13 Concrete Placement Record

Complete the Department's Drilled Shaft Concrete Placement Log. Accurately record all data required on the form as the concrete is placed. After the drilled shaft concrete has been placed and before the end of the day, furnish the completed form to the Project Manager. The Department will provide copies to the Contractor upon request.

558.03.14 Drilled Shaft Concrete

Place concrete in the drilled shaft as specified for either dry excavations or wet excavations.

A. Dry Excavations. Place concrete by gravity tremie tube or pumping. Concrete may free fall into the shaft if the concrete can be directed so that it does not strike the reinforcing steel, the excavation wall or any other obstruction during the fall.

B. Wet Excavations.

1. Place all drilled shaft concrete by tremie tube, pumping, or other approved method to avoid separation and segregation of the concrete mix components.
2. Separate the first concrete placed from the fluid in the excavation using a plug in the tube, or other approved device.
3. Begin concrete placement in a manner that minimizes mixing of the concrete with the water and material in the shaft.
4. Maintain a minimum 10 feet (3 m) of tremie pipe embedment and continuously place drilled shaft concrete to ensure upward displacement of all contaminated concrete. If at any time during the placement, it is necessary to temporarily stop or the tremie pipe orifice is removed from the concrete, stop and restart concrete placement in a manner that ensures that air, water, or other undesirable material is not allowed to be mixed into the concrete or incorporated into the drilled shaft. Concrete that is discharged above the rising concrete level in the shaft is considered undesirable material.
5. Once concrete has reached the top of the drilled shaft, remove and dispose of the top layer of concrete and any concrete contaminated with mud or fluid from the drilled shaft. Remove sufficient concrete to fully expose sound, homogeneous and uncontaminated concrete in the shaft.

558.03.15 Shaft Testing and Acceptance

A. Cross-Hole Sonic Logging. The Project Manager may use CSL to check the structural soundness of any completed drilled shaft. The CSL testing will be performed when the concrete has cured sufficiently to give consistent test readings. Schedule construction activities to allow twelve calendar days from the time concrete is placed in the shaft until the shaft is tested. Provide a stable 110-Volt AC or a 12-Volt DC electrical supply if requested. When the CSL testing access tubes are no longer needed for testing, as

determined by the Project Manager, cut off the tubes flush with the top surface of the drilled shaft and remove the antifreeze solution to a depth of 4 inches (100 mm) from the top of the tubes. Permanently cap the CSL access tubes to provide a watertight seal that does not interfere with the subsequent construction operations. The Project Manager will accept or reject the shaft based on the CSL testing or a subsequent drilled core sample. For any drilled shaft determined by CSL testing to be of uncertain quality, drill core samples with a minimum diameter of 2½ inches (65 mm), at locations and to depths specified by the Project Manager. Use a core drilling method that provides complete core recovery and minimizes abrasion and erosion of the core. Grout all core holes when directed by the Project Manager.

B. Corrective Action. If the CSL or subsequent coring identifies any defect in the shaft that compromises the capacity of the shaft; repair the shaft by a method approved by the Project Manager. Submit a repair plan no later than 14 calendar days after notification. Include 4 copies of calculations and working drawings, stamped by a professional engineer licensed in Montana, to the Project Manager. Furnish all materials and work necessary to correct shaft defects at Contractor expense. Prior to constructing other shafts, submit 4 copies of a written proposal to the Project Manager that describes changes in construction methods or materials designed to avoid defects in subsequent drilled shafts.

558.04 METHOD OF MEASUREMENT

558.04.1 Drilled Shaft

Drilled shaft will be measured by the linear foot (m) of shaft between the actual bottom elevation of the drilled shaft and the top of shaft elevation shown on the contract.

558.04.2 Drilled Shaft Concrete

Drilled shaft concrete will be measured by the cubic yard (m^3) of concrete placed calculated from the planned cross sectional area times the as built length of the drilled shaft.

558.04.3 Reinforcing Steel

Drilled shaft reinforcing steel will be measured by the pound (kg) in accordance with Subsection 555.04.

558.04.4 Drilled Shaft Casing

Permanent drilled shaft casing will be measured by the linear foot (m) of permanent casing installed as shown in the contract or as directed by the Project Manager in writing.

558.04.5 Temporary Casing

When the Contract contains the pay item Temporary Drilled Shaft Casing, temporary drilled shaft casing will be measured by the linear foot (m) of temporary casing measured from the higher of the ground or water surface elevation down to the bottom elevation of the installed temporary casing.

558.04.6 CSL Tubes and Testing

Include all costs associated with furnishing and installing CSL access tubes and any required extensions and providing a power source in the Drilled Shaft pay item. No measurement or payment will be made for construction delays resulting from the initial CSL drilled shaft testing. The Department will extend the contract time by 1 day for each day over 12 calendar days required to complete the CSL drilled shaft testing. The Department will pay the costs for the initial CSL drilled shaft testing. Pay for all costs associated with coring, engineering design, cost required to correct the defect and any construction delay costs, if a defect is found based on the CSL drilled shaft testing or coring. Pay the costs of CSL drilled shaft retesting of the repaired

drilled shafts. If no defect is found in the drilled shaft based on the coring, the Department will pay all costs of coring and any delays necessitated by the coring.

558.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Drilled Shaft	Linear Foot (m)
Reinforcing Steel	Pound (kg)
Drilled Shaft Casing	Linear Foot (m)
Drilled Shaft Concrete	Cubic Yard (m^3)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract. Temporary casings remain the property of the Contractor.

If the Contract contains the pay item Temporary Drilled Shaft Casing, all costs associated with temporary casing including, but not limited to, procurement, fabrication, transportation, installation and removal, are included in the pay item Temporary Drilled Shaft Casing. If the Contract does not contain the pay item Drilled Shaft Temporary Casing, no measurement or payment will be made. Include all costs associated with temporary casing including, but not limited to, fabrication, providing, transporting, installation and removal in the Drilled Shaft pay item.

Payment for obstruction removal will be made on a force account basis.

SECTION 559
PILING

559.01 DESCRIPTION

This work consists of furnishing and placing piling.

559.02 MATERIALS

Furnish materials in accordance with the following section and subsection requirements:

Hydraulic Cement Concrete 551
Steel Pipe Piles 711.10.2
Structural Steel Piles 711.10.1

559.02.1 Inspection of Steel Pile

Steel pile may be inspected at the rolling mill and will be inspected at the project.

Furnish copies of the mill test reports showing the chemical and physical test results for each steel pile heat number included in the shipment.

Provide steel pile with a maximum camber or sweep of 0.013 inches per foot (1 mm/m) of pile length.

Store and handle steel piles to prevent damage. Bent, deformed, or kinked piles will be rejected.

559.02.2 Furnish Pile

Furnish pile quantities shown in the contract.

The specified lengths are those required below cutoff. Adjust lengths for the difference between the cut off length and the pile position in the driving equipment and as necessary to meet the requirements of Subsection 559.02.5. Increase pile lengths 1.0-foot (305 mm) for steel pile. Remove and dispose of excess pile length after the pile is driven.

559.02.3 Metal Pile End Protection

Furnish prefabricated cast steel driving point or cutting shoe conforming to AASHTO M 103 requirements. Furnish cast steel driving point for H-pile. Furnish cast steel inside-flanged, open-end cutting shoe or 60°, inside-flanged conical driving point for pipe pile as specified. Weld driving point or cutting shoe to steel pile in accordance with ANSI/AASHTO/AWS D1.1 or D1.5, as applicable. Use welders certified by the Department or a Certified Welding Inspector.

559.02.4 Splicing Piles

When directed by the Project Manager, splice piles driven to plan grade that do not obtain the required driving resistance and continue driving until the required bearing resistance is obtained. Weld steel pile in accordance with AWS D1.5 requirements. Use 10-foot (3-m) minimum spacing for steel pile splice welds. When steel piles are driven less than 10 feet (3 m) below the cutoff elevation specified, use 1 splice to obtain the required cutoff elevation.

559.02.5 Holes in Piling

Pile segments with 1 drilled hole having a diameter of ⅞-inch (22 mm) or less in any cross-section may be incorporated into the finished structure. Pile with more than 1 hole in a cross-section, flame cut hole(s), or a hole greater than ⅞-inch (22 mm), must be cut off to remove the hole(s).This requirement does not apply to holes drilled for attaching dynamic testing equipment, holes shown in the contract or holes within 12 inches (305 mm) of the cutoff elevation.

559.03 CONSTRUCTION REQUIREMENTS

559.03.1 Equipment for Driving Pile

A. Pile Hammers. Drive piles with impact hammers that include air, steam, diesel or hydraulic hammers.

For air or steam hammers, provide equipment that maintains the volume as specified by the manufacturer of the hammer as the pile is driven. Provide equipment with accurate pressure gauges that are easily read from ground level. Ensure that the striking parts of the hammer are at least ⅓ the weight of the helmet and the pile being driven or 2,750 lbs. (1,250 kg), whichever is greater.

Provide open-end (single-acting) diesel hammers with rings or other indicators on the ram that permit visual determination of the hammer stroke as the pile is driven. Submit a copy of the hammer manufacturer's chart that equates the stroke and blows per minute for the hammer being used.

Provide closed-end (double-acting) hammers with an accurate bounce chamber pressure gauge that is easily read from ground level. Submit a copy of a chart, calibrated to the actual hammer performance that equates the bounce chamber pressure to the equivalent energy or stroke of the hammer.

Provide equipment for hydraulic hammers that are sized to maintain the manufacturer's specified volume and pressure during driving. Provide equipment with accurate pressure gauges that are easily read from ground level.

Delays and additional costs resulting from load tests or other extra work required to verify approval of the vibratory hammer or driving aids is at Contractor expense. If a vibratory hammer is used, re-drive each pile with an impact hammer having the energy to verify the required bearing resistance during driving, as required in Subsection 559.03.3.

B. Pile Driving Aids and Accessories.

1. **Followers.** Do not use followers.
2. **Helmet.** Provide metal helmets for pile to be driven by impact drivers. Helmets must fit around the pile top, align axially with the hammer and pile, distribute the hammer energy to the total pile head cross section and have leads to guide them.
3. **Hammer Cushion.** When driving pile with an impact hammer, use a cushion to prevent damage to the pile and hammer. Use a cushion recommended and approved by the hammer manufacturer. Use a striker plate recommended by the hammer manufacturer on the hammer cushion to provide uniform compression of the cushion material.
4. **Leads.** Support the piles in line and position during driving. Use pile hammer leads that permit free movement of the hammer, maintain hammer and pile alignment and provide concentric impact for each blow.
5. **Jets.** Do not use water jets.
6. **Caps.** Follow the pile manufacturer's recommendations regarding caps, driving heads, mandrels or other required devices.

C. Pile Pre-drilling. When specified in the contract, use the prescribed drilling methods discussed in this specification. Do not impair the bearing resistance of previously installed pile or the safety of adjacent structures. If drilling reduces the bearing resistance of previously placed pile, restore the disturbed pile to conditions in accordance with this specification by re-driving after drilling operations in the area have been completed.

1. **Pile Pre-bore.** When pile pre-bore is specified, use an auger, wet-rotary drill or other approved method. Drill pre-bore holes to the specified diameter and depth. Drive the pile in the pre-bore hole, starting from the bottom of the hole, with an impact hammer

evaluated in accordance with Subsection 559.03.2. Continue driving the pile to the required bearing resistance and the depth specified. After driving, fill the annular void around the pile with dry, fine concrete aggregate in accordance with Subsection 701.01.1 and Table 701-2.

2. **Pile Drill and Socket.** At each pile location, drill pilot holes a maximum of 1-inch (25 mm) in diameter less than the outside diameter of the round pile and a maximum of 4 inches (100 mm) less than the outside diagonal cross sectional measurement of square or H-pile, to the elevation specified. Drive the pile into the pre-drilled pilot hole to the bottom of the hole with an impact hammer evaluated in accordance with Subsection 559.03.2. Continue driving the pile below the bottom of the drilled hole to the design tip elevation specified in the contract, or deeper if directed by the Project Manager.

559.03.2 Evaluation of Pile Driving Equipment

The Department will evaluate pile-driving equipment provided by the Contractor. Furnish equipment with the capability to drive the project pile to the design pile tip elevation and required bearing resistance during driving without damage to the pile. Provide pile driving equipment that produces the following results from the wave equation analysis:

- 35 to 120 blows per 1-foot (0.3 m) at the required bearing resistance; and
- Maximum compressive driving stress less than 90% of the minimum pile material yield strength.

The Department will base hammer evaluations on a wave equation analysis. Submit the pile driving equipment information on Form CSB 559_03_2.

The Project Manager will notify the Contractor of results of the pile driving equipment evaluation within 14 calendar days after receipt of the Pile and Driving Equipment Data form. If the Department's wave equation analysis indicates that pile damage may occur or that the proposed pile driving equipment cannot drive the pile to the specified required bearing resistance and design tip elevation, re-submit a plan that modifies the equipment or the method to ensure the ability to drive pile to the specified required bearing resistance and design tip elevation without pile damage. The Project Manager will notify the Contractor of results of the revised pile driving submission within 7 calendar days after receipt of the re submittal.

Do not vary from the evaluated driving system without prior written approval. The Department will consider proposed changes to the pile driving equipment or method only after submittal of revised information for a new wave equation analysis. The Project Manager will notify the Contractor of evaluation results of the pile driving system changes within 7 calendar days after receipt of the submittal. Delays and additional costs associated with developing, submitting and obtaining evaluation results for pile driving proposals and resulting changes in the pile driving equipment and work methods are at Contractor's expense.

559.03.3 Pile Bearing Resistance

A. **Driven Pile Bearing Resistance.** Drive the pile to the design tip elevation shown on the contract, or deeper, if necessary and to the required bearing resistance during driving shown in the contract. The Project Manager will use the wave equation analyses to determine the required bearing resistance and the service pile driving criteria. The Department will determine ultimate pile capacity based on a wave equation analysis. Drive piles with the pile driving equipment evaluated in accordance with Subsection 559.03.2 to the depths necessary to obtain the required bearing resistance. Do not use other methods to aid pile penetration, unless specified or approved after a revised driving resistance is established from the wave equation analysis. Unless otherwise specified, adequate pile penetration consists of reaching

the specified wave equation resistance criteria within 1-foot (0.3 m) of the pile tip elevation. Drive pile not achieving the specified resistance within these limits to penetrations established by the Project Manager.

B. Compression Load Tests.

1. **Static Load Tests.** If specified, perform compression load tests to meet the requirements of ASTM D1143 using the Quick Load test method. Load the test pile to the required bearing resistance shown in the contract. Provide testing equipment and measuring systems in accordance with ASTM D1143, except the loading system must be capable of applying 150% of the required bearing resistance. Provide a load cell and spherical bearing plate. Submit detailed plans for the proposed loading system prepared by a professional engineer licensed in the State of Montana for approval. The load system must gradually and incrementally place the load on the test pile without vibration. If the static load test method includes tension (reaction) anchor pile, provide anchor pile of the same type and size as the service pile. Drive the anchor pile in a permanent pile location, unless the Project Manager approves another location.

   Determine top elevation of the test and anchor pile immediately after driving and again just before load testing to check for heave. Re-drive all pile that heaved in excess of ¼-inch (6 mm) or jack the pile to the original elevation before testing. Wait 72 hours between driving the anchor pile or the load test pile and performing the load test.

   Define the failure load for a tested pile as the axial compressive load that produces a settlement of the pile head equal to:

   a. For piles 2 feet (610 mm) or less in diameter or width:

   $$s_f = \Delta + (0.15 + 0.008b) \quad \text{(english)}$$

   $$s_f = \Delta + (4.0 + 0.008b) \quad \text{(metric)}$$

   b. For piles greater than 2 feet (610 mm) in diameter or width:

   $$s_f = \Delta + b / 30 \quad \text{(english and metric)}$$

   Where:

   s_f = Settlement at failure in inches (mm)
   b = Pile diameter or diagonal width in inches (mm)
   Δ = Elastic deformation of total pile length in inches (mm)

   If the Project Manager determines that the pile has failed before achieving the required bearing resistance, perform additional load tests. The Department will measure and pay for each additional load test.

   When load testing is complete, remove all test or anchor pile not part of the finished structure or cut them off at least 1-foot (305 mm) below the bottom of the footing or below the finished ground elevation, if the pile fall outside the footing area.

2. **Dynamic Load Tests.** If specified, perform dynamic load tests in accordance with ASTM D4945 on pile designated for dynamic load tests. Use a pile specialty consultant with at least 3 years experience in dynamic load testing and analysis to perform the dynamic load test, Case Pile Wave Analysis Program (CAPWAP) and the wave equation analysis. Use a geotechnical engineer licensed as a professional engineer in Montana who has achieved at least advanced level on the Foundation QA Examination for Providers of PDA Testing Services to perform the CAPWAP analysis. Use a technician with a basic level classification on the Foundation QA Examination

for Providers of PDA Testing Services Operation to operate the pile driving analyzer. Provide the specialty consultant on site during the dynamic load tests. Submit the specialty consultant's resume for approval.

Furnish digital data acquisition system equipment with a display screen and printer.

With dynamic testing equipment attached, drive the pile in one continuous operation to the design tip elevation, or deeper if directed by the Project Manager. The Project Manager may lower the required tip elevation based on the bearing resistance measurements at the time of driving or re-driving. Reduce the driving energy to the pile to maintain pile stresses below the values specified in Subsection 559.03.3(A)(2), using additional cushions or reduction of the hammer's output energy. If eccentric driving is indicated, immediately re-align the driving system. Provide a printed summary of the dynamic load test results and recommendations for service pile driving criteria (blow count and stroke) and pile tip elevation. The Project Manager will determine the service pile driving criteria and minimum pile tip elevations based on the dynamic load test results.

Perform a re-drive of the test pile when required by the Project Manager. After initial driving, wait the minimum time specified, then re-drive each dynamic load test pile with the instruments attached. Apply at least 20 resistance blows to warm the hammer before re-driving. Do not warm the hammer using the dynamic load test pile. Re-drive the dynamic load test pile for a maximum penetration of 6 inches (150 mm) or a maximum of 50 blows, whichever occurs first.

Verify the assumption used in the initial wave equation analysis submitted in Subsection 559.03.3(A)(1) using CAPWAP. Analyze one blow from the original driving and one blow from the re-driving for each pile tested.

Perform additional wave equation analysis with adjustments based on the CAPWAP results. Provide a graph showing blow count versus bearing resistance. For open-ended diesel hammers, provide a blow count versus stroke graph for the bearing resistance. Provide the driving stresses, transferred energy and pile bearing resistance as a function of depth for each dynamic load test. Submit a written report with numerical and graphical results of the dynamic load testing, CAPWAP analysis and wave equation analysis.

C. Vibratory Hammer. Base the bearing resistance of pile driven with vibratory hammers on the driving resistance recorded during impact driving after the vibratory equipment has been removed. Splice vibrated pile not reaching the bearing resistance at the design tip elevation at the Contractor's expense, then drive with an impact hammer until the required bearing resistance is achieved as indicated by the requirements of Subsection 559.03.3.

559.03.4 Pile Driving Location and Alignment

Drive piles so the pile head at cutoff elevation is horizontally within 2 inches (50 mm) of the plan location for bent caps supported by piles and within 6 inches (150 mm) of plan location for piles capped below final grade. Ensure no pile is within 4 inches (100 mm) of a cap edge.

The allowable alignment tolerance from a plumb line is ¾-inch per yard (20 mm per meter) of pile length.

The Project Manager may suspend driving if the either the pile location or alignment is not maintained as the pile is driven.

Submit a written plan for correcting piles that do not meet the alignment or location tolerances.

Do not laterally pull on misaligned pile. Do not splice a properly aligned section on a misaligned pile.

559.03.5 Service Pile

Do not initiate driving of the service piles until all test piles and analysis are complete unless authorized by the Project Manager. Drive the pile to the design tip elevation shown in the contract, or deeper if necessary to achieve the required bearing resistance during driving. If specified, establish pile tip elevation and bearing resistance by compression load testing or dynamic load testing.

Furnish the service pile lengths specified in the contract. Adjust pile lengths for the difference between cutoff length and the pile position in the driving equipment.

The Project Manager will observe the pile driving and calculate the predicted bearing resistance as it is being driven.

When a re-drive of the service pile is required, re-drive the pile not less than 24 hours or more than 72 hours after initial driving and do not drive the pile below cut off elevation. If the Project Manager determines pile stresses during driving are damaging the pile, the Department may require other installation methods or equipment to obtain pile penetration.

Correct or replace improperly driven, damaged or defective pile at Contractor's expense.

Temporary welded plates for aligning field splices or hoisting may be used with the Project Manager's approval. Remove temporary plates and grind welds smooth.

559.03.6 Cutting Off Steel Pile or Steel Pipe Pile

Cut steel pile heads square and furnish a driving cap before driving the pile. After driving piles to the required bearing resistance and receiving approval from the Project Manager, cut piles off at the specified elevation.

559.03.7 Steel Pipe Pile

Securely cover driven pipe piling to prevent open-hole hazards.

Remove water in steel pipe piles before placing concrete or place the concrete using a tremie when water is present in the pile.

Provide lighting to illuminate the full pile length when requested to aid inspection of the pile before placing concrete. Fill steel pipe piles to an elevation no less than 2 feet (610 mm) below the cut off elevation with Class General hydraulic cement concrete a minimum of 12 hours prior to pouring the cap.

Do not place concrete in pipe piles until all piles for the bent have been driven.

559.03.8 Painting Steel Pile or Steel Pipe Pile

Paint steel pile having a portion of the pile exposed to the atmosphere in accordance with the following requirements.

A. Paint. Furnish paint in accordance with Subsection 710.02(B)(3).

B. Surface Preparation. Prepare the pile surface to the paint manufacturer's recommendations.

C. Painting. Before driving, apply two coats of paint to the pile starting a minimum of 2 feet (610 mm) below finish ground surface or finish channel bottom to the top of exposed steel.

Apply the first two paint coats to produce a minimum 12 mils (0.300 mm) dry film thickness. Field repair paint damage caused by transport, splicing and handling following the paint manufacturer's recommendations before applying the finish coat.

When piles are in the final location in the structure, apply the finish coat paint. Provide a finish coat with a minimum 3 mils (0.075 mm) dry film thickness on all surfaces exposed

to the air at time of paint application. The Project Manager will select the finish coat paint color from one of the following:

TABLE 559-1
FINISH COAT PAINT COLOR

Color	Federal Specification 595b Pigment Code
Montana Brown	33578
Montana Blue	35450
Montana Green	34138
Concrete Gray	36440

559.04 METHOD OF MEASUREMENT

559.04.1 Load Tests

Static and dynamic load tests, and test pile re-drives, completed and accepted are measured by the unit. Include all materials, tools, the first 24 hours of standby time for items dedicated solely to this work, and equipment required to perform each test or test pile re-drive in the unit bid price for the item.

Furnishing, driving, splices, re-driving of service piles and pile end protection are measured for payment as outlined in other Subsections. Do not include these costs in the static and dynamic load tests.

559.04.2 Furnish Pile

Furnish pile is measured by the foot (m) based on the plan quantity.

559.04.3 Drive Pile

Drive pile is measured by the foot (m) of pile driven into the ground. Drive pile is measured by the foot (m) of pile driven through pile drill and socket pilot holes. Pile driven through pre-bore holes is not measured for payment.

559.04.4 Pile Pre-drilling

Pile pre-bore and pile drill and socket pilot holes are measured by the foot (m) drilled below the existing or finished ground elevation to the bottom of the hole.

559.04.5 Pile Splice

When the pile tip extends more than 1-foot (305 mm) below the plan estimated pile tip elevation, splices required to obtain specified cutoff elevation are measured for payment. Pile splices are measured by the number of pile splices performed in the field and approved by the Project Manager.

Splices made for Contractor convenience, to facilitate driving operations, or to produce pile sections in accordance with specified design lengths are not measured for payment.

559.04.6 Pile Driving Point and Cutting Shoe

Pile driving point and cutting shoe are measured by the unit for the quantity specified in the contract.

559.04.7 Filler Concrete

Filler concrete is not measured for payment.

559.04.8 Painting Steel Pile and Steel Pipe Pile

Painting steel pile and steel pipe pile is not measured for payment.

559.05 BASIS OF PAYMENT

The Department will not pay for:

- Furnishing or driving falsework pile;
- Pile driven out of place and not accepted;
- Defective pile, or pile damaged in handling or driving;
- Forming holes;
- Lengths of pile cut off according to Subsection 559.02; or
- Welding temporary plates, removing the plates and grinding the welds smooth.

Include payment for the costs associated with painting steel pile and steel pipe piles and filler concrete in the contract unit price per foot (m) of drive pile.

Pile furnished, based on the plan quantities, but not incorporated in the finished structure, is paid for at the contract unit price per foot (m) of furnish pile and becomes the property of the Contractor. Pile furnished and incorporated in the finished structure in addition to plan quantity, is paid for by lump sum agreed price or in accordance with Subsection 109.04.2.

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Drive Pile	Foot (m)
Dynamic Load Test	Each
Furnish Pile	Foot (m)
Pile Conical Driving Point	Each
Pile Cutting Shoe	Each
Pile Drill and Socket	Foot (m)
Pile Driving Point	Each
Pile Pre-bore	Foot (m)
Pile Splice	Force Account
Re-drive Test Pile	Each
Re-drive of Service Pile	Force Account
Static Load Test	Each

Partial payments for drive pile will be made based on the total quantity as follows:

1. 95% when the piles are driven to final penetration.

2. 100% when the piles are cut off and painted as specified.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 561
BRIDGE DECK MILLING

561.01 DESCRIPTION

This work involves milling of deck concrete using hydrodemolition or mechanical scarification.

561.02 RESERVED

561.03 CONSTRUCTION REQUIREMENTS

561.03.1 Submittals

At least 2 weeks before beginning construction, submit to the Project Manager for approval a written plan detailing the methods, materials, equipment and personnel to be used. If hydrodemolition is used, include in the submittal how wastewater will be managed for each hydrodemolition site and controlling the wastewater from the time it leaves the hydro milling machinery until its final disposal. Do not begin concrete removal until receiving approval.

Ensure adequate capacity to handle the amount of wastewater generated.

561.03.2 Equipment

A. **Hydrodemolition.** Use a self-propelled hydrodemolition machine with high-pressure water jets capable of removing concrete to the removal depth shown in the contract. Use equipment of sufficient capacity and size to remove rust and concrete from the reinforcing steel. The equipment must have means to control the removal depth to within a tolerance of ⅜-inch (10 mm) above or below the plan depth. The equipment must have controls adequate to vary the water pressure, traverse and progression of the nozzle, oscillation or rotation of the nozzle head and the distance between the nozzle and the concrete surface. Provide accurate working pressure gauges at pumps and at the hydrodemolition unit.

B. **Scarification.** Use self-propelled mechanical scarifying equipment capable of removing ¼-inch (6 mm) depth minimum across the cutting path in one pass.

561.03.3 Procedures

A. **Hydrodemolition.** Mechanical scarification equipment may be used in conjunction with hydrodemolition to remove the portion of the deck above the top mat of reinforcement. If the milling equipment snags reinforcing steel, adjust the depth of removal to prevent further snagging. Remove the remaining concrete to the specified depth using hydrodemolition.

Before beginning hydrodemolition, configure the hydrodemolition unit by adjusting water pressure, nozzle size and angle, nozzle travel speed and unit travel speed to remove sound concrete to the plan depth. Record all the settings and provide them to the Project Manager. During hydrodemolition, verify the removal depth every 30 feet (10 m) along the length of the deck and along the width of the hydrodemolition path. Record the settings at each of these points and provide them to the Project Manager.

Remove any remaining unsound concrete. Do not operate the hammers at an angle greater than 45° from the deck.

Use only potable water for hydrodemolition. Do not use stream or lake water. Plug all deck drains. Install dams of clean, washed aggregate, hay bales, sand bags, or other materials as needed to strain and to direct the flow of runoff. Provide and use settlement basins if necessary to produce visibly clear water before disposal. Do not allow wastewater or waste-cement slurry to run across active travel lanes. Obtain necessary permits before beginning the work and comply with applicable water quality regulations

when disposing of the wastewater. Protect all adjacent areas and the traveling public from flying debris during removal operations.

B. Mechanical Scarification. Scarify the deck to the depth indicated in the contract. If the equipment snags reinforcing steel, stop work immediately and notify the Project Manager.

Remove concrete in areas designated for milling that the mechanical scarification equipment cannot reach with chipping hammers no larger than a nominal 15 pound (7 kg) class or other equipment as approved by the project manager.

Thoroughly clean the deck of all aggregate, paste, residue, oil, and any other substance that may interfere with the repair or overlay concrete.

Keep heavy loads off of reinforcing steel left unsupported by concrete due to concrete removal.

561.04 METHOD OF MEASUREMENT

Bridge deck milling is measured by the square yard of deck surface removed. No measurement will be made for mechanical scarification used in conjunction with hydromilling. Include costs associated with mechanical scarification used in conjunction with hydromilling in the unit price bid for Bridge Deck Milling.

561.05 BASIS OF PAYMENT

Payment for the completed and accepted work is made under the following:

Pay Item	Pay Unit
Bridge Deck Milling	Square Yard (m^2)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 562
BRIDGE DECK REPAIR

562.01 DESCRIPTION

This work involves Class A and B deck repair as specified in the contract or identified by the Project Manager.

A. Class A Repair. Areas of removal and replacement of existing unsound deck concrete, no deeper than the top of the bottom mat of reinforcing steel.

B. Class B Repair. Areas of removal and replacement of existing unsound concrete full depth through the slab.

562.02 MATERIALS

Use Class Structure or Deck concrete for Class A and B repair unless otherwise approved. Obtain the Project Manager's approval before using rapid-setting concrete or polymeric concrete.

562.03 CONSTRUCTION REQUIREMENTS

562.03.1 Submittals

Submit for review, a minimum of 14 calendar days before placement, the following:

1. Any proposed rapid set or polymeric concrete product data sheets.
2. Description of deck preparation measures that will be used to promote a competent bond between existing and new concrete.

562.03.2 Equipment

Provide equipment in accordance with the following requirements:

1. Power-driven hand tools for removal of concrete with the following limitations:
   - **a)** Jackhammers of a nominal 30 pound (14 kg) class or smaller.
   - **b)** Operate jackhammers or other mechanical chipping tools at an angle of 45° or less from the deck surface.
   - **c)** To remove concrete from beneath a reinforcing bar in a Class A repair, use chipping hammers in a nominal 15 pound (7 kg) class or smaller.
2. Hand tools such as hammers and chisels for removing final particles of unsound concrete and to achieve final required depth.

562.03.3 Location and Inspection of Repair Areas.

1. Complete milling operations, if included in the contract, prior to locating Class A or B repair areas
2. Use compressed air to dry the deck and to blow it clean of debris. The Project Manager will then locate nominal areas of Class A and Class B deck repair.
3. Notify the Project Manager if areas differ significantly from the nominal areas.
4. If the Project Manager determines that an area of Class A repair or bridge deck milling has exposed more than minimal amounts of the bottom mat of reinforcing steel, the Project Manager may require Class B repair in that area. Do not perform Class B repair without prior approval.

562.03.4 Concrete Removal

1. For unmilled surfaces, first saw cut ½-inch (13 mm) deep around all Class A and B repair area edges.
2. Remove all delaminated, cracked, disintegrated, loose, or otherwise unsound concrete using mechanical equipment. Finish the removal with lightweight hand tools. If the bond between existing concrete and reinforcing steel breaks, remove concrete around the

circumference of the bar at least 1-inch (25 mm). Prevent cutting, stretching, or other damage to exposed reinforcing steel.

3. If the Project Manager finds an excessive amount of unsound concrete while performing a final check on a removal area, rework that entire area.
4. The Project Manager may approve the use of high-pressure water-blast equipment for concrete removal. The Project Manager will suspend the use of such equipment at any time if, the process produces unsatisfactory results.

562.03.5 Reinforcing Steel

If an existing reinforcing bar has less than 1-inch (25 mm) clearance from the new finished concrete surface, remove concrete from under the bar, then press it down and fasten it in place to provide 1-inch (25 mm) clearance. Remove concrete as necessary to provide a clearance of 1-inch (25 mm) around the circumference of the bar.

Replace any reinforcement bar that is corroded, cut, or damaged to the point that it has lost 25% or more of its effective cross-sectional area. Replace such bars with new ones of the same size. The Project Manager will determine splice locations where bars need cutting and splicing. Repair epoxy coating that is damaged on reinforcing bars during concrete removal operations.

Prior to placing new concrete, remove all rust, dirt, laitance, oil, or other foreign materials from reinforcement surfaces.

562.03.6 Placing and Finishing Concrete - Class A and B Repair

A. Repair.

1. Prepare the surface as necessary in order to ensure a competent bond between the existing and repair concrete.
2. Use forms for new concrete in Class B repair areas. Do not attach forms to existing reinforcing bars unless approved by the Project Manager.
3. Repair concrete may be placed concurrently with an overlay if approved by the Project Manager. Provide a description of the proposed sequence and equipment to be used to place and consolidate the repair concrete ahead of the screed.
4. If repair concrete is not placed concurrently with an overlay, finish and cure the repair concrete as follows:
   - **a.** If the repair concrete will not be the final grade, provide roughened surfaces to a full amplitude of 0.25-inch (6 mm).
   - **b.** If the repair concrete will be the final grade, provide broom finish.
   - **c.** Cover the repair concrete with a single layer of clean, wet burlap immediately after completion of surface finishing.
   - **d.** Place a minimum 4 mil polyethylene film over the burlap.
   - **e.** For rapid-setting and polymeric concretes, cure according to manufacturer's recommendations. For other concrete, maintain the wet cure for a minimum of 72 hours.

B. Acceptance.

1. Surface Smoothness will be checked per Subsection 552.03.11(B)(6). Correct areas identified by the Project Manager. Correct variations that prevent drainage from any part of the bridge deck.
2. A drag-chain survey will be conducted to determine the soundness of bond between the repair and the deck, placing particular emphasis on areas of visible cracking. Remove and replace areas that have debonded. The Project Manager may core the repair to determine depth of cracking. When directed by the project manager, seal cracks in repair concrete with a bridge deck crack sealant listed on the QPL. Apply the product in accordance with the manufacturer's recommendations. In cases of

excessive cracking, the Project Manager may require removal and replacement of part of or all of a repair.

3. All corrective actions, including crack sealing are at Contractor expense.

562.04 METHOD OF MEASUREMENT

Class A bridge deck repair and Class B bridge deck repair are measured by the square yard of deck surface and includes the repair concrete. Areas of concrete removed by milling operations, even if deeper than plan, are not measured for payment in accordance with Class A bridge deck repair.

Areas of concrete removed by milling operations, which then require additional Class A or B repair, as determined by the Project Manager, are measured for payment.

When an area of Class A bridge deck repair is upgraded to Class B bridge deck repair, the area will be measured as Class B bridge deck repair.

Replacement of reinforcing bars will be measured and paid for in accordance with Subsection 109.04.1. Replace any reinforcing bars damaged by Contractor operations at Contractor expense.

562.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Class A Bridge Deck Repair	Square Yard (m^2)
Class B Bridge Deck Repair	Square Yard (m^2)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 563
MODIFIED CONCRETE OVERLAY

563.01 DESCRIPTION

This work consists of placing a bridge deck overlay of either a latex modified concrete or silica fume modified concrete. Select a single type of modified concrete overlay and use it for all locations shown in the contract.

563.02 MATERIALS

563.02.1 Cement

Furnish cement in accordance with Subsection 551.02.1. Use only one brand of cement in a given overlay. Do not use Type III cement.

563.02.2 Aggregate

1. Use aggregate in accordance with Subsection 701.01.
2. Furnish ¾-inch coarse concrete aggregate.
3. Use aggregate in a saturated surface dry (SSD) condition at the time of mixing concrete.
4. Test the moisture content using MT 221, document the results for both total moisture content and for surface moisture content, and provide them to the Project Manager.

563.02.3 Latex Admixture

Use a latex admixture containing a polymer of 66% ± 5% styrene and 34% ± 5% butadiene, with the polymer comprising between 46% - 49% of the total emulsion. The emulsion must have a sodium alkyl sulfate stabilizer acting as an anionic surfactant, polymer average particle size between 1,900 and 2,500 angstroms, a weight of 8.43 to 8.52 lb/gal at 75 °F (mass of 1.01 - 1.02 kg/l at 25 °C), and a pH between 9.5 and 11.0.

Protect the latex admixture from temperatures below 32 °F (0 °C) and above 85 °F (29 °C) at all times. Provide a thermometer capable of storing minimum and maximum temperatures and place it with any admixture stored on site. Replace admixture subjected to temperatures outside the range above at Contractor expense to the Department.

563.03 CONSTRUCTION REQUIREMENTS

563.03.1 Submittals

Submit the following items to the Project Manager for approval at least 10 business days before concrete placement:

1. The method and materials used to contain, collect, and dispose of all debris generated by the cleaning and surface preparation process.
2. Details of the screed rail support system, including details of anchoring the rails and providing rail continuity, and of other equipment used to apply the overlay.
3. The methods that will be used to prepare the surface to ensure bonding of the overlay to the existing deck concrete.

563.03.2 Pre-placement Conference

Hold a pre-placement conference with a technical representative from the modified concrete supplier and the Project Manager at least 15 calendar days before the planned concrete placement. Present the mix design and methods of accomplishing all phases of the concrete overlay work.

563.03.3 Surface Preparation

Prepare the surface to ensure bonding between the surface and the overlay. Blow standing water out of depressions, holes, or areas of concrete removal with oil filtered compressed air. Protect the prepared surface from contamination using plastic sheeting or other means.

Deck preparation work may be performed in areas adjacent to newly placed overlay concrete. If this work begins less than 72 hours after overlay placement, perform the work with the following restrictions:

1. Wait a minimum of 1 day after placing the concrete to begin the adjacent surface preparation.
2. Minimize the disturbance of burlap and plastic sheeting and maintain uncured concrete in a wet condition at all times. Restore disturbed burlap and plastic sheeting as soon as possible.
3. Use no power tools heavier than 15 pound chipping hammers.
4. Operate air compressors on the deck only directly over piers or bents.
5. Prior to placement and completed cure of new concrete, allow no loads other than approved construction equipment on any part of the deck that has undergone surface preparation.

563.03.4 Mobile Mixing Equipment

Use mobile mixing equipment for batching Class Overlay-LM concrete. Do not use mobile mixing equipment to batch Class Overlay-SF concrete unless approved by the Project Manager.

Demonstrate that mobile mixing equipment meets the following requirements:

1. **Mixing Equipment.** Use self-contained, mobile, continuous-mixing equipment in accordance with the following requirements:
   - **a.** A capacity to mix a batch of at least 8 cubic yards (6 m^3). The machine capacity must allow finishing operations to proceed at a steady pace, with final finishing completed before formation of the plastic surface film.
   - **b.** A positive means of controlling cement content entering the mix, complete with a recording meter visible at all times and a continuous printout of the accurately measured quantity.
   - **c.** Positive control of the water, and the latex emulsion (if applicable), flow into the mixing chamber. Positive means to adjust the water flow for variations in aggregate moisture and a flow meter indicating the water quantity.

   The Project Manager will approve each mobile mixer used on the project based on a demonstration of its ability to produce concrete in accordance with the contract. Calibrate each mobile mixer in the presence of the Project Manager, using the following tests. Record all test results and required calculations and provide the Project Manager with a copy of those data.

   Inform the Project Manager what moisture content (percentage) the fine and coarse aggregates will have on entering the mix. Dry or wet the stockpiles to within 0.5% of this percentage at the beginning of each workday. Take moisture readings on the stockpiles before calibrating the mixer trucks and before each day's placement of latex modified concrete. Record the readings and give the information to the Project Manager. Perform yield, slump, and air content tests on concrete from each mixer in the Project Manager's presence.
2. **Cement Meter.** Obtain the operating speed (in revolutions per minute) and the approximate number of counts required on the cement meter to deliver one 94 pound (43 kg) bag of cement from the truck manufacturer's mix setting chart. Place at least 40 bags

of cement in the cement bin. Place the mixer on a level surface and provide an electrical ground.

Adjust the engine throttle to obtain the specified revolutions per minute (rpm). Discharge cement until the belt has made 1 complete revolution. Stop the belt and reset the cement meter to zero. Discharge approximately 1 bag of cement into a container while timing the discharge with a stopwatch. Record the number of counts on the cement meter and determine the mass of cement discharged on the Field Calibration form included in this specification. Repeat the process of discharging 1 bag at a time for a total of 6 runs. Reset the cement meter to zero each time.

At the end of the 6 runs, total the number of cement counts, the mass of cement discharged, and the times of each of the runs, in seconds.

Perform the following calculations:

a. Mass of cement per cement meter count. Divide the total mass of cement discharged in the 6 runs by the total number of counts on the meter for the 6 runs.

b. Counts per bag of cement. Divide 94 pounds (43 kg) by the mass of cement per cement meter count.

c. Cement discharge rate. Divide the total mass of cement for the 6 runs by the total of the times for each of the 6 discharges.

d. Discharge time for 1 bag. Divide 94 pounds (43 kg) by the cement discharge rate.

3. **Latex Throttling Valve.** Clear the latex strainer of any obstructions. Adjust the latex throttling valve to deliver 3.5 gallons (13.2 L) of latex, or 30 pounds (13.3 kg) for each bag, or 94 pounds (43 kg) of cement, using the calculation results from Subsection 563.03.4(2), where necessary.

   With the unit operating at the specified rpm, discharge latex into a container for the discharge time for 1 bag calculated above and determine the weight of the latex discharged. Adjust the valve until the machine discharges 30 lbs. (13.6 kg) in the discharge time for 1 bag. Verify the accuracy of this setting by repeating the latex discharge 3 more times.

4. **Water Flow Meter.** Set the water flow meter to flow at the rate of 0.5 gallons (1.9 L) per minute. Collect and weigh the water discharged during 1 minute with the equipment operating at the specified rpm to verify the discharge rate. Repeat the process with the flow meter adjusted to 1.5 gallons (5.7 L) per minute.

5. **Aggregate Bin Gates.** Set the gate openings to provide aggregate at a rate matching the specified concrete mix proportions.

563.03.5 Concrete Placement

Place concrete in accordance with Section 551.

Install necessary bulkheads to the required grade and profile before placing any concrete. Alternatively, over-pour the end of the overlay by a minimum of 6 inches (150 mm). Saw cut and remove the over-pour from the rest of the overlay.

Dispose of materials that dry out, set, or show evidence of loss of cement paste. Stop overlay placement on discovering those conditions and do the surface preparation again.

Strike off the modified concrete at a level ¼-inch (6.0 mm) above final grade. Complete hand finishing and texturing within 15 feet (4.5 m) of the finishing machine. Float and vibrate the concrete as needed to provide a tight finished surface.

Vibrate concrete more than 3 inches (75 mm) thick internally, in addition to the vibration of the surface screed. After finishing the concrete, check for surface irregularities with a 10 foot (3 m) straight edge. Correct surface areas that vary more than ⅛-inch (3 mm) in that distance.

563.03.6 Curing

Cure the overlay per Subsection 551.03.7.

563.03.7 Phased Construction

If the overlay is placed in phases, apply a bridge deck crack sealant to the phase line joint(s) after the overlay has cured. Furnish a bridge deck crack sealant in accordance with Subsection 717.02.2.

563.03.8 Acceptance

1. Cast at least 1 latex modified concrete cylinder for each day's overlay placement. Cure the cylinders with their matching deck segments. Break the cylinders at the end of the dry curing process to demonstrate the strength the overlay concrete has attained.
2. Correct areas identified by the Project Manager. Correct variations that prevent drainage from any part of the bridge deck. Do not start the process of saw cutting the transverse deck grooves until the Project Manager has approved all of the finished repair work.
3. A drag-chain survey will be conducted to determine the soundness of bond between the repair and the deck, placing particular emphasis on areas of visible cracking. Remove and replace areas that have debonded. The Project Manager may core the repair to determine depth of cracking. When directed by the Project Manager, seal cracks in repair concrete with a bridge deck crack sealant listed on the QPL. Apply the product in accordance with the manufacturer's recommendations. In cases of excessive cracking, the Project Manager may require removal and replacement of part of or all of a repair.

All corrective actions required for acceptance are at Contractor expense.

563.04 METHOD OF MEASUREMENT

Bridge deck overlay is measured by the cubic yard (m^3) of modified concrete overlay placed. Include the cost of trial batches in the unit cost of modified concrete overlay.

Transverse deck grooving is measured by the square yard (m^2) in accordance with Subsection 552.04.

Bridge deck crack sealant applied to phase line joint(s) is not measured for payment. Include all costs associated with bridge deck crack sealant applied to phase line joint(s) in the modified concrete overlay item.

563.05 BASIS OF PAYMENT

Payment for the completed and accepted work is made under the following:

Pay Item	Pay Unit
Modified - Concrete Overlay	Cubic Yard (m^3)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 564
STRUCTURE TOLERANCES

564.01 DESCRIPTION

This work is meeting the specified tolerances for the listed structure elements.

564.02 RESERVED

564.03 CONSTRUCTION REQUIREMENTS

Meet the tolerances shown in Table 564-1. In case of conflicting tolerances, the tighter tolerance controls. Increase precision as necessary to meet other contract requirements.

TABLE 564-1
STRUCTURE TOLERANCES

Item	Tolerance Type	Tolerance
Substructure: Drilled Shafts	Horizontal Location	3 inches (75 mm)
	Top Elevation	+ 1-inch (25 mm), - 3 inches (75 mm)
	Diameter	+ 3 inches (75 mm), - ½-inch (13 mm)
	Deviation from Plumb	± 2%
Substructure: Walls, Footings, Columns	Horizontal Location	1-inch (25 mm)
	Elevation Exposed Concealed	 ± ¾ inch (19 mm) ± 1 inch (25 mm)
	Dimensions	+ ½-inch. (13 mm), - ¼ inch (6 mm)
	Deviation From Plumb	± 2%
Substructure: Piling	Horizontal Location Bent Caps Supported By Piles Piles Capped Below Final Grade	 2-inch (50 mm) 6-inch (150 mm)
	Edge Cover	4-inch (100 mm), minimum
	Vertical (Cutoff Elevation)	± 1-inch (25 mm)
	Deviation From Plumb Or Batter	± 2%
Elastomeric Bearings	Horizontal Location	± ¼-inch (6 mm)
	Thickness	- 0, + ⅛-inch (3 mm)
	Length, Width	- 0, + ¼-inch (6 mm)
Bearing Plates (Shoes, Masonry, Embedded)	Horizontal Location	± ¼-inch (6 mm)
	Thickness	± 1/16-inch (2 mm)
	Length, Width	± ¼-inch (6 mm)
	Bevel Slope	± 0.002 Radians
	Deviation From Plane	± 1/16-inch (2 mm)
Beam seats	Deviation From Plane	± 1/16-inch (2 mm)
	% Slope, For Cast In Place Deck Superstructures	± 0.5%
	% Slope, For Deck Beam Superstructures	± 0.2%
	Elevation	+ 0, - ½-inch (13 mm)
Anchor bolts	Refer to Subsection 552.03.13	

Item	Tolerance Type	Tolerance
Superstructure	Dimensions	+ 1-inch (25 mm), - ¼-inch (6 mm)
	Deck Form Elevation	+ ⅛-inch (3 mm), - ¼-inch (6 mm)
	Deck Thickness	+ ¼-inch (6 mm), - ⅛-inch (3 mm)
	Deck Smoothness (Parallel To Roadway Centerline)	± 3/16-inch (5 mm) per 10 feet (3 m)
Strip Seal Joint Opening	Width	± ¼-inch (6 mm)
Pre-Stressed Concrete Beams	Refer to Subsection 555.03.15	
Steel Beams	Refer to Subsection 556.03.10	
Non Pre-Stressed Steel Reinforcement[1]	Cover	- ⅜-inch (10 mm)
	Location / Spacing	± 1-inch (25 mm)
	Drilled Shaft Top of Cage Elevation	+ 6-inch (150 mm), - 3-inch (75 mm)
	Longitudinal Location of Bends in Bars and Ends of Bars	± 2-inch (50 mm)
	Embedded Length of Bars	
	No. 3 through 11 (No. 10 through 36) Bar Sizes	- 1-inch (25 mm)
	No. 14 through 18 (No. 43 through 57) Bar Sizes	- 2-inch (50 mm)
	Length of Bar Laps	
	No. 3 through 11 (No. 10 through 36) Bar Sizes	- 1-inch (25 mm)
	No. 14 through 18 (No. 43 through 57) Bar Sizes	Laps Not Permitted
Concrete Barrier Rail[2]	Tangents: Longitudinal, Straight Edge Deviation	± ¼-inch (6 mm) per 10 feet (3 m)
	Curves: Longitudinal, Deviation from the Ideal Curve	± ¼-inch (6 mm) per 10 feet (3 m)

Notes:
1. The Project Manager may approve requests for exceptions as necessary to avoid interference with anchor bolts or other conflicts.
2. Curved concrete barrier may be constructed of tangent segments, each having a maximum length of 10 feet (3 m).

In the event an item does not meet a specified tolerance, the Project Manager may approve an exception if it is determined that there will be no detrimental effect to the structure. If the Project Manager determines that a nonconforming item may be detrimental to the structure, submit a written plan for approval that details corrective action.

564.04 METHOD OF MEASUREMENT

Meeting the listed tolerances is not measured for payment.

564.05 BASIS OF PAYMENT

Meeting listed tolerances is incidental to the work. Include all costs associated with meeting the listed tolerances in the bid item that includes the structure item listed.

SECTION 565
BEARING DEVICES

565.01 DESCRIPTION

This work is the furnishing and placing of bearing devices.

565.02 MATERIALS

Furnish material in accordance with the following subsection requirements:

A. Elastomeric Devices
- **1.** Elastomeric Bearing Devices..... 711.14
- **2.** Steel Laminates..... 711.14
- **3.** Polytetrafluoroethylene (PTFE) 711.20
- **4.** Stainless Steel Sheets..... 711.20

B. Fiber Reinforced Pads 711.16

C. Steel Bearing Plates..... 711.02

565.03 CONSTRUCTION REQUIREMENTS

565.03.1 General

Submit shop drawings as directed by the contract. Do not fabricate bearings prior to receiving approved drawings.

A. Packaging. Package and protect the bearings from damage and prevent contamination of the contact surfaces of the sliding elements during handling, transporting, and storage. Replace any bearing damaged by handling, transporting or storage at no cost to the State.

B. Installation of Elastomeric Devices. Place bearings on a level surface. Correct any misalignment of the support to form a level surface. The instantaneous temperatures of the sole plates must not exceed 300 °F (149 °C) when field welding the sole plate to the steel girder or base plates embedded in concrete beams. Replace any bearing damaged during installation at Contractor expense.

565.03.2 Bearing and Anchorage

Place masonry bearing plates on bearing areas that meet the contract requirements. Install bearing plates level to provide full bearing on the masonry.

Place masonry bearing plates on fiber reinforced pads in accordance with Subsection 711.16 that project a minimum ½-inch (13 mm) on all sides of the bearing plate.

Finish the bearing area to a level plane. The surface must not vary by more than $^{1}/_{16}$-inch (2 mm) from a straightedge placed in any direction across the area. Extend the bearing area at least 1-inch (25 mm) beyond the bearing contact area. The finished elevation of the bearing surface must not vary by more than ⅛-inch (3 mm) from the specified beam-seat elevation unless otherwise approved by the Project Manager.

A. Steel Structures. Make allowances for bottom chord elongation due to dead load when setting shoes or bearing plates for steel truss spans.

Install bridge rocker shoes to be vertical under full dead load at 32 °F (0 °C). Raise spans and make adjustments if the rockers are not correctly positioned with the final dead load on spans.

B. Steel Shims. Use steel shims when necessary to bring the masonry plates up to grade. Use shims of the same size as the masonry plate and a minimum ¼-inch (6 mm) thick.

565.03.3 PTFE Bearings

Furnish PTFE bearings composed of pure, unreinforced, polytetrafluoroethylene fluorocarbon resin sheets bonded to the elastomeric pads. Weld stainless steel sheets to the sole plates as

shown in the contract. Use only new materials for the manufacture of the bearings with no reclaimed material incorporated into a finished bearing. The dimensions of the finished bearings must meet the tolerances as specified in Section 564.

Unless otherwise approved by the Project Manager, furnish bearing assemblies, including the sole plates, as a complete unit from one manufacturing source.

Polish stainless steel in contact with the PTFE surface to a mirror bright finish as specified in ASTM A480, finish No. 8.

Edge weld the stainless steel sheets to the sole plates using E308L or E309L electrodes as specified in ASW A5.4 and Section 624, sized for the stainless steel sheet. Any portion of the weld that extends above the surface of the finish of the stainless steel sheet must be ground to the surface of the sheet. Repair any imperfections in the finish of the stainless steel sheet caused by welding or grinding prior to shipment.

Vulcanize bond steel backing plates and masonry plates, if any, to the elastomeric pad.

565.04 METHOD OF MEASUREMENT

Elastomeric devices are measured by each device required for 1 beam seat.

Fiber reinforced pads are not measured for payment.

Steel bearing plates are included in the cost of concrete beams, but are measured in accordance with Subsection 556.04 if steel girders are supplied.

565.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Elastomeric Bearing Devices	Each
Elastomeric Bearing Devices-PTFE	Each

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 601
WATER SERVICE LINES

601.01 DESCRIPTION

This work is constructing polyethylene, steel and copper water service lines, ½-inch through 2-inch (13 mm through 50 mm) nominal diameter.

601.02 MATERIALS

Furnish materials in accordance with the following subsection requirements:

Copper Pipe 709.10
Polyethylene Pipe 708.08
Seamless Steel Pipe 709.09

601.03 CONSTRUCTION REQUIREMENTS

Install water service lines, make all connections, and pressure test the system in accordance with the Montana Public Works Standard Specifications, and the contract.

Meet the requirements of Section 207 for trench excavation, foundation preparation, and backfilling.

601.04 METHOD OF MEASUREMENT

Water service lines are measured by the foot (m).

Excavation is measured by the cubic yard (m^3) in accordance with Subsection 207.04.

601.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Excavation	Cubic Yard (m^3)
Water Service Line	Foot (m)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 602
REMOVE AND RELAY PIPE CULVERT

602.01 DESCRIPTION

This work is removing pipe culverts from the specified locations, salvaging and storing, disposing of, or cleaning and re-laying the removed pipe.

602.02 MATERIALS

Replacement pipe for existing pipe not re-usable is specified in the contract.

602.03 CONSTRUCTION REQUIREMENTS

602.03.1 Culvert Removal

Remove pipe culverts without damaging the pipe. Replace pipe that is damaged by removal with equal lengths of pipe, at Contractor expense. The replacement pipe must be the same type and diameter and in equal or better condition than the removed pipe before it was damaged.

Store removed pipe at the specified locations.

Backfill pipe removal locations within the new roadway template section in accordance with Subsections 203.03.2 and 203.03.3.

602.03.2 Relaying Culverts

Clean out pipe to be re-laid of dirt, rubbish, and other materials and relay in accordance with Section 603.

602.03.3 Restoration and Maintenance of Existing Pavement

Restore and maintain existing pavement structures disturbed during the removal or relaying of pipe culverts in accordance with Subsection 603.03.5.

602.04 METHOD OF MEASUREMENT

602.04.1 Remove Pipe Culverts

Pipe culvert removal is measured by the foot (m) of pipe removed.

Excavation required to remove pipe culverts is not measured for payment.

602.04.2 Relay Pipe Culverts

Pipe culvert removal is measured by the foot (m) of pipe removed.

Excavation required to remove pipe culverts is not measured for payment.

602.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Relay Pipe Culvert	Foot (m)
Remove Pipe Culvert	Foot (m)

Payment for all costs associated with excavation required for removing or relaying pipe culverts is included in the contract unit price per foot (m) of remove or relay pipe culvert.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 603
CULVERTS, STORM DRAINS, SANITARY SEWERS, STOCKPASSES, AND UNDERPASSES

603.01 DESCRIPTION

This work is furnishing and installing culverts, storm drains, sanitary sewers, stockpasses, underpasses, further referred to as pipe.

603.02 MATERIALS

Furnish materials in accordance with the following subsection requirements:

Bituminous Coated Corrugated Steel Pipe, Pipe Arches,
Steel Structural Plate Pipe and Pipe Arches.....709.04
Concrete Pressure Pipe 708.02
Corrugated Aluminum Pipe and Pipe Arch Culverts 709.07
Corrugated Aluminum Pipe for Underdrains.....709.08
Corrugated Steel Pipe and Pipe Arches 709.02
Corrugated Steel Pipe for Underdrains.....709.06
Culvert Sealers 707.02
Ductile Iron and Steel Water Pipe 709.01
High Density Polyethylene Pipe 708.08
PVC Sewer and Drain Pipe 708.05
PVC Water Pipe.....708.06
Polyethylene Corrugated Drainage Pipe or Tubing.....708.07
Pre-coated, Galvanized Steel Culverts and Underdrains.....709.05
Reinforced Concrete Pipe 708.01
Seamless Steel Pipe 709.09
Slotted Corrugated Steel Pipe.....709.11
Steel Structural Plate Pipe and Pipe Arches.....709.03

Materials will be acceptance inspected at the manufacturing source.

Aluminized FETS may only be used in conjunction with aluminum pipe or poly coated pipe.

603.03 CONSTRUCTION REQUIREMENTS

603.03.1 General

The locations and pipe lengths shown in the contract are an estimate only and may be revised. Order pipe using only the Project Manager furnished list of sizes and lengths.

Repair or replace pipe damaged during delivery, storage, or placing at Contractor expense.

When the contract allows optional types of pipe material for culverts at specific locations, any of the material types shown in the contract may be used for that installation.

Provide the Project Manager in writing, at the pre-construction conference, a list of proposed materials for use at each location optional material is allowed.

The type and quantity of material for bidding is listed in the contract in columns under the heading “Basic Bid Items”. The information in these columns is what would be required to complete the planned installation using the “Basic Bid Pipe”, which is steel, when it is an option. If steel is not an option, concrete pipe is the basic bid pipe. Include terminal sections, and connection hardware, where required.

Each pipe size is paid for at the contract unit price and is full compensation for the pipe regardless of the pipe optioned by the Contractor. Only work shown in the “Basic Bid Items” columns in the contract is paid for at a given installation, and the quantities are based on

measurements for the basic pipe. Additional work that is required due to field conditions and not associated with the selected pipe is measured and paid for on quantity changes that would result if the basic bid pipe had been installed. All pay items required for installation are measured and paid for based on the basic bid pipe in the contract. Pay items not required for installation of the selected pipe will not be measured and paid for.

Strut pipe arches if specified in the contract.

603.03.2 Excavation and Foundation Preparation

Excavate and prepare the pipe foundation as specified in Section 207.

Place bedding material in accordance with Section 207 and the Detailed Drawings.

603.03.3 Installation

A. Prefabricated Non-metal Pipe. Lay non-metal pipe on the foundation in standard lengths starting at the outlet end, with the groove or bell ends upgrade. Recess the bell ends into the foundation.

Join the pipe ends to form a positive, tight-fitting joint by applying uniform pressure along the entire circumferential ends of the sections. Place pipe, using methods that prevent pipe damage. Replace pipe damaged during placing at Contractor expense.

Make the joints watertight for round concrete pipe, used for irrigation, storm drainage, or sanitary sewage, or other purposes subject to continuous flow, sealing them with rubber gaskets in accordance with Subsection 707.02.1. Use flexible plastic joint seal compound for concrete arch pipe joints that meet Subsection 707.02.2 requirements.

The culvert joints for normally dry installations may be sealed with rubber-type gaskets or an approved joint-sealing compound, except where open joints are specified.

Construct angles, turns, and branch connections using pre-fabricated sections or construct as shown in the Detailed Drawings.

Construct pipe dead ends and branches using closed ends or stoppers of equal strength to the pipe wall, cemented to the pipe.

Flared end terminal sections used with concrete pipe may be precast standard sections or cast in place as shown in the Detailed Drawings.

Cap one end of concrete pipe tee sections that connect to median inlets when specified. Use a pre-fabricated cap or construct a cap of reinforced concrete and connect to the tee section forming a watertight joint with a strength equal to the pipe wall strength.

Keep all trenches dry when placing pipe and until the joint filler has cured.

B. Prefabricated Corrugated Metal Pipe. Place the pipe on the foundation with each section approximately 1-inch (25 mm) apart. Follow the pipe manufacturer's instructions for connecting joints. Connect the sections with bolted coupling bands shaped to fit the formed pipe. Tap the coupling bands with mallets as the bolts are tightened.

The difference in diameter of abutting pipe ends to be coupled must not exceed ½-inch (13 mm).

Do not damage the pipe coating.

Culverts for siphons are designated as CSP Siphon or CSP irrigation.

Construct field joints following the manufacturer's instructions for the type of pipe and coupling bands or devices used.

Construct the field joints for corrugated metal pipe to maintain the pipe alignment and prevent the fill material from infiltrating the joints. Provide circumferential and longitudinal strength using the structural joint performance criteria of Division 2, Section 23 of the *AASHTO Standard Specifications for Highway Bridges*. Ensure the field joints for siphon and irrigation pipe installations are watertight and meet Subsection 709.02 requirements. Correct all installations not meeting any of these requirements at Contractor expense.

Conduct all required water-tightness tests on siphon and irrigation pipe installations using MT 420 or an approved procedure.

Cap one end of steel and aluminum pipe tee sections that connect to median inlets. Use a metal cap of equal thickness to the pipe wall and attach it to the tee section forming a watertight joint of equal strength to the pipe wall strength.

Field coat aluminum or Type II aluminized pipe to be in contact with fresh concrete with an asphalt mastic in accordance with AASHTO M 243 over the full surface to be in contact. The asphalt container's label must provide the following information:

1. Name of product;
2. Specification;
3. Lot number;
4. Date of manufacture;
5. Quantity of mastic in container; and
6. Manufacturer's name and address.

Separate aluminum pipe coupled to dissimilar metals by either a bituminous-coated coupling, polyvinyl sheeting, painted with rubber-base paints, or use aluminized steel.

C. Structural Plate Types. Follow the manufacturer's field erection recommendations and the contract requirements. Do not start work until the Project Manager and Contractor have the manufacturer's specifications and instructions at the work site.

Do not place backfill until all plates in a ring are complete and all bolts in the structure are tightened to the manufacturer's specifications.

Compact backfill using hand-operated compaction equipment within 6 feet (1.8 m) of the pipe neat lines.

Tighten all bolts in the assembly to the pipe manufacturer's torque specifications.

Long-span structure requirements are specified in the contract.

Match the existing pipe section extensions for existing steel structural plate pipe and pipe arch culverts and stockpasses. Remove beveled ends on existing pipe, install the new pipe sections, and re-install or replace the beveled ends as specified.

Pipe end treatment and slopes are detailed in the contract.

Replace damaged structural plates at Contractor expense.

D. Ductile Iron Pipe. Lay pipe to the specified line and grade, installing all appurtenances as specified. Uniformly support the pipe throughout its length, except at joints. Make depressions in the foundation for bells, couplings or other connectors at joints.

Bring the pipe to grade by working the material along the barrel of the pipe, leaving the joints un-supported. Flare, grind, file, or machine the pipe cut ends to make the connections. Prevent foreign material from entering the pipe during the work.

Do not deflect pipe beyond the manufacturer's allowable tolerances.

Inspect fittings for cracks, blowholes, chips, and coating damage before installation. Replace defective fittings.

Lower fittings into the trenches without damaging the inside lining or outside coating.

Install concrete thrust blocks against undisturbed soil.

Make pipe joint connections following the manufacturer's recommendations.

E. Storm Drain Manhole and Trunkline Connections.

1. **Concrete Pipe to Manhole and Trunkline Connections.** Install the pipe entering the manhole wall so the pipe end is flush with the inside wall of the manhole as shown in the Detailed Drawings. Grout the connection using a commercial non-shrink grout.

2. **Stub Connections to Trunklines.** Place the stub pipe with the pipe end projecting a maximum 2 inches (50 mm) into the trunkline. Contour the projecting end to match the trunklines inside wall. Grout the connection using a commercial non-shrink grout.

F. **Embankment Protectors.** Construct embankment protectors as shown in the Detailed Drawings. Include the flared end section, the 18-inch (450 mm) CMP, the reducer and the bends in the total length of embankment protector.

603.03.4 Backfilling

A. **General.** Use backfill material free of sticks, sod, frozen soil, or other deleterious matter. Do not permit stones, rocks, chunks of broken concrete, or other material larger than 3 inches (75 mm) within the top 2 feet (610 mm) of the top of water and sanitary sewer lines and within 1-foot (305 mm) of the pipe top for all other installations.

Replace the top 2 feet (610 mm) of backfill for excavations in existing roadway sections “in-kind”.

Place backfill material in maximum 6-inch (150 mm) layers loose thickness and compact. Firmly tamp the backfill under the pipe haunches. Extend the backfill material placed above the excavation limits or the ground line beyond each side of the pipe equal to twice the pipe diameter or 12 feet (3.7 m), whichever is less.

Compact backfill equally on each side of the pipe to at least 1-foot (305 mm) above the pipe top.

Use equipment and methods for backfilling and compacting that do not distort, misalign, or damage the pipe. Replace pipe that is distorted, misaligned, or damaged at Contractor expense.

Do not allow heavy equipment to pass over any pipe until at least 4 feet (1.2 m) or one-half pipe diameter of backfill, whichever is greater, is placed and compacted over the pipe.

B. **Rock Embankment.** Install pipes placed in blasted or fractured rock embankments as follows:

- Envelope the exposed pipe surface above the level of the bedding trench with graded bedding material.
- Extend the envelope to ½ the nominal pipe diameter or 3 feet (915 mm), whichever is greater. Completely surround the pipe with graded bedding material when a bedded trench is not specified.
- Use graded bedding material in accordance with Subsection 701.04.1; placed and compacted in accordance with Subsection 603.03.4(A).

603.03.5 Restoration and Maintenance of Existing Pavement

Restore the existing pavement excavated for pipe installation using material equal to or better than the in place pavement. Restoration includes replacing and compacting excavated aggregate base with materials equal to those in the existing roadway and placing new bituminous surfacing equal to the existing, but not less than 0.25 feet (75 mm) in thickness. Place and compact the replacement bituminous surfacing to match the adjacent pavement providing a smooth riding surface, including the joints.

Maintain the restored pavement areas in good condition until the new pavement is placed.

603.04 METHOD OF MEASUREMENT

603.04.1 Pipe

Pipe is measured by the foot (m) in place from end-to-end of the installed structure along the bottom or pipe invert. Gasket material, specified coatings, coupling bands, bolts, bands, fittings, tees, risers, end sections, joint testing, restoring disturbed pavement, flared ends, beveled,

skewed, and similar shapes or special designs, riser pipe lengths, riser tee sections and field cast concrete bends and connections are not measured separately but are included in the pipe lengths measured.

Storm drain and sanitary sewer are measured by the foot (m) from manhole center to manhole center.

Excess pipe installed and not ordered by the Project Manager is not measured for payment.

603.04.2 Excavation

Excavation is not measured for payment.

603.04.3 Bedding and Foundation Material

Bedding material is measured by the cubic yard (m^3) in place for pipes greater than 48-inch (1.2 m) diameter, and for all sizes of storm drain trunklines. Include the cost of bedding material for pipes 48-inch (1.2 m) diameter or less in the cost of the pipe.

603.04.4 Embankment Protectors

Embankment protectors are measured by the foot (m) of installed pipe and include all necessary hardware.

603.04.5 Granular Bedding Material for Storm Drains

Granular Bedding material is measured by the cubic yard (m^3) in place for storm drain trunklines and laterals.

603.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Bedding and Foundation	Cubic Yard (m^3)
Embankment Protector	Foot (m)
Granular Bedding	Cubic Yard (m^3)
Pipe (Type and Size)	Foot (m)

Payment at the contract unit price is full compensation for all resources necessary to complete those items of work in accordance with the contract.

Payment for all costs associated with excavation, foundation preparation and backfilling is included in the unit price bid per foot (m) of pipe.

No additional payment will be made for CLSM used as bedding material.

SECTION 604
MANHOLES,
COMBINATION MANHOLES
AND INLETS, AND INLETS

604.01 DESCRIPTION

This work is constructing manholes, combination manholes and inlets, and inlets.

604.02 MATERIALS

604.02.1 General

Furnish materials and precast structures in accordance with the contract requirements.

604.02.2 Concrete

Furnish Class General concrete or equivalent in accordance with Section 551, except that precast concrete manhole riser sections must have a minimum 4,000-psi (27.6 MPa) 28-day compressive strength.

604.02.3 Reinforcing Steel

Furnish reinforcing steel in accordance with Subsection 711.01.

604.03 CONSTRUCTION REQUIREMENTS

604.03.1 General

Construct and install the structures as specified in the contract.

604.03.2 Excavation

The Project Manager will establish the lines and grades for structure excavation.

Compact foundations in accordance with Subsection 203.03.3 to provide full bearing for the structures.

604.03.3 Backfill

Uniformly place backfill around structures in maximum 6-inch (150 mm) deep loose layers, and compact in accordance with Subsection 203.03.3.

Maintain the established structure lines and grades while backfilling.

604.04 METHOD OF MEASUREMENT

Manholes, combination manholes and inlets, and inlets are measured by the unit for each specified type, complete in place. Slotted drain, as shown in the Detailed Drawings, is measured by the foot (m) and includes the end cap and the elbow connection to the inlet.

Excavation and backfill are not measured for payment.

604.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Manhole, Manhole and Inlet, and Inlet	Each
Slotted Drain	Foot (m)

Payment for all costs associated with excavation and backfill required for manholes, manhole and inlets, inlets, and slotted drains is included in the contract unit price of each respective drainage item.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 606
GUARDRAIL AND CONCRETE BARRIER RAIL

606.01 DESCRIPTION

This work is the furnishing, installing, removing, resetting, replacing and revising metal beam guardrail, cable guardrail, box beam guardrail and concrete barrier rail.

606.02 MATERIALS

Furnish metal beam guardrail, cable guardrail, box beam guardrail and concrete barrier rail materials in accordance with the following section and subsection requirements:

Box Beam Guardrail	Detailed Drawings
Concrete Barrier Rail	554
Guardrail Reflectors	704 and Detailed Drawings
Steel Beam Guardrail and Fittings	705.01.1
Steel Guardrail Post	705.01.5
Wood Guardrail Posts and Blocks	705.01.2
Wire Rope and Connecting Hardware	705.02

Furnish all new materials. Do not use refurbished material unless specified in the contract documents.

606.03 CONSTRUCTION REQUIREMENTS

606.03.1 General

Install guardrail and concrete barrier rail meeting the requirements of Detailed Drawings and the contract. Install all guardrail, terminal sections and impact attenuators according to the manufacturer's instructions. When requested by the Project Manager, submit 2 copies of the installation instructions at least 15 calendar days prior to the installation.

Submit a completed form CSB606_03 prior to installing guardrail items. At the Project Manager's request, provide documentation that each item or system of guardrail installation meets NCHRP 350 or MASH requirements.

The Project Manager will establish the line and grade for the terminal sections. Establish the line and grade between the terminal sections.

Correct all vertical and horizontal misalignment to the specified line and grade at Contractor expense. Optional terminal sections must be installed within 12 hours from the time the rail is exposed when conditions prevent completion in one working day. Approved temporary end treatments must be installed to protect blunt ends, ends of barriers, fixed objects, or other obstacles within the clear zone if left for more than 12 hours. Temporary end treatments are not measured for payment. Place, at Contractor expense, object markers at maximum 50-foot (15.2 m) spacing to delineate partial installation areas when work on those installations is not active.

Excavate the postholes and drive the posts using methods and equipment that do not damage the adjacent pavement.

Stop post driving that heaves the adjacent pavement more than ½-inch in 10 feet (13 mm in 3 m), measured using a 10-foot (3 m) straightedge parallel to the pavement.

Level and repair all damaged surfaces around the installed posts.

Use only steel or wood guardrail posts for new metal beam guardrail runs unless wood posts are specified.

Where the contract specifies extending an existing guardrail run, the Contractor may use either the existing post type or other approved post types in the extension. Use the post type specified for terminal sections.

When wood posts and blocks are damaged, cut or bored after treatment, treat the injuries in accordance with Subsection 706.04.1.

606.03.2 Installing Posts

If the posthole is excavated, compact the posthole bottom, insert the post, and backfill and compact around the post in 6-inch (150 mm) loose layers ensuring the material is at optimum moisture before placing and compacting the next layer. Maintain the post line and grade.

Always drive steel posts. Wood posts may be placed by excavating and backfilling or by driving.

Replace all posts damaged by post driving.

Maintain the post alignment as the posts are driven.

Fill the area between the surrounding ground and the post by backfilling and tamping. Re-compact the loose material around the post and level the area as directed.

Remove, replace or re-install misaligned, loose or damaged posts at Contractor expense.

When driving wood posts, pilot holes approximately 6 inches (150 mm) in diameter may be used when necessary.

606.03.3 Metal Beam Guardrail Erection

Install metal beam guardrail, including the terminal sections and bridge approach sections as shown in the Detailed Drawings and in accordance with the contract.

Splice the metal rail sections with the lap in the direction of traffic. Locate all rail splices at the posts. Construct splices, laps, and terminal connectors as shown in the Detailed Drawings and in accordance with the contract. Splice the terminal connectors for attaching the rail sections to the bridge ends by lapping as shown in the Detailed Drawings.

Tighten the bolts through the splices and mounting bolts “snug tight”.

Ensure the bolts project at least ¼-inch (6 mm) beyond the nut. Place the bolt heads on the traffic side of the guardrail.

Drilling or cutting in the field is only allowed for special connections and sampling. Do not use cutting torches to cut guardrail or make bolt holes. Obtain Project Manager approval prior to drilling bolt holes or cutting guardrail for special connections.

Paint holes, slots, or cut ends in metal guardrail caused during installation with an approved galvanizing paint. Spot paint all bruised, broken, scaled, or damaged spelter coating on metal parts following the paint manufacturer’s recommendations after the guardrail is installed.

606.03.4 Stiffened Guardrail Sections

Construct stiffened guardrail sections as shown in the Detailed Drawings.

606.03.5 Box Beam Guardrail

Construct box beam guardrail and bridge approach sections as shown in the Detailed Drawings.

606.03.6 Cable Guardrail

Furnish and install cable guardrail and terminal sections in accordance with the Detailed Drawings and the contract. Install the posts plumb without damaging the post and its protective coating. For terminal sections, set the end posts, backfill and machine compact the backfill material in 4-inch (100 mm) lifts.

Install reflectors in accordance with Section 704 on every other post in the guardrail run excluding posts in the terminal sections that curve away from the driving lanes.

606.03.7 Concrete Barrier Rail

Install concrete barrier rail in accordance with the Detailed Drawings and the contract.

606.03.8 Reserved

606.03.9 Raise Guardrail

Unbolt the W-beam and block from the guardrail post, raise and re-bolt through the upper hole of the guardrail post.

606.03.10 Remove Guardrail

Remove and salvage the existing guardrail from the specified locations in accordance with Section 202. Replace all guardrail damaged during removal at Contractor expense. Dispose of removed materials not designated to be salvaged.

Load all salvaged guardrail materials from the project, transport and unload it at the specified location or as directed.

Backfill and compact the postholes left from post removal using clean material or crushed base or top surfacing, to the base of the adjacent bituminous surfacing. Apply a light asphalt spray to the hole sides and bottom and backfill with asphalt surfacing. Compact the plant mix surfacing as specified.

Do not cut off and leave existing posts in place.

606.03.11 Revise Guardrail Elements

Revise the guardrail elements as specified. The items include but are not limited to W-beam sections, bridge approach sections and terminal sections.

606.03.12 Nested W-Beam Guardrail Sections

Construct nested guardrail as shown in the Detailed Drawings.

606.03.13 Reset Guardrail Items

Reset existing guardrail items to the specified locations in the contract. Meet all the requirements of this section and the Detailed Drawings.

Remove the rail elements or cable, and completely remove the post. Backfill and compact the posthole bottom, re-install the posts and compact the backfill around the post in accordance with Subsection 606.03.2, and replace the rail elements or cable to the specified height.

Replace all guardrail materials damaged during the work at Contractor expense.

Correct all horizontal and vertical alignment in the guardrail to the specified line and grade.

606.03.14 Optional Terminal Sections

Supply the optional terminal section(s) as listed in the contract meeting the requirements for the specified item. The items include but are not limited to metal guardrail terminal sections and box beam terminal sections. When new terminal sections tie into existing rail, it may be necessary to raise the existing rail to match the new terminal section height. Transition a minimum of 50 feet (15.2 m).

606.03.15 Guardrail End Terminal Section Widening

Furnish and place embankment material or gravel to widen the roadway to accommodate guardrail extensions or new optional terminal sections as shown in the and Detailed Drawings. This work may also include the removal of sanding material and shaping of the existing soils to achieve positive drainage.

Compact widening to a minimum of 90% of maximum density with no optimum moisture requirement.

606.04 METHOD OF MEASUREMENT

606.04.1 Metal Guardrail

Metal guardrail, excluding terminal sections, is measured by the foot (meter) from center-to-center of the end posts of each section.

606.04.2 Optional Terminal Sections

Optional terminal sections are measured by the unit as shown in the Detailed Drawings, unless otherwise specified, for each type specified. When transitions are needed to tie into existing rail, the labor and equipment necessary to perform this work is not measured for payment and is to be included in the price for optional terminal sections.

606.04.3 Bridge Approach Sections

Bridge approach sections, including tapered curbs, are measured by the unit for each type specified as shown in the Detailed Drawings.

606.04.4 Stiffened Guardrail Sections

Stiffened guardrail sections are measured by the foot (m) from center-to-center of the end posts of each stiffened section as shown in the Detailed Drawings.

606.04.5 Box Beam Guardrail

Box beam guardrail is measured by the foot (m), excluding the terminal sections, as shown on the Detailed Drawings.

606.04.6 Reserved

606.04.7 Cable Guardrail

Cable guardrail is measured by the foot (m), excluding the terminal sections as shown on the Detailed Drawings.

606.04.8 Cable Guardrail Terminal Sections

Cable guardrail terminal sections are measured by the unit as shown on the Detailed Drawings.

606.04.9 Concrete Barrier Rail

Concrete barrier rail is measured by each 10-foot (3.05 m) section. Connections to the existing barriers are included in the cost of the rail.

Measurement does not include those portions of barrier constructed as an integral part of sign foundations.

606.04.10 Impact Attenuators

Impact attenuators are measured by the unit as specified in the contract.

606.04.11 Reserved

606.04.12 Concrete Barrier Rail Transition

Concrete barrier rail transitions are measured by each 10-foot (3.05 m) section.

606.04.13 Concrete Barrier Rail Terminal Section

Concrete barrier rail terminal sections are measured by each 10-foot (3.05 m) section.

606.04.14 Raise Guardrail

Raise guardrail, including terminal sections, is measured by the foot (m) from center-to-center of the end posts of each section.

606.04.15 Remove Guardrail

Remove guardrail is measured by the foot (m) from center-to-center of end posts of each section removed. Material and equipment necessary for backfill and compaction of post holes is not measured for payment and is to be included in the price for remove guardrail.

606.04.16 Remove Concrete Barrier Rail

Remove concrete barrier rail is measured by each 10-foot (3.05 m) section.

606.04.17 Revise Guardrail Elements

Revise guardrail elements is measured by each element revised, as specified in the contract.

606.04.18 Nested W-Beam Guardrail Sections

Nested guardrail is measured by the foot (m), as shown in the Detailed Drawings.

606.04.19 Reset Guardrail Items

Reset guardrail items are measured by the unit as specified in the contract.

Material and equipment necessary for backfill and compaction of post holes is not measured for payment and is to be included in the price for reset guardrail.

606.04.20 Guardrail End Terminal Section Widening

Optional terminal section widening is paid by each end section completed. Include the cost of topsoil, seeding and fertilizer used in the widened areas in the unit bid price for optional terminal section widening.

606.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following.

Pay Item	Pay Unit
Box Beam Guardrail	Foot (m)
Bridge Approach Section	Each
Cable Guardrail	Foot (m)
Cable Guardrail Terminal Section	Each
Concrete Barrier Rail	Each
Concrete Barrier Rail Terminal Section	Each
Concrete Barrier Rail Transition	Each
Guardrail End Terminal Section Widening	Each
Impact Attenuators	Each
Metal Guardrail	Foot (m)
Nested Guardrail Sections	Foot (m)
Optional Terminal Section	Each
Raise Guardrail	Foot (m)
Remove Concrete Barrier Rail	Each
Remove Guardrail	Foot (m)
Reset Guardrail	Foot (m)
Reset Guardrail Items	Unit
Stiffened Guardrail Sections	Foot (m)

Revise guardrail elements is paid for in accordance with the appropriate section.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 607
FENCES

607.01 DESCRIPTION

This work is constructing, removing and resetting barbed wire, combination barbed and woven wire, chain link fences and gates.

607.02 MATERIALS

Furnish materials in accordance with the following section and subsection requirements:

Chain Link Fence 712.01
Hydraulic Cement Concrete 551
Wire Fence..... 712.02

Fence material acceptance test samples will be taken from the materials delivered to the project.

607.02.1 Snow Fence

Furnish all timbers, lumber and hardware as specified.

1. Lumber used must meet the Western Wood Products Association requirements, or equivalent grading rules. Grade lumber with a nominal thickness of 2 inches (50 mm) as structural light framing #2 grading or better. Grade lumber with a nominal thickness of 1-inch (25 mm) as boards #3 common or better. All lumber must meet ASTM D245.
2. All treated material must meet the requirements of Subsection 706.04 or the special provisions.

607.03 CONSTRUCTION REQUIREMENTS

607.03.1 General

Construct fencing before any other work is performed on all parcels of land. This requirement may be waived where the Contractor has obtained a landowner written waiver. The waiver must state a completion date agreed to by the landowner and the Contractor for completing the fence work.

Maintain all existing fence enclosures. Close Contractor fence openings using new permanent fence, or use temporary fence, cattle guards, or watchman where new permanent fence cannot be constructed the same day.

Temporary fence may be used in place of new permanent fence if approved.

607.03.2 Fence Preparation

Fence preparation consists of removal of vegetative and ground surface obstacles prior to actual fence installation. For fence preparation, clear only those portions of brush, shrubs and vegetation interfering with the fence installation. Cut off, trim or mow interfering vegetation without exposing bare soil in, or adjacent to, streams, stream banks, natural drainages or wetlands. Dispose of the resulting debris, slash, branches, etc. in accordance with Subsection 201.03.5. Avoid or minimize injury or damage to remaining vegetation. Do not grub, excavate, grade, or disturb the soil surface, unless in direct conflict with fence wire.

Soil disturbance associated with fence preparation, both inside and outside the construction limits, may not be included in the SWPPP permit. If disturbance of soil is unavoidable, revise and update the SWPPP, and install appropriate erosion and sediment control features (i.e. BMPs) as required. Prior to fence installation, seed all exposed soil in accordance with the contract requirements. The seeding dates specified in the contract do not apply to this seeding.

Prior to commencing work that alters or disturbs the bed or banks of any stream or its tributaries, obtain authorization from FWP; commonly referred to as the SPA 124.

Prior to conducting any work that results in the placement, or discharge of soils into waters of the United States, including wetlands, obtain a COE Section 404 authorization.

Prior to conducting any work in State waters, including wetlands, that causes an increase in turbidity; obtain a 318 authorization from the DEQ.

Use equipment that minimizes disturbance to soil and vegetation (i.e. low pressure rubber tired equipment, wide tracked low-weight tractors, etc.) in fence preparation areas, for setting fence posts and installing fencing material. If it is necessary to operate equipment in wetlands, place and operate the equipment on mats, or utilize other measures as necessary to avoid or minimize soil and vegetation disturbance. When installing fence posts and fencing, utilize measures, including hand work, to avoid or minimize soil and vegetation disturbance in streams and natural drainages and on, or adjacent to, stream banks.

607.03.3 Constructing Chain Link Fence

Construct chain link fence as specified in the contract and in accordance with the following requirements:

A. Posts. Set posts vertically, spaced at maximum 10-foot (3 m) centers, measured parallel to the ground surface.

Set posts for 5, 6 and 8-foot (1.5, 1.8 and 2.4 m) fence in concrete. Set end, corner, and pull posts for 3 and 4-foot (0.9 and 1.2 m) fence and line posts connected by bracing to end, corner, or pull posts in concrete. Drive or set in concrete, line posts on 3 and 4-foot (0.9 and 1.2 m) fence as specified.

Use the footing dimensions and post embedment depths shown in the Detailed Drawings. Crown concrete footings to shed water.

Do not damage posts while driving them. Backfill and compact the voids around posts.

Set line posts placed in solid rock without soil overburden, at least 14 inches (355 mm) deep. When in solid rock, set end, corner, gate, and pull posts at least 20 inches (510 mm) deep. Excavate or drill holes to a minimum width or diameter 1-inch (25 mm) greater than the largest dimension of the post being set.

Cut posts to the required length before installing. The Contractor may use an even post length set deeper into the solid rock at Contractor expense.

For metal posts placed in bored rock holes or consolidated soils, set the post plumb and fill the holes with cement grout that meets the requirements of Subsection 713.04. Work the grout into the holes to eliminate voids. Concrete footings are not required where posts are set in bored holes.

Place posts, set in solid rock covered by soil or loose rock, to the specified depths or to the minimum solid rock depths specified above, whichever is less. When solid rock is encountered before reaching the specified depth, construct concrete footings from the solid rock to the top of the ground on 5, 6 and 8-foot (1.5, 1.8, and 2.4 m) fence and on end, corner, and pull posts for 3 and 4-foot (0.9 and 1.2 m) fence. Grout around that part of the post that is in solid rock.

Check that all posts are solid once they are driven, backfilled, or concrete is placed.

B. Top Rail or Cable. Pass the top rails through the line post tops, providing a continuous brace from end-to-end of each fence section. Join top rail sections using sleeve-type couplings. Fasten the top rails to the terminal posts using pressed steel fittings.

Replace the top rails with a ⅜-inch (9.5 mm) diameter galvanized steel cable when fences are placed within 50 feet (15.2 m) from the edge of the nearest driving lane.

C. Fence Fabric. Place chain link fabric for 6 and 8-foot (1.8 and 2.4 m) fence on tangents, on the post face away from the highway. On 3, 4, and 5-foot (0.9, 1.2, and 1.5 m) fence,

place the fabric as directed. On curves, place the fabric for all fence heights on the outside face of the posts on curves.

Place the chain link fabric on a straight grade between posts, leveling high points on the ground. Obtain the Project Manager's approval to fill in depressions along the fence line.

Stretch taut and securely fasten the fabric to the posts. Stretching by motor vehicle is prohibited. Use stretcher bars and fabric bands spaced at 1-foot intervals (305 mm) to fasten to end, gate, corner, and pull posts. Cut the fabric and attach each span independently at all pull and corner posts. Fasten fabric to line posts at 14-inch (355 mm) intervals with tie wire, metal bands, or other approved fasteners. Fasten the top edge of the fabric to the top rail or cable with tie wires spaced at 18-inch (455 mm) intervals.

Join rolls of wire fabric by weaving a single strand into the ends of the rolls forming a continuous mesh.

When a winged cattle guard is located in a chain link fence, extend the wire fabric beyond the post supporting the wing and securely fasten it to the wing.

D. Tension Wire. Attach a tension wire to the bottom of the chain link fabric using ring fasteners at 24-inch (610 mm) maximum intervals and secure at the terminal posts or pull posts using brace bands.

E. Gates. Fasten chain link fabric to the gate frame end bars using stretcher bars and fabric bands, and to the top and bottom of gate frame bars using tie wires for the chain link fence, or by other approved standard methods.

Clean welded connections on steel gate frames with burned spelter coating by wire brushing, to remove all traces of the welding flux and loose or cracked spelter. Paint the cleaned areas with two coats of zinc oxide-zinc dust paint mixed in a weight ratio of one part zinc oxide to four parts zinc dust.

Provide the drop-bar locking device for double metal gates with a 12 x 15-inch square (305 x 380 mm) deep Class General concrete footing crowned at the top. Provide a minimum 6-inch (150 mm) hole in the footing to receive the locking bar.

F. Panels. Install panels as shown in the Detailed Drawings.

Double panels at fence corners and angle points consist of one corner post, two line posts, two braces, two truss rods, two top rails, concrete, and other fixtures. Single panels at gates and fence ends consist of one gate or end post, one line post, one brace, one truss rod, one top rail, concrete, and associated fixtures.

607.03.4 Constructing Barbed and Woven Wire Fence

Construct barbed, smooth and woven wire fences meeting the contract requirements and the following:

A. Posts and Braces. Excavate post holes, footing excavations, and anchors as shown in the Detailed Drawings.

Wood posts may be driven. Repair or replace all damaged posts at Contractor expense.

Treat cut or trimmed areas on posts and braces with 3 applications of a copper naphthenate solution containing a minimum of 2% copper metal or with chromated copper arsenate (CCA) in accordance with AWPA M4.

Securely nail braces to terminal and brace posts.

Metal posts not specified to be set in concrete may be driven. Place and grout metal posts placed in rock as specified.

Backfill and compact post hole material in 6-inch (150 mm) loose lifts.

Dampen holes before placing concrete. Ensure the concrete has set before placing and stretching the fence wire or attaching gates to the posts and braces.

B. Placing Wire. After the posts, braces, and footings are set, place the woven wire and/or barbed wire, stretch it tightly, and fasten to the posts.

Apply tension following the wire manufacturer's recommendations with a mechanical or other approved wire stretcher. Do not use motor vehicles to stretch fence.

Diagonally drive U-shaped staples across the wood grain so both points enter different grains. Where wire uplift occurs, drive staples with the points slightly upward. On level ground and over knolls, drive staples slightly downward. Staple the wire tightly at corner, end, and pull posts. The staples on line posts must allow wire movement without damaging the wire.

Place deadman as shown in the Detailed Drawings at grade depressions, alignment angles, and other places where stresses might pull posts from the ground or out of alignment.

Install one metal line post in each 500-foot (150 m) wood post fence run and in smaller runs between gate post ends for lightening protection.

Construct gates as shown in the Detailed Drawings and in accordance with Subsection 712.02.

C. Fence Panels. Install panels as shown in Detailed Drawings.

607.03.5 Temporary Fence

Erect temporary fence to keep livestock and traffic out of the work area. Temporary fence may remain in place only during the work or until the fence is directed to be removed.

Use Type F3M as temporary fence for livestock enclosures. Construct all temporary fence from metal posts and materials in accordance with Section 712. Use the minimum number of braces, panels, deadmen, and other accessories for constructing temporary fence.

Undamaged material used in the temporary fence that meets specifications may be used in the permanent fence. Material not used in permanent fencing remains the Contractor's property.

Remove temporary fence at Contractor expense.

607.03.6 Remove and Reset Fence

When removing and resetting a fence, furnish all required materials over and above the usable salvaged fence that are new materials in accordance with Section 712. Required new materials are listed in the contract. Use, to the extent practical, materials of the same type and quality as those of the old fence that meet of Section 712 requirements.

Replace rotten, damaged, or broken posts and rusty, unusable wire with new material. Do not use any galvanized materials with abraded or broken coating.

Furnish all additional fence wire required for depressions.

Carefully handle and stockpile, at designated locations, all removed fence determined to be salvageable.

607.04 METHOD OF MEASUREMENT

607.04.1 New Fence

New fence is measured by the foot (m). The measurements are made on the fence line along the top wire or rail or along a line parallel thereto, from end post to end post including wing fences to structures. Gates, cattle guards, or other openings are measured separately. Double sections of fence erected across depressions are measured for payment. All other temporary closures are included in the measurement of temporary fence. Temporary fence materials ordered by the Contractor but not used in the work will not be measured or paid for. Temporary fence removal is not measured separately.

607.04.2 Remove and Reset Fence

Remove and reset fence is measured by the foot (m). Measurement of reset fence in place is made in accordance with Subsection 607.04.1.

New posts and wire required to reset the removed fence is measured as follows:

1. Wood and metal posts are measured by the unit;
2. Barbed wire is measured by the foot (m); and
3. Woven wire is measured by the foot (m).

The post and wire quantity specified in the contract is an estimate only. The actual quantity required to complete the work will be paid for at the contract unit price.

Panels required for remove and reset fence are not measured for payment.

607.04.3 Gates

Gates are measured by the foot (m) from center to center of adjacent fence posts.

607.04.4 Fence Panels

Single and double fence panels are measured by the unit. Where R/W monuments are set, the construction of the corner gap as shown in the Detailed Drawings is not measured for payment. Include the cost of this construction in the adjacent panel(s).

607.04.5 Deadman

Deadman are measured by the unit. Anchors are not measured for payment.

607.04.6 Dozer Operation

Dozer operation is measured by the hour in accordance with Subsection 210.04.1. When dozer operation is not a bid item, it is incidental to and included in other fencing items.

607.04.7 Remove Fence

A. **Replaced with New Fence.** When the removed fence is being replaced with new fence, the existing fence removal is not measured for payment.
B. **Without New Fence.** Remove fence is measured by the foot (m) in place before removal along the top wire, or on a line parallel thereto, exclusive of gates, cattle guards, and other openings.
C. **Postholes.** Backfill and compact the postholes left from post removal using clean material or crushed base. Do not cut off and leave existing posts in place.

607.04.8 Fence Preparation

Fence preparation is not measured for payment but is incidental to the fencing items.

607.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Deadman	Each
Dozer Operation	Hour (see Subsection 210.05)
Fence Panels	Each
Gates	Foot (m)
New Fence	Foot (m)
New Wood or Metal Posts	Each
Remove and Reset Fence	Foot (m)
Remove Fence	Foot (m)

When the removed fence is being replaced with new fence, the cost of removing existing fence is included in the contract unit price per foot (m) of new fence.

Fence preparation is not paid for but is included in the contract unit price of the fencing items.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 608
CONCRETE SIDEWALKS

608.01 DESCRIPTION

This work is the construction of concrete sidewalks and the installation of Detectable Warning Devices (DWDs) at the locations shown in the contract.

608.02 MATERIALS

Furnish materials in accordance with the following section and subsection requirements:

Hydraulic Cement Concrete 551
Joint Materials..... 707.01
Reinforcing Steel..... 711.01

Use DWDs – Type 1 for new sidewalk construction. DWDs – Type 1 are cast directly into sidewalk. Use DWDs – Type 2 for retrofits on existing sidewalks where new concrete is not being placed. DWDs – Type 2 are surface applied on the sidewalk.

Meet all of the Department's requirements on the QPL for DWDs – Type 1 and for DWDs – Type 2.

Use DWDs that are a brick red color.

608.03 CONSTRUCTION REQUIREMENTS

Construct concrete sidewalks as specified in the contract and as follows.

608.03.1 Subgrade and Forms

Excavate, shape, and compact the foundation to the specified width and grade.

Place and compact aggregate base to the specified thickness.

Use forms and form in accordance with Section 552 and Subsection 609.03.

608.03.2 Concrete

Furnish and place concrete in accordance with Section 551.

Place reinforcing steel as specified.

Dampen the foundation and forms immediately before placing concrete.

Do not place concrete on a frozen foundation course or subgrade.

Construct sidewalks in accordance with Subsections 501.03.18 and 501.03.19.

608.03.3 Detectable Warning Devices

Install DWDs so they extend the full width of the ramp and the edge of the dome panel is located no more than 6 inches (150 mm) from the back of curb. If the DWD used is embedded in concrete, install so the top of the panel is flush with the adjacent concrete and the domes will protrude above the adjacent surface. If DWDs require cutting, locate non-factory edges on the exterior side of DWD installation.

608.04 METHOD OF MEASUREMENT

Concrete sidewalk is measured by the square yard (m^2), including wheelchair ramps and concrete under detectable warning devices.

DWDs are measured by the square yard (m^2).

A. Contracts with Sidewalk Work Not in Conjunction with Roadway Reconstruction. Reinforcing steel, expansion joint material, bond breaker, excavation or embankment, crushed gravel base, and disposal of material associated with the work are not measured for payment.

B. All Other Contracts. Reinforcing steel, expansion joint material, bond breaker, disposal of material, and crushed gravel base are not measured for payment. Excavation or embankment associated with the work is measured by the cubic yard (m^3).

608.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
DWD – Type 1	Square Yard (m^2)
DWD – Type 2	Square Yard (m^2)
Sidewalk-Concrete	Square Yard (m^2)

A. Contracts with Sidewalk Work Not in Conjunction with Roadway Reconstruction. The cost of reinforcing steel, expansion joint material, bond breaker, excavation or embankment, crushed gravel base, and disposal of material associated with the work are included in the contract unit price of sidewalk.

B. All Other Contracts. The cost of reinforcing steel, expansion joint material, bond breaker, crushed gravel base, and disposal of material associated with the work are included in the contract unit price of sidewalk. Excavation or embankment associated with the work is paid for in accordance with the specified type of earthwork.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 609
CURBS AND GUTTERS

609.01 DESCRIPTION

This work is constructing curbs, integral curb and gutter, median curbs, and furnishing and installing precast concrete curbs.

609.02 MATERIALS

Furnish materials in accordance with the following section and subsection requirements:

Air-entrained Class General Concrete..... 551
Bituminous Mixtures..... 401
Joint Materials..... 707.01
Reinforcing Steel..... 711.01
Pavement Markings 714

609.03 CONSTRUCTION REQUIREMENTS

609.03.1 General

Construct curbs and integral curb and gutter having uniform surfaces and true lines. Remove and replace curb sections that prevent drainage or proper joining of subsequent work at Contractor expense.

Material may be placed adjacent to curbs and curbs and gutters 24 hours after the curbs or curbs and gutters are placed as long as no damage is caused. Correct all damages at Contractors expense.

609.03.2 Foundation and Forms

Excavate, prepare and compact cast-in-place curb and curb and gutter foundations in accordance with Subsection 203.03.3.

Use full depth metal or straight-grained finished lumber forms, free of warp or irregularities, and having the strength to resist springing or deviation from alignment and grade. Securely stake and brace forms with headers and clamps. Clean and oil form surfaces in contact with concrete before placing the concrete.

609.03.3 Cast-in-Place Curb and Gutter

Moisten the foundations and forms immediately before placing concrete.

Place and consolidate the concrete in uniform layers not exceeding 6-inch (150 mm) loose depth.

Do not place concrete on a frozen foundation course or subgrade.

Construct concrete curb in accordance with Subsections 501.03.18 and 501.03.19.

Once the concrete has its initial set, remove the forms and repair honeycombed and rough surfaces using 1:2 mortar. Use wooden floats to remove form marks or other irregularities. Apply a brush finish to the final surface using an approved brush before the concrete sets. Finish all concrete edges, including those at expansion joints, to the required radii.

Water cure concrete or use a curing compound in accordance with Subsection 551.03.7. Water cure, keeping the concrete wet for 7 calendar days after finishing.

609.03.4 Slip-formed Concrete Curb and Gutter

Concrete curb and gutter may be constructed using a curb forming or slip-form machine.

609.03.5 Precast Concrete Curbs

Furnish precast curb in accordance with Section 554.

609.03.6 Bituminous Curbs

Clean surfaces receiving bituminous curb and prime with SS-1 emulsified asphalt diluted 1:1 with water. Apply approximately 0.2 gallons per square yard (0.91 L/m^2).

Use the project surfacing bitumen mixed with water in a mixer of at least 3 cubic feet (0.08 m^3) capacity that meets Section 401 requirements.

The asphalt quantity in the bituminous curb mixture will be established by the Project Manager and will be at least 1% more than that used in the surfacing mixture.

Feed the bituminous mixture to the extrusion or curb machine at a temperature that prevents sloughing or tearing of the material or surface. Pressurize the mixture through an orifice or plate. The machine must heat and compact the curb as it is produced.

Compact all material not placed and compacted by the curb machine using mechanical tampers.

If other than 60-70 penetration asphalt cement is used, apply a fog coat of SS-1 emulsified asphalt diluted 1:1 with water to the finished curb at approximately 0.2 gallons per square yard (0.91 L/m^2).

609.03.7 Painting Curbs

Paint curbs, island curbs, and median curbs in accordance with Section 620.

609.04 METHOD OF MEASUREMENT

Curb, integral curb and gutter, and median concrete curb are measured by the foot (m) along the face of the curb at the flow line.

Paint and painting is measured by the gallon (L) in accordance with Subsection 620.04.

A. Contracts with Curb, Integral Curb and Gutter, Median Curb, and Precast Concrete Curb Work Not in Conjunction with Roadway Reconstruction. Reinforcing steel, expansion joint material, bond breaker, excavation or embankment, crushed gravel base, emulsified asphalt, backfill and/or necessary plant mix surfacing, and disposal of material associated with the work are not measured for payment.

B. All Other Contracts. Reinforcing steel, expansion joint material, bond breaker, disposal of material, and emulsified asphalt are not measured for payment. Excavation or embankment associated with the work is measured by the cubic yard (m^3).

609.05 BASIS OF PAYMENT

Payment for completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Curb	Foot (m)
Integral Curb and Gutter	Foot (m)
Median Concrete Curb	Foot (m)
Curb Paint	Gallon (L)

A. Contracts with Curb, Integral Curb and Gutter, Median Curb, and Precast Concrete Curb Work Not in Conjunction with Roadway Reconstruction. The cost of reinforcing steel, expansion joint material, bond breaker, curing compound, excavation or embankment, crushed gravel base, emulsified asphalt, backfill and/or necessary plant mix surfacing, and disposal of material associated with the work are included in the contract unit price of curb and gutter.

B. All Other Contracts. The cost of reinforcing steel, expansion joint material, bond breaker, curing compound, emulsified asphalt, and disposal of material associated with the work are included in the contract unit price of curb and gutter. Excavation or embankment associated with the work is paid for in accordance with the specified type of earthwork.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 610
ROADSIDE RE-VEGETATION

610.01 DESCRIPTION

This work is re-establishing vegetative cover on specified areas with salvaged topsoil in accordance with Subsection 203.03.6 or furnished topsoil, seeding, planting, fertilizing, mulching, composting, soil retention blankets, and sodding.

610.02 MATERIALS

Furnish materials in accordance with the following subsection requirements:

Compost 713.13
Fertilizer 713.09
Mulch 713.10
Reclamation Seed 713.08
Sod 713.11
Rolled Erosion Control Products 713.12
Topsoil 713.05
Water 713.01

610.03 CONSTRUCTION REQUIREMENTS

610.03.1 Furnished Topsoil

When topsoil is a bid item, furnish topsoil and notify the Project Manager of the proposed topsoil source(s) as soon as possible after the contract award. Topsoil from proposed sources may be used only after sample tests show the material is acceptable.

Complete topsoil areas to the lines, grades, and elevations specified. Do not place topsoil until the designated areas are prepared and all construction work in the area is completed.

Scarify or rip slopes to be top soiled.

Break up ordinary sod and soil containing grass roots into maximum 2-inch (50 mm) clumps.

Remove and dispose of, at Contractor expense, all clods, rocks, large roots, litter, and other foreign material exceeding 4 inches (100 mm) in its greatest dimension from the topsoil before placing it on the roadway and before final acceptance. Break up the topsoil to an average 4 inches (100 mm) deep.

610.03.2 Seeding, Fertilizing, and Mulching

These requirements apply to establishing vegetation on areas disturbed by the work. Landscaping interchange areas, rest areas, urban areas, and other areas are specified elsewhere in the contract.

A. General. Work the areas to be seeded to the specified line and grade before seeding and fertilizing.

Seed all disturbed areas. Permanent seeding of the finished slopes may require multiple seeding. Fertilizing, mulching, composting, permanent erosion control blanket placement and seeding are specified in the contract.

After all condition seedbed surface, seeding, and fertilizing work is complete, remove and dispose of any oversize material that protrudes 4 inches (100 mm) or more above the conditioned seedbed surface.

B. Seeding Season. The seeding season is October 1st through May 15th. Obtain the Project Manager's approval to seed outside this period.

C. Condition Seedbed Surface. Condition the seedbed surface area by killing growing weeds, removing or mowing old weedy growth, tilling, disking, harrowing, or scarifying compacted areas, and compacting unstable areas.

Condition all seeding areas unless otherwise directed. The Project Manager may exclude wet, soft or rocky areas from conditioning.

Cultivating, tilling, harrowing, disking, and similar work may, if approved, be performed any time after the contract is awarded.

Break up tight or compacted soils into 2-inch (50 mm) or smaller pieces. Remove or repair discs, harrows, cultipackers, and similar equipment not in good operating condition. Operate disking, harrowing, and soil tilling equipment at right angles to the natural slopes.

Prepare soil using equipment that produces a rough-textured surface ready for seeding and mulching. Operate equipment normal to the natural slopes. The final surface must be 1 to 1½ inches (25 to 38 mm) below the tops of curbs, catch basins, and other structures.

Re-scarify areas to be broadcast seeded within 48 hours before seeding.

D. Seed Distribution.

1. General. Apply seed within 48 hours of the final seedbed conditioning.

Do not broadcast seed or hydraulic seed when weather conditions prevent uniform seed distribution.

Do not cover seed with more than ½-inch (13 mm) of soil.

The seed application rate is specified in the contract.

2. Drill Seeding. Drill seed Area 1 and Area 3 using equipment that regulates the seed application rate and planting depth. Acceptable drills are custom seeders, furrow drills, disc drills, or other approved drills. If seed-sowing equipment does not have press wheels, compact the seed using a cultipacker once the ground has been drilled.

Maintain uniform seed distribution in the drill hopper during the work.

Operate all seeding related equipment at right angles to the slope.

Regulate planting depth with depth bands or coulters. Use a drill box partitioned by dividers a maximum 24 inches (610 mm) apart.

Seed rows a maximum 8 inches (200 mm) apart and at right angles to the slope.

3. Broadcast Seeding. Hand seeding or mechanical seeding of Area 2 is preferred for all areas where drill seeding is not possible or practical. These areas include narrow medians, or areas too small to effectively operate drill seeding equipment.

4. Hydraulic Seeding. Hydraulic seeding is permissible for Area 2 only if broadcast seeding is not possible due to steep slopes or unstable footing. Do not use hydraulic seeding without the Project Manager's prior approval.

Perform hydraulic seeding in two operations:

a. Apply the seed with 1 pound (0.454 kg) of wood or recycled paper mulch per 3 gallons (11.3 L) of water; and

b. Apply the remaining mulch, and/or compost, along with fertilizer, if specified. See Subsection 610.03.2(F)(5).

E. Application of Fertilizer. When broadcasting seed, apply the fertilizer separately.

When drill seeding, do not apply seed and fertilizer in a single mixture. The fertilizer must be applied separately, either broadcast before seed application, or surface banded during seeding.

F. Mulching.

1. General. Use the mulch type specified in the contract.

Apply mulch to seeded areas within 24 hours after seeding without disturbing the seedbed surface.

Do not apply mulch to ground having free surface water or if wind prevents uniform distribution.

2. **Application of Vegetative Mulch.** Uniformly apply vegetative mulch with a mulch spreader at the specified rate once seeding and fertilizing are completed.

   Secure all vegetative mulch to the slopes with a non-asphalt based tackifier containing either plant derived hydrocolloid or polymeric materials. Add the tackifier to the fertilizer/mulch slurry when wood cellulose or recycled paper fibers are used as an over-spray onto the straw/hay mulch.

   Tuck vegetative mulch on slopes 3H:1V or flatter into the seedbed. Use a mulch tiller for tucking. Operate the equipment perpendicular to the slope.

   Use mulch tillers having round, notched blades approximately ¼-inch (6 mm) thick by 18 inches (455 mm) in diameter spaced 8 inches (200 mm) apart that force the vegetative mulch at least 3 inches (75 mm) into the soil. Equip tillers with disc scrapers.

   If temporary erosion controls are needed, straw tucking followed by permanent seeding within the seeding season are acceptable measures.

3. **Applying Fabricated Mulch or Netting.** Place fabricated mulch or netting on the specified or directed areas, securing it to the ground using wire staples, wood pegs, or other approved devices. Apply the mulch or netting over the seeded areas.

4. **Applying Wood Cellulose Fiber or Recycled Paper Mulch.** Apply wood cellulose fiber or recycled paper mulch and fertilizer in one operation with a hydraulic distributor using water as the vehicle. Equip the distributor with a continuous agitator keeping the fertilizer and mulch uniformly suspended throughout the distribution cycle. Adjust the pump pressure to maintain a continuous slurry stream. Size the slurry distribution lines to prevent plugging. Equip the discharge line with hydraulic spray nozzles to uniformly distribute the slurry to the seedbed.

   Start mulching at the top of the slope and work downward. Use extension hoses to reach the slope extremities.

5. **Finishing.** Re-mulch areas where mulch is weather damaged.

   Repair seedbed and seeding damage caused by displaced mulch material and re-seed the areas before re-mulching. Seedbed repair, re-seeding, and re-mulching required due to the Contractor's negligence is at Contractor expense.

G. Composting. Use the compost type specified in the contract. Apply the compost at the rate, method and sequence specified in the contract.

610.03.3 Sodding

A. Season. Perform sodding during the normal seeding season or as specified.

B. Source of Materials. Notify the Project Manager of the sod source(s) at least 3 days before sod cutting begins. Cut and deliver only approved sod to the project.

C. Surface Preparation. Prepare the surfaces to be sodded to the required cross section, grade, and contour. Make the surface smooth and uniform, free of stones, roots, lumps, weeds, and other foreign material. Undercut the prepared surface below the adjacent areas so the top of the new sod is flush with adjacent seedbed or turfed areas and 1-inch (25 mm) below sidewalk and curb tops.

Break the surface up to a fine, granular texture at least 2 inches (50 mm) deep before placing sod.

Fertilize the surface to be sodded a maximum 48 hours before placing sod. Use inorganic fertilizer having minimum active ingredients of 15 pounds of nitrogen and 40 pounds of P_2O_5 per acre (17 kg of nitrogen and 44 kg of P_2O_5 per hectare).

D. Cutting and Handling Sod. Machine-cut sod in uniform rectangular sections.

Cut sod to a depth that retains intact, the grasses live dense root system and prevents tearing or breaking of the sod.

Load, unload, and place sod to prevent tearing or breaking of the sod.

E. Placing Sod. Lay sod within 36 hours of cutting. Protect sod from dry or cold weather until placed.

Place and fit sod as close as possible staggering the joints between horizontal rows.

Lay the sod strips horizontally on slopes, starting at the slope bottom and work upwards. On slopes steeper than 3H:1V, anchor the sod with fasteners spaced a maximum 2 feet (610 mm) apart and driven flush with the sod surface.

In waterways, lay the strips parallel to the flow, staggered, and fitted snug and even with the strips already placed.

Fill gaps between sod strips with sod pieces cut to the gap size and shape.

At slope bottoms, extend the sod edges at least 2 inches (50 mm) into the ground or ditch bottom. Turn all other sod area edges into the ground and cover with topsoil, compact and smooth to blend with the adjacent finished grades.

Roller compact the sod with a roller immediately after placement. Provide a smooth, even surface, free from bumps and depressions.

Thoroughly water the sod and re-roll to ensure good soil contact.

F. Sod Maintenance. Water new sodded areas until the sod is firmly rooted.

Maintain the new sod until it is well rooted and replace all dead, dying, and damaged sod as directed at Contractor expense.

610.03.4 Erosion Control Blanket

Prepare, fertilize, and seed the erosion control blanket areas before placing the blanket. Handle and place it following the manufacturer's recommendations. If recommendations are not provided, install as follows:

1. In ditches, unroll the blanket downstream and lap 4 inches (100 mm) over the adjoining blanket. Bury the ends and edges to prevent water and wind undercutting.
2. On slopes, the blanket may be unrolled horizontally or vertically to the slope, then lapped 4 inches (100 mm) over the adjoining blanket and stapled as above. Lap the blanket in the direction of flow.

610.04 METHOD OF MEASUREMENT

610.04.1 Topsoil

Topsoil is measured by the cubic yard (m^3) of loose material level with the haul vehicle box at the point of use on the project. Strike or level loads when directed. All costs for obtaining and furnishing topsoil are incidental and are not measured separately for payment. Include these costs in the unit bid price for topsoil.

610.04.2 Seeding

Seeding is measured by the acre (ha), parallel to the ground surface.

610.04.3 Fertilizing

Fertilizing is measured by the acre (ha), parallel to the ground surface.

610.04.4 Condition Seedbed Surface

Condition seedbed surface is measured by the acre (ha), parallel to the ground surface.

Removal of oversized material from the conditioned seedbed surface is not measured separately for payment.

610.04.5 Mulch

A. **Vegetative Mulch and Wood Cellulose Fiber Mulch.** Vegetative mulch and wood cellulose fiber mulch is measured by the acre (ha), parallel to the ground surface.
B. **Fabricated Mulch and Netting.** Fabricated mulch and netting is measured by the square yard (m^2) in place.
C. **Bituminous Mulch.** Bituminous mulch is measured by the gallon (L) for the gallons (L) applied at the specified rate.

610.04.6 Sodding

Sodding is measured by the square yard (m^2) in place, parallel to the ground surface.

Re-sodded areas damaged from causes not the fault of the Contractor are measured for payment.

610.04.7 Soil Retention Blanket

Soil retention blanket is measured by the square yard (m^2) in place.

610.04.8 Composting

Composting is measured by the acre (ha).

610.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Compost	Acre (ha)
Condition Seedbed Surface	Acre (ha)
Fabricated Mulch and Netting	Acre (ha)
Fertilizing	Acre (ha)
Mulch	Acre (ha)
Seeding	Acre (ha)
Sodding	Square Yard (m^2)
Soil Retention Blanket	Square Yard (m^2)
Topsoil	Cubic Yard (m^3)

Include the cost of removing oversized material from the conditioned seedbed surface in the cost of Topsoil – Salvaging and Placing, or Topsoil (furnished) whichever is applicable.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 611
CATTLE GUARDS

611.01 DESCRIPTION

This work is furnishing and installing cattle guards or removing and resetting cattle guards.

611.02 MATERIALS

611.02.1 Concrete

Furnish air-entrained hydraulic cement concrete in accordance with Section 551 for poured-in-place base concrete and precast bases.

611.02.2 Steel

Furnish reinforcing steel in accordance with Subsection 711.01.

Furnish low-alloy weldable steel in accordance with AASHTO M 270 Grade 36 (250 MPa) or ASTM A572, Grade 42 (290 MPa) requirements for crossbars.

Furnish other steel in accordance with Section 711.

611.02.3 Paint

Furnish paint in accordance with the following Subsection requirements:

Aluminum Epoxy (Two Coats).....710.02(B)(2)
Aluminum Paint (Finish Coat).....710.02(B)(1)
Shop (Prime Coat) .....710.02(B)(6)

611.02.4 Cattle Guards

Furnish standard pre-fabricated cattle guards in accordance with the following requirements:

- HS-20 (AASHTO M 518) live loading;
- The Detailed Drawings; and
- Subsections 556.03.2 and 556.03.3.

Submit all fabrication drawings for review before fabrication and footing elevations are set.

611.03 CONSTRUCTION REQUIRMENTS

611.03.1 Excavation

Excavate cattle guard foundations to the specified depth allowing space for formwork.

Complete and compact earth fills in accordance with Section 203 before excavating for the cattle guard foundation.

611.03.2 Placing Concrete Bases

Construct poured-in-place concrete bases in accordance with Section 552 and the Detailed Drawings.

Furnish precast concrete bases in accordance with Section 554 and the Detailed Drawings.

Construct stringer bearing surfaces to provide full bearing under each stringer. Bushhammer uneven surfaces to provide even bearing.

611.03.3 Placing Cattle Guards

Fasten the metal structure to the base as specified.

Attach the metal wings to the cattle guard and to the fence as shown in the Detailed Drawings.

All welding must meet the requirements of Subsection 556.03.10 and Section 624.

Backfill and clean up around the completed structure.

611.03.4 Painting

Apply one shop coat of primer to all metal parts. Apply a prime coat and a finish coat in the shop or in the field.

Perform all painting in accordance with Section 612.

Re-paint damaged painted surfaces at Contractor expense.

611.03.5 Resetting Cattle Guards

Dismantle and reset existing cattle guards at the locations specified in the contract.

611.04 METHOD OF MEASUREMENT

New and reset cattle guards are measured by the unit, including the concrete bases, excavation and backfill.

611.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
New Cattle Guard	Each
Reset Cattle Guard	Each

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 612
STRUCTURE FINISHES

612.01 DESCRIPTION

This work is the surface preparation, painting, coating and finishing requirements of steel components.

612.02 MATERIALS

Furnish material in accordance with Section 710. Provide coatings from a single manufacturer if multiple products or coats are required. Submit documentation such as catalogue cuts or product brochures for all claimed product compatibilities. Coat powder coated items with a zinc-rich prime coat and a Triglycidyl Isocyanurate (TGIC) Polyester powder top coat. Use paint materials suitable for the environment in which they will be exposed.

Either the contract or the Project Manager will specify the final coat color.

612.02.1 Paint Coating Systems

A. **New Structural Systems.** Furnish the products necessary for a three coat system consisting of inorganic zinc primer, a mid-coat of high build epoxy, and a topcoat of urethane.
B. **Bridge and Pedestrian Rails.** Furnish a three coat system or a TGIC powder coat system.
C. **Pipe Piling and Casings.** Furnish a two-component self-priming epoxy.
D. **Cattle Guards.** Furnish a paint system composed of a prime coat and aluminum finish coat or aluminum epoxy paint.
E. **Existing Structural Steel.** If existing steel is to be painted, the contract requirements will specify whether to fully remove the existing paint, or to apply additional paint over an existing coating.
   1. **Full Removal of Existing Paint.** Apply a three coat system
   2. **Overcoat.** Provide a product that can be applied over the existing coating without causing the existing paint to debond.
F. **Miscellaneous Items.** Furnish one of the following: two-component aluminum epoxy paint, two-component self-priming epoxy, zinc phosphate alkyd, leafing aluminum paint, a three coat system or TGIC powder coating.
G. **Other Paint Systems.** Other paint systems will be considered if they are recommended for the purpose intended.

612.03 CONSTRUCTION REQUIREMENTS

Prevent environmental pollution including stream and air pollution caused by paint, paint spray, paint chips, dust, or other harmful materials in accordance with all federal, state and local regulations and requirements.

612.03.1 Submittals

Submit the following to the Project Manager for review:

A. **Paint Products.** Submit a written description of the complete coating system to the Project Manager for review at least 30 business days before use.

   Include in the written submittal the manufacturer's product information including but not limited to paint characteristics, surface preparation, film thickness recommendation, safety data, repair procedures and application recommendations.

   Bring conflicts between the coating system submittal and the specifications to the Project Manager's attention for resolution.

Submittals for paints to be applied over existing paint are to be based on successful test applications to the surface being painted.

B. Pollution Controls. Submit a work plan that meets OSHA and EPA regulations.

1. **Environmental.** Design a containment system in accordance with the Society for Protective Coatings (SSPC) Guide 6, Class 1, 2 or 3 *Guide for Containing Debris Generated during Paint Removal* requirements except that permeable wall materials cannot be used. The containment system may be located on or off the project site.

   Submit shop drawings and design calculations for containment systems attached to the structure. Include design calculations that address all load conditions on the structure resulting from the containment system including debris. Specify ventilation and negative pressure equipment capacity, layout, and related calculations
2. **Worker Protection.** Meet the OSHA lead standards of Title 29, CFR 1926.62. Describe medical surveillance, exposure monitoring, respiratory protection, personal hygiene, employee training, and employee access to records, hazards communication and a compliance program to reduce lead exposure to within the permissible exposure limits. Exposure monitoring must meet the National Institute of Occupational Safety and Health Method 7028.
3. **Disposal.** Submit a work plan detailing how paint scrapings and wastewater will be collected and disposed of.
4. **Staging and Scaffolding.** Submit for approval planned use of an existing structure for attachments of scaffolding or staging, or any equipment on the bridge that weighs 20 tons (18.1 MT) or more.

612.03.2 Surface Preparation

Prepare a test area to define the level of surface preparation needed. This area is to be approved by the Project Manager. If the paint manufacturer recommends a higher degree of surface preparation, use the manufacturer's recommendations.

Hand-clean the steel bridge bearing components containing PTFE, stainless steel and neoprene pads to prevent surface damage. Remove fins, tears, slivers and burred or sharp edges by grinding and re-clean the area as specified before coating. Remove blast residue from steel surfaces with clean brushes, compressed air (free of oils), or commercial grade vacuum equipped with a brush-type cleaning tool, or by double blowing. Guard angles, pier nose angles, deck expansion joints and other small structural steel elements may be prepared for painting using wire brushed, scrapers, chisels or sand blasting as approved. After cleaning, keep steel dry and dust free and prime within 24 hours after cleaning.

A. New Structural Steel. Brush-off blast cleaning to SSPC SP-7 requirements all new steel that is not to be painted. Solvent wash to SSPC SP-1 requirements, then commercial blast to SSPC SP6 requirements all new steel that is to be painted except as noted. Solvent wash to SSPC SP-1 requirements, then blast to SSPC SP-10 (near white) all new steel that is to be painted with the three coat system. The surface profile for all new steel being painted is to be between 1.5 and 3.5 mils, or as specified by the paint manufacturer.

B. Steel Pipe Piling and Casings. Solvent wash to SSPC SP-1, then commercial blast to SSPC SP-6 all portions of steel pipe piling that are to be painted.

C. Existing Structural Steel (no paint present). Remove all loose material including soil, concrete and loose rust in accordance with SSPC-SP2 (hand tool cleaning) or SSPC-SP3 (power tool cleaning) prior to solvent cleaning per SSPC-SP1. Brush-off blast clean to SSPC-SP7 surfaces that are too large for the above methods. Clean to SSPC-SP6 requirements.

D. **Existing Structural Steel (overcoat existing paint).** Clean areas of loose paint as described in Subsection 612.03.2(C). Roughen, de-gloss, and clean existing paint surface as recommended by the paint manufacturer.
E. **Existing Structural Steel (full paint removal).** Clean to SSPC-SP1 and SSPC-SP6.
F. **Surface Cleanliness and Profile.** Clean and establish a surface profile on the steel as if it were new structural steel.
G. **Galvanized Surfaces.** Treat galvanized surfaces with phosphoric acid solutions of the zinc phosphate of phosphate chromate types formulated for this use. Dry the treated surface for 20 minutes and rinse with water. Begin painting dry surface within 24 hours.

612.03.3 Painting

Protect pedestrian, vehicular and other traffic upon or under the structure, the superstructure and substructure against damage or disfigurement by splatters, splashes, smirches or over-spray of paint material. Clean all surfaces with paint damage at the contractor's expense.

A. **General.** Unless otherwise approved by the Project Manager, painting season for structural steel, metal posts or poles and bridge rail is from May 1st to October 31st. Apply paint only to dry clean surfaces. Do not paint when weather conditions would cause unsatisfactory results.

Allow each coat of paint to dry before applying succeeding coats. Follow the manufacturer's recommendations for drying time unless field conditions require longer drying time. The Project Manager may stop painting operations at any time if current or impending weather conditions could cause unsatisfactory coating performance.

Provide Inspectors ready and safe access to work at all times. The Project Manager will suspend work for unsafe or inadequate access to work. Ensure all fabrication inspections are complete prior to painting.

Thin paint only as recommended by the manufacturer.

B. **Paint Representative.** Furnish the services of a painting technical representative from the paint manufacturer at the beginning of paint application to notify the Project Manager that surface preparation is adequate and to provide technical assistance to the Contractor in application methods that may be unique to the particular product used. Keep this technical representative on-call as required during operations.

Do not apply paint until surface preparation has been approved by the Project Manager. Do not apply additional or subsequent coats of paint without the Project Manager's approval.

C. **Application.** If using the three coat system, apply three coats of paint to all new steel work. Unless noted otherwise, apply a minimum of two coats of paint for all other paints listed in Subsection 612.02. Paint in a neat and workmanlike manner. Apply paint in full coats by brush or spray, completely covering all surfaces.

Apply paint by brush or spray following the paint manufacturer's recommendations to produce a uniform coat to the metal or previous paint coat. If using brush painting, thoroughly coat surface irregularities and brush out and smooth to produce an even paint film thickness. Use spray pressure tanks with an agitator to thoroughly stir the paint.

If surfaces are inaccessible to paint brushes, paint with sprayers or daubers made for that purpose.

Keep materials painted under cover in damp or cool weather until the paint has dried or weather permits removal of cover.

1. **Shop Paint.** Apply a shop coat to all metal surfaces unless otherwise specified. Do not paint surfaces in contact with other metal surfaces or concrete, except as noted in

Subsection 612.03.6(A). This includes faying surfaces and contact surfaces of nuts, bolts and washers for bolted connections.

Apply shop coat immediately after fabrication, shop inspection and shop cleaning are complete and the work is accepted.

Do not load materials for shipment until paint is dry. Do not apply field coats in the fabrication shop except by written approval of the Project Manager.

Use erection marks for field identification of members on painted surface. Use paint for marking that is compatible with the shop coat and the first field coat. Cover erection marks, fabricator's name and other identification with subsequent coats.

2. **Spot Painting.** Field clean masonry and sole plates, bottom of expansion devices and all parts of steel inaccessible for painting after erection as noted above. Spot coat and apply all field coats before erection. Paint on site and allow drying thoroughly before assembling. Handle painted material carefully to prevent damage. Repair and repaint damaged surfaces at no cost to the State.

   Apply the spot coat after erection and field cleaning is approved by the Project Manager, to the edges of plates, rolled shapes and to the heads of bolts and nuts and areas where the shop coat has been damaged. Where the shop coat is damaged, the Project Manager may require a substantially complete reconditioning or replacement of the shop coat. This painting is considered spot painting and is done at no cost to the Department.

   Reseal small cracks and cavities not sealed by the first field coat with a zinc paste before the second field coat is applied.

Mix paint as recommended by the paint manufacturer while in original containers. Mix or agitate paint in containers throughout application period. When mixing two-component paint systems, mix each component first, and then mix together. The Project Manager may allow hand mixing when each coat of paint is 5 gallons (19 L) or less.

Minimum dry film thicknesses (DFT) are shown in Table 612-1, unless in conflict with the manufacturer recommendations.

TABLE 612-1
MINIMUM DRY FILM THICKNESS

Paint System	Minimum Dry Film Thickness
Three coat system	Primer: 3 mils (above peaks of surface profile) Second coat: 4 mils Finish coat: 2 mils
Epoxy paint for pipe piles and casings	First 2 coats with total DFT of 12 mils Final coat: 3 mils
Epoxy mastics for misc. structural steel	3 mils per coat for new steel or existing coatings 5 mils per coat for lightly rusted surfaces.
Two-component epoxies	4 mils per coat 6 mils over light rust
Calcium sulfonate alkyd	5 mils per coat
Zinc phosphate alkyd	3 mils for primer coat 1 mil for finished coat
Aluminum epoxy paint:	5 mils per coat

612.03.4 Weather Conditions

Apply paint using manufacturer's recommendations for temperature (air, substrate and paint material) and relative humidity or as follows, whichever is more restrictive.

Do not apply paint when ambient temperature is at or expected to drop below 40 °F (4 °C) within 2 hours. Do not apply paint when rain, snow or condensation is expected within 2 hours after application at the location where paint is applied. Do not apply paint when the relative humidity is greater than 85% or when temperature and humidity cause condensation on the surface to be painted. Do not apply paint to metal with surface temperatures over 110 °F (43 °C) or when the surface temperature causes the paint to blister or produce a porous paint film.

Neither weather conditions nor Department acceptance of paint materials negate your responsibility for satisfactory application of paint. If the painting is unsatisfactory, remove paint, thoroughly clean the surfaces and repaint at no cost to the Department. The painting is unsatisfactory if:

- Rusting occurs;
- The paint coat lifts;
- Blisters;
- Wrinkles;
- The paint has excessive runs or sags;
- The paint shows evidence of application under unfavorable conditions;
- The workmanship is poor;
- Impure or unauthorized paint has been used; or
- For other reasons determined by the Project Manager.

612.03.5 Steel Components

A. Metal Bridge Rail. Apply the spot coat and all required field coats to the following contact areas before erection:

- rail to post contact surface;
- expansion sleeves; and
- rail post base plates.

Apply required field coats to the rest of the rail after erection, fit-up and final adjustment of the rail to line and grade.

B. Steel Pipe Piles and Casings. Paint piles and casings as described in Subsections 559.03.8 and 612.03.4.

C. Existing Structural Steel. Apply and undercoat of paint prior to the other field coats to all exposed edges of plates and rolled shapes; the heads of rivets, bolts and nuts; and all surfaces where bare metal is exposed.

612.04 METHOD OF MEASUREMENT

Structure finish is not measured separately but is incidental to the items being finished.

612.05 BASIS OF PAYMENT

Structure finish is not paid for separately but is included in the cost of the item finished and includes all materials and resources necessary to complete the work.

SECTION 613
RIPRAP AND
SLOPE AND BANK PROTECTION

613.01 DESCRIPTION

This work is the construction of protective rock, stones, gravel, or concrete coverings as specified.

Riprap is a cover of stone or fragmented rock, with or without grout, placed along embankment slopes, stream banks, culvert inlets and outlets, foundations, bridge berms, dikes, and other specified locations.

Bank protection is a cover of rock or coarse gravel placed on the side slopes of structure channels and other specified locations.

Concrete slope protection is a cover of hydraulic cement concrete placed on slopes at structure ends.

613.02 MATERIALS

Furnish materials in accordance with the following section and subsection requirements:

Bank Protection..... 701.07
Bedding Material 701.04.1
Hydraulic Cement Concrete 551
Handlaid, Random, and Grouted Riprap 701.06
Sand-gravel Cushion..... 701.08

613.03 CONSTRUCTION REQUIREMENTS

613.03.1 Riprap

A. General. Place the riprap at the locations specified in the contract.

Key the riprap ends into the embankment slopes at least 2 feet (610 mm) from the outer face of the riprap for the full height of the riprap.

B. Handlaid Riprap. Bed the stones at right angles to the slope with the larger stones used in the lower courses. Lay the stones in close contact with staggered vertical joints and placed so each stone rests on the embankment slope instead of the underlying stones. Fill the spaces between the stones with smaller stones or rock, securely placed.

Finish the work to present an even, tight plane varying no more than 3 inches (75 mm) from the general contour of the revetment.

Provide a minimum riprap thickness of 12 inches (305 mm), measured perpendicular to the slope, or as specified.

C. Random Riprap. Place the stones on the slopes to form the specified cross section. Uniformly distribute the smaller stones throughout the work. Manipulate the stones by hand or machine to provide a uniform surface and stable mass.

Provide the riprap thickness specified in the contract.

Place the riprap around pipe openings without damaging the pipe. Repair damaged pipe at Contractor expense.

D. Grouted Riprap. Provide a minimum riprap thickness of 9 inches (230 mm) measured perpendicular to the slope, or as specified.

Place one or more layers of bedding material before placing the riprap as specified. Place each bedding layer on the prepared surface to the specified thickness in one operation without segregating the layer. Finish the top layer to produce an even surface free from mounds or ridges. Do not inter-mix the materials of each layer.

Fill the voids between stones with spalls or small stones so all stones are wedged or keyed. Prevent earth and sand from filling the spaces between the stones.

Finish the final surface to provide an even, tight surface with the plane not varying more than 3 inches (75 mm) from the general contour.

Wet the riprap surface and fill the crevices and openings with at least 3 inches (75 mm) of mortar. Immediately sweep the surface with a stiff broom.

Grouting may begin when the ambient temperature is at least 35 °F (2 °C) and rising and must stop when the ambient temperature is 30 °F (−1 °C) and falling.

Keep finished grout work moist for 3 days.

613.03.2 Bank Protection

Bank protection may be hand-placed or machine placed and leveled. Construct the finished bank protection to be stable with no voids larger than the smallest stone used in the work.

Use rock spalls or gravel to fill the voids. Not more than 5% of the total bank protection volume may be earth, sand, or rock material smaller than $^{3}/_{16}$-inch (5 mm) for filling voids.

Bed the bank protection as shown in the contract.

613.03.3 Concrete Slope Protection

Trench, shape, compact, and trim the slopes as specified before starting concrete work. Excess excavated material may be used elsewhere in the work or disposed of by the Contractor.

Construct the concrete slope protection as specified or directed.

613.03.4 Concrete Drainage Chute

Construct concrete drainage chutes as shown in the Detailed Drawings.

613.04 METHOD OF MEASUREMENT

613.04.1 Riprap

A. **Handlaid and Random Riprap.** Handlaid and random riprap is measured by the cubic yard (m^3) complete in place. The volume measured for payment is that bounded by the staked length and height and the plan thickness.

Excavation is incidental to the riprap and not measured for payment.

B. **Grouted Riprap.** Grouted riprap is measured by the square yard (m^2) on the face of the revetment.

Excavation is incidental to the riprap and not measured for payment.

Bedding material is measured by the cubic yard (m^3).

613.04.2 Bank Protection

Bank protection is measured by the cubic yard (m^3) complete in place. The volume measured for payment is that bounded by the staked length and height and the plan thickness.

Excavation and bedding material are not measured for payment.

613.04.3 Concrete Slope Protection

Concrete slope protection is measured by the square yard (m^2). Measurement is made parallel to the surface of the exposed surface area including the surfaces of curbs and head walls.

Excavation is incidental to the item and not measured for payment.

Sand-gravel cushion is measured by the cubic yard (m^3) compacted in place.

613.04.4 Concrete Drainage Chute

Concrete drainage chutes are measured by the cubic yard (m^3) and include the excavation, concrete placement, and bank protection at the chute ends.

613.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Bank Protection	Cubic Yard (m^3)
Bedding Material	Cubic Yard (m^3)
Concrete Drainage Chute	Cubic Yard (m^3)
Concrete Slope Protection	Square Yard (m^2)
Grouted Riprap	Square Yard (m^2)
Handlaid and Random Riprap	Cubic Yard (m^3)
Sand-gravel Cushion	Cubic Yard (m^3)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 614
RETAINING WALLS

614.01 DESCRIPTION

This work is constructing concrete and metal bin-type retaining walls.

614.02 MATERIALS

Furnish materials in accordance with the following section and subsection requirements:

Backfill for Metal Bin-Type Retaining Walls 701.09
Hydraulic Cement Concrete 551
Metal Bin-Type Retaining Walls 711.17
Reinforcing Steel..... 711.01

614.03 CONSTRUCTION REQUIREMENTS

614.03.1 Foundations

Excavate and prepare foundations for concrete retaining walls in accordance with Subsection 209.03.

Construct metal bin-type retaining wall foundations to the established lines and grades and compact in accordance with Subsection 203.03.3.

The Project Manager will inspect and approve all foundations before subsequent work.

614.03.2 Concrete Retaining Walls

Construct concrete retaining walls as specified in the contract. Perform concrete work in accordance with Section 552.

Remove all deleterious material from the footings before placing concrete. Prepare the footing surface in accordance with Subsection 552.03.6. Make vertical construction joints in accordance with Subsection 552.03.6.

614.03.3 Bin-type Retaining Walls

Assemble the wall parts following the wall manufacturer's recommendations.

If approved, the wall height and depth may be varied but cannot exceed the maximum dimension shown.

Two or more retaining wall designs may be used in the same wall, using standard split columns to make the step back connection.

614.03.4 Backfill

A. **Concrete Structures.** Furnish the backfill material specified in the contract. Place backfill as specified in Subsection 203.03.2(B).

B. **Metal Bin-type Retaining Walls.** Follow the manufacturer's recommendations for placing and compacting backfill material. If no recommendations are made, bring the backfill up equally inside and outside the bins as follows:
   - For backfill material outside the bins, use roadway excavation and place it as specified in Subsection 203.03.2(B).
   - Furnish backfill material for inside the bins in accordance with Subsection 701.09.
   - Place the backfill in 8-inch (200 mm) maximum compacted lifts, completely filling in all corrugations. Compact backfill as specified in Subsection 203.03.3. Hollow sounding corrugations in the bin wall face detected by the Inspector is cause to remove, replace, and re-compact the backfill at Contractor expense.

614.04 METHOD OF MEASUREMENT

614.04.1 Concrete

Concrete is measured by the cubic yard (m^3) in accordance with Subsection 552.04.

614.04.2 Reinforcing Steel

Reinforcing steel is measured by the pound (kg) in accordance with Subsection 555.04.

614.04.3 Metal Retaining Walls

Metal bin-type retaining walls are measured by the nominal square foot (m^2) of facial area of wall.

614.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made as follows:

Pay Item	Pay Unit
Concrete	Cubic Yard (m^3)
Metal Retaining Wall	Square Foot (m^2)
Reinforcing Steel	Pound (kg)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 615
IRRIGATION FACILITIES
AND HEADWALLS

615.01 DESCRIPTION

The work is constructing irrigation facilities and headwalls.

615.02 MATERIALS

Furnish material in accordance with the following section requirements:

Concrete, Class General 551

615.03 CONSTRUCTION REQUIREMENTS

Construct irrigation facilities and headwalls in accordance with the following:

Excavate in accordance with the applicable Section 209. Construct and install concrete structures in accordance with Section 552. Place reinforcing steel as shown in the contract. Moisten all surfaces where concrete is to be placed before the concrete is placed.

615.04 METHOD OF MEASUREMENT

Concrete is measured in accordance with Subsection 552.04. Reinforcing steel and excavation are incidental to concrete and not measured for payment.

615.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Concrete	See Subsection 552.05

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work in accordance with the contract.

SECTION 616
CONDUITS AND PULL BOXES

616.01 DESCRIPTION

This work is furnishing and installing plastic and steel electrical conduit, including fittings, junction boxes, pull boxes, and accessories.

616.02 MATERIALS

Furnish materials in accordance with the following subsection requirements:

Conduit 703.02
Pull Boxes 703.03

616.03 CONSTRUCTION REQUIREMENTS

616.03.1 General

Install conduit and pull boxes in accordance with the NEC.

Conduit lengths in the contract are estimated, and may require changes, approved by the Project Manager, to avoid underground obstructions. Refer to Subsection 107.18 regarding locating of underground utilities before excavation.

Provide the specified conduit type and size, or substitute a larger size conduit at Contractor expense. Do not change conduit size within any conduit run. Use minimum 2-inch (53 mm) diameter conduit between pull boxes and adjacent standard bases.

Have conduit enter the foundation at least 24 inches (610 mm) below the top. Conduit stubs on structures are specified in the contract.

Place and securely hold in position conduit ends, anchor bolts, and other fittings set in concrete until the concrete sets.

Lay conduit a minimum of 18 inches (455 mm) below the curb grade in sidewalk areas and not less than 24 inches (610 mm) below the finished grade in all other areas.

Install conduits under railroad tracks to railroad company requirements. Notify the Department and the railroad company at least 48 hours before starting work on railroad property.

Terminate conduit in standard or pedestal foundations at least 3 inches (75 mm) above the foundation top. Keep conduit within foundations at least 6 inches (150 mm) from the foundation face. Extend conduit terminating in standards or pedestals above the foundation and slope it towards the handhole opening.

Terminate conduit entering concrete pull boxes 2 inches (50 mm) inside the box wall, at least 2 inches (50 mm) above the bottom, and slope it to aid cable pulling. Locate conduit entrances in pull box bottoms near the end walls leaving most of the box clear. Install conduit outlets in the box from the direction of the run. Seal conduit leading into socket walls, lights, or fixtures below the pull box grade using a watertight sealing compound.

Install a pull wire in all unused conduits over 10 feet (3 m) long. Double at least 2 feet (610 mm) of pull wire back into the conduit at each termination point for runs over 100 feet (30.5 m); double 1-foot (305 mm) back for shorter runs.

Install a conduit expansion joint, detailed in the contract, where the conduit crosses a fixed or structure expansion joint. Equip each expansion fitting with a grounding strap jumper. Thoroughly clean contact areas before clamping grounding straps.

Secure all conduit bonds, lighting bracket anchor bolts, and bridge rail anchor bolts to form a continuous mechanical and electrical system. When not included as part of a new foundation, furnish, install, and pay for all work and materials (such as grounding straps and bare AWG No. 6 wire) necessary to make a continuous grounded system as part of the unit price for conduit.

Clean out existing underground conduit incorporated into new conduit with compressed air and mandrel for size if required.

Install pull boxes and conduits as specified with the pull box covers flush with the concrete facing or as directed.

Compact backfill material for conduit trenches constructed outside of the roadbed sections to the density of the adjacent material.

Restore existing surfaces disturbed by conduit or pull box installations to the original type and condition.

Push or bore conduit under existing roadways. Install conduit that is to be under new surfacing prior to new surfacing being put in place. Keep jacking and drilling pits at least 2 feet (610 mm) away from the roadway surface edge. Do not undermine the roadway surface or soften subgrade when using water.

Open cutting across the existing roadway will be allowed only after 3 unsuccessful attempts at conduit installation using either a fluid assisted directional boring system with a minimum push and pull back force of 4,946 lbf (22 kN), or a directional rod pusher with a minimum push and pull back force of 38,217 lbf (170 kN). The Project Manager may approve cutting small test holes in the roadway surface to locate obstructions.

When approved by the Project Manager, trench across paved roadways without disturbing or injuring the paved surface on both sides of the trench.

Cut asphalt pavements leaving a straight cut face. Excavate, install conduit, and backfill with approved material. Fill the top 1-foot (305 mm) of the trench with compacted plant mix or as directed. Replace all damaged pavement.

Fill open cuts across roadways with CLSM in accordance with the contract. Furnish and place CLSM as an alternative to compacted soil to the lines and grades shown in the contract.

Submit 2 copies of a mix design to the Project Manager for approval 14 calendar days before start of production.

Provide CLSM in accordance with Section 551.

Payment for all costs associated with furnishing and placing CLSM is included as part of the conduit bid item.

616.03.2 Plastic Conduit

Excavate trenches for plastic conduit a minimum 24 inches (610 mm) deep. Tamp the trench bottom and bed with 2 inches (50 mm) of sand before laying the conduit. Once the conduit is placed, place and compact sand, or soil free of rocks or hard lumps, 6 inches (150 mm) above the pipe. Complete the backfill using material passing a minus 3-inch (75 mm) screen.

Join conduit using a solvent-welded slip-fitter coupling to provide a watertight joint.

Separate plastic parallel and perpendicular conduit runs from each other with at least 3 inches (75 mm) of sand or soil cushion. Cap open ends of conduit to prevent moisture, dirt, or rocks from entering the conduit.

For plastic conduit runs 300 feet (91 m) or longer, leave one end disconnected or insert an “O” ring expansion coupling near one end of the run.

616.03.3 Steel Conduit

Install rigid conduit in accordance with the NEC article 346.

Make field cuts square and true so that the ends join full circumference. Ream the conduit ends to remove burrs and rough edges.

Slip joints or running threads are not permitted for coupling conduit. Use an approved threaded union coupling when a standard coupling cannot be used.

Coat any new threads on conduit with a cold galvanizing compound before making couplings.

Tighten couplings until the conduit ends are brought together making a good electrical connection throughout the entire conduit run.

Paint damaged conduit coating with a cold galvanizing compound.

Thread and cap conduit with standard pipe caps until the wiring is placed. Install insulated grounding bushings when caps are removed.

Connect new steel conduit directly to stubs of existing steel conduit protruding from existing foundations and at nearest coupling points. New threaded joints may be approved by the Project Manager if the above requirements are met. Do not use plastic conduit in the system.

Make conduit field bends having a minimum radius of six times the inside diameter of the conduit. Factory conduit bends must not crimp or flatten the conduit and use the longest practical radius.

616.03.4 Pull Boxes and Manholes

Construct and install pull boxes and manholes as specified. The Contractor may install additional pull boxes to aid the work at the Contractor's expense. Install pull boxes and manholes with covers level with curbs, sidewalks, and surrounding ground. Bed the box bottoms in concrete or crushed rock as specified. When replacing or adjusting an existing pull box, adjust conduit stub heights accordingly.

When installing pull boxes in sidewalk, install so water runs away from the pull box lip. When installing pull boxes in open ground, encase pull box in a Class General concrete pad extending 12 inches (305 mm) horizontally away from the pull box in all directions and at least 12 inches (305 mm) deep.

Prevent damage to any existing pull box to be re-used on this project. Any pull box damaged by the Contractor is to be replaced by the Contractor at no cost to the Department.

This item includes all excavation, gravel base, the concrete pad around the pull box, placement of the pull box, electrical bonding of conduits, backfill, and repair of the surface and surrounding area.

616.04 METHOD OF MEASUREMENT

616.04.1 Lump Sum Basis

When a conduit system or portion thereof is specified in the contract on a lump sum basis, the system is measured by the lump sum.

616.04.2 Conduit

Conduit is measured by the foot (m).

616.04.3 Pull Boxes and Manholes

Pull boxes and manholes are measured by the unit.

616.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Conduit	Foot (m)
Conduit System	Lump Sum
Manhole	Each
Pull Box	Each

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 617
TRAFFIC SIGNALS AND LIGHTING

617.01 DESCRIPTION

This work is installing or modifying of traffic signal(s), lighting, and other electrical systems.

617.02 MATERIALS

Furnish materials in accordance with the following section requirements:

Hydraulic Cement Concrete 551
Lighting and Signal Materials 703

617.03 CONSTRUCTION REQUIREMENTS

617.03.1 General

Consult with the Project Manager and affected utility companies about the work prior to commencement of work. Obtain daily, safety circuit clearance from the servicing utility before starting work on existing series street lighting circuits. Pull cut-out plugs and place worker signs at cut-out boxes before work is started.

Use rosin core solder in all electrical soldered connections.

Pick up Department-furnished material and equipment from the Traffic Engineering Section, 2701 Prospect Avenue, Helena, Montana, and transport to the project as part of the contract unit price. Provide the Traffic Signal Engineer at least 5 business days advance notice before arriving to take delivery. The date/time arranged for equipment pickup will be mutually agreed to and be as close as possible to the contractor's request.

Repair or replace all existing improvements and equipment disturbed, damaged, or removed in performing the work at Contractor expense.

The locations in the contract for signal and light standards, controller pedestals, conduit runs, pull boxes, illuminated signs, and appurtenances are approximate. The Project Manager will establish the exact field locations and elevations.

Furnish and install all incidental parts not specified but necessary to complete or modify the traffic signal, lighting, or other electrical systems at Contractor expense.

Make arrangements with the serving utility for providing service to the project. Work with the serving utility to determine the schedule for and exact location of the service.

Pay all fees and energy costs used for temporary Contractor operations. The Department will pay the energy costs to operate signals and lighting used by the public.

All systems must be complete and operable when the work is completed.

Coordinate all construction activities to ensure all interim and/or permanent pavement markings and all associated signs are in place prior to the signal turn-on. Place new traffic signal installations into "flash" for a period of 3 to 5 days immediately prior to the turn-on. The traffic signal will be put into operation upon approval, and at the sole discretion, of the traffic signal engineer from the traffic engineering section. The sole discretion of the traffic signal engineer is based on the whether the project intent has been met, the completeness of the project, and the ability to turn on the traffic signal safely.

Inform the project manager of the desired turn-on date prior to the time the signals are to become operational. Have the project manager inform the traffic signal engineer of the desired turn-on date at least 2 weeks prior to that date. The date arranged for the signal turn-on will be mutually agreed to and be as close as possible to the contractor's desired turn-on date.

617.03.2 Equipment Lists and Drawings

Submit the following for approval after award:

1. A complete list of the proposed equipment and material. Include the quantity, description, size, name of the manufacturer, and catalog number of each item. Indicate which items are on the QPL.
2. Manufacturer's product data sheets for each item of equipment and material listed that are not on the QPL. The data sheets must have the specific items to be used underlined in red or highlighted, including item specifications.
3. Shop drawings, design calculations, and welding procedures for all metal signal and luminaire standards that are not on the QPL. Check and approve the shop drawings and design calculations before submitting, and show the Contractor's approval on the drawings.
4. Documentation required by the QPL for items that are on the approved QPL list.
5. Certified mill test report's for pole material and the manufacturer's certification that pole material and galvanizing meets specifications.

Materials and equipment listed as approved on the QPL at the time that the list of proposed equipment and materials is submitted, may be accepted as a pre-approved QPL item in lieu of the normal submittal and approval process outlined in this section.

Obtain further information and requirements on the QPL website, located at http://www.mdt.mt.gov, within the contracting/consulting link.

The Department has 20 business days after receipt to approve the submittals. Upon receipt of the approved list of equipment and material, immediately order the materials and submit copies of the dated purchase orders for major items. Re-submit any disapproved items for Department review within 20 business days of notification of disapproval.

Submit copies of the invoices showing the shipping dates within 10 calendar days of the invoice dates.

The calendar date or the number of working/calendar days allowed for completion of the contract will be adjusted by the number of days the Department's review of the submittals overran the Department's review time, if the Departments delay effects the Contractors operation as shown on the most recently reviewed schedule. No additional compensation is allowed for these Department-caused delays.

The Department is not liable for any materials purchased, labor performed, or work delay (except as stated above) before approval of the required submittals.

All material is subject to inspection after delivery to the project and during installation on the project. Failure by the Project Manager to note defective material or faulty workmanship during construction does not relieve the Contractor of responsibility for removing or replacing defective material or redoing work at Contractor expense. Inspection or sampling of certain materials may be made at the factory or warehouse before delivery to the site at the Project Manager's discretion. No material rejected before delivery, is to be delivered to the project, and all material rejected on the project must be removed from the work.

Submit all equipment guaranties and warranties.

Comply with the requirements of Subsection 106.09.

617.03.3 Maintenance of Signals

Maintain existing traffic signals that are moved or modified once work begins.

The responsibility for existing traffic signals continues with the agency normally responsible for the traffic signals until work begins.

Be responsible for new or modified traffic signals placed in service until the project is accepted. Provide in writing the names and phone numbers of the persons responsible for the operability and maintenance to the jurisdictional law enforcement agency and the Project Manager in case of signal malfunction.

617.03.4 Excavation and Backfilling

Excavate for conduit, foundations, other equipment and materials as specified. Excavate trenches to the width necessary to install electrical equipment, materials, and foundations. Saw cut all existing pavements before excavating.

Do not start excavation until the conduit, equipment, and materials are on site.

Place excavated material without obstructing vehicular or pedestrian traffic or surface drainage. Remove and dispose of surplus excavated material at the end of each workday.

Backfill excavations in accordance with Subsection 209.03.6. Bring excavations up level with the adjacent surface or grade to drain as required until permanent repairs are made.

When construction is suspended each day, clear all equipment and material from the roadway for public use as specified in Section 618.

617.03.5 Removing and Replacing Improvements

Replace or re-construct existing sidewalks, curbs, gutters, pavement, bituminous surfacing, base material, landscaping, and other improvements removed, broken, or damaged by the Contractor with equal or better quality materials.

Cut concrete sidewalk and pavement borders to be removed without damaging the adjacent surface. Whenever a part of the existing concrete sidewalk, driveway or pavement is broken or damaged, remove the entire square or slab and replace the concrete as specified.

Repair or remove and replace all existing improvements damaged by the Contractor at its expense.

617.03.6 Foundations

Construct post, standard, controller cabinet, and pull box concrete encasing pad foundations using Class General or better hydraulic cement concrete in accordance with Section 551.

Place the concrete foundation bottoms on undisturbed ground. Monolithically pour foundations where practical. Form the exposed faces. Ensure forms are rigid and braced true to line and grade. Finish the footing tops for posts and standards, except special foundations, to the curb or sidewalk grade or as directed. Position and hold in place conduit ends and anchor bolts using a template until the concrete has set. Provide the proper anchor bolt circle for all standards.

Install luminaire and Type 1 signal foundations to ensure that no portion of the foundation or base that is non-breakaway projects more than 4 inches (100 mm) above the ground line. Leave anchor bolts projecting at least 3 inches (75 mm) from the foundation.

Apply an ordinary surface finish to the exposed concrete surfaces in accordance with Subsection 552.03.11(D).

Where obstructions prevent the construction of planned foundations, the Contractor may propose an alternate foundation construction method.

Posts, poles, standards, and pedestals may be erected, plumbed and raked after the foundation concrete has cured at least 72 hours.

Concrete quantity increases for foundations to accommodate the standard furnished by the manufacturer are at Contractor expense.

Construct foundations to accommodate the conduit and anchor bolts as specified.

Do not use pancake grounds.

Reinforce foundations with No. 4 (#13) hoops at 1-foot (610 mm) centers and with eight No. 6 (#19) bars equally spaced around the hoops. Form the top 6 inches (150 mm) of the foundation, beveling the exposed concrete edge 2 inches (50 mm). Electrically bond all steel conduits in each foundation to an anchor bolt using an AWG No. 6 copper grounding strap. Connect a bare copper AWG No. 6 solid wire between the grounding lug on the standard and the grounding strap.

617.03.7 Standards

Field drill other holes for wire entry, mounting pedestrian and vehicle signals, or pedestrian pushbuttons. Treat the holes or threads with a cold galvanizing compound following the manufacturer's recommendations. Seal unused pipe tenons on mast arms with metal caps.

Once the non-breakaway standards, posts, or pedestals are erected and the installation complete, grout the gap between the base and foundation using grout in accordance with Subsection 713.04. Form or drill a ¾-inch drain hole in the grout at the lowest point.

Repair all damage to galvanized pole and standard surfaces by applying one coat of cold galvanizing compound to the damaged area.

617.03.8 Luminaires

Check luminaires on the ground to ensure they provide the specified ANSI/IES light distribution pattern before mounting. Adjust the luminaires at night, as directed, to provide the best roadway light distribution. Notify the Project Manager when the luminaire system is complete. The luminaires may be put into operation when necessary for public use as directed by the Project Manager.

617.03.9 Advanced Flashing Beacons

Furnish mounting hardware to mount the traffic signal and sign as shown in the Detailed Drawings. Furnish a traffic signal as specified in Subsection 703.08. Payment for the sign and its mounting is covered on the signing plans.

617.03.10 Conductors and Cable

Install wiring in accordance with the NEC requirements.

Neatly arrange and lace wiring in cabinets, junction boxes, and the like.

Run conductors in conduit except inside poles. Remove all dirt and moisture from the conduit runs before pulling wiring. Use powdered soapstone, talc, or other approved lubricant when placing conductors in conduit.

Run signal light conductors without splices from a terminal block located in the cabinet, compartment, or signal head to a similarly located terminal block.

Splice conductors only where specified using approved watertight connectors. Locate connectors in pole bases to be easily accessible through the handhole. Furnish watertight connectors with midget ferrule type fuses.

Leave 4 feet (1.2 m) of slack for all cables or conductors entering each cabinet. Prepare cables for connection in the cabinet by removing at least 2 feet (610 mm) of the cable sheath. Coil slack cable and conductor neatly inside the cabinet. Furnish spade type connectors for all of the conductors in each cable. Supply connectors and fuses shown in the contract and required to complete the work. Include the cost of these items in the bid items for cable or conductor.

Leave at least 2 feet (610 mm) of slack for each cable and conductor at each standard and pull box.

Use a conductor separate from the signal light circuit for all 24-volt circuits, such as pedestrian push-button circuits.

When conductors and cables are pulled through conduit, tape the conductor and cable ends to seal out moisture until the splices are made or terminal appliances attached. Tape the ends of spare conductors.

Tag cables at controller cabinets to show routing. Label cable and conductor with the appropriate pole number or as approved by the Project Manager to show individual wire routing.

A. **Detector Loop Shielded Cable.** Ground the drain wire at the controller cabinet and dead end where the cable connects to the loop wires. Make cable to loop wire connections within the pull boxes with soldered, waterproof splices.

B. **Emergency Preemption Detector Cable.** Run the cable from the detector head to the discriminator. Follow the preemption manufacturer's recommendations for detector cable connections at the discriminator and detector head.

C. **50 Ohm Coaxial Cable.** Use a standard type "N" male connector with silver plated bodies and pins at the end of the cable. Use type "N" connectors manufactured by the coaxial cable manufacturer.

Provide a jumper cable to connect the lightning arrestor to the local radio that meets all of the same specifications as the coaxial cable and type "N" connectors listed above. Provide a jumper cable that is approximately 4.5 feet (1.3 m) in length. A pre-manufactured, super flexible, jumper cable may be used in place of coaxial cable.

Route the cable from the yagi antenna through the traffic signal pole as shown in the details. Field drill a hole in the traffic signal pole of approximately ¾-inch (19 mm) diameter for cable entrance. Break sharp edges and treat the hole with cold galvanizing compound. Furnish and install a cable-protecting weatherproofing grommet to ensure the installation is weather tight. Furnish and install a stainless steel wire mesh grip to provide strain relief for the cable.

Provide approximately 2 feet (0.6 m) of extra cable in the lower right side of the controller cabinet prior to making the connection to the lightning arrester.

Install coaxial cable in one continuous run from the antenna to the controller cabinet. Do not place stress on the cable during installation such that the cable is twisted or stretched.

617.03.11 Service and Control Assembly

Equip and locate service and control assemblies as shown in the contract. Meet all applicable Codes and local utility company requirements.

Furnish lock and 3 keys to the lock.

Service pole locations shown in the contract are approximate. The Contractor, Project Manager and serving utility will jointly determine the exact locations. The utility must specify the riser location when the Contractor is to install the lower section of a riser on a utility pole. Include the cost of the 6 x 6 inch (150 x 150 mm) pressure treated wood post, if necessary, as part of the service assembly bid item.

Seat, backfill, and compact around the poles. Compact backfill in 9-inch (230 mm) lifts. Plumb and rake the pole as directed.

Treat injuries, cuts, and holes in poles after treatment with three applications of copper napthenate (CuN) solution containing a minimum 2% copper metal or with CCA in accordance with AWPA M4.

Furnish all steel conduit, ground wire, insulated clevis, service wire, all mounting hardware and fittings required to complete this item of work. Include the cost of these items, if necessary, as part of the service assembly bid item.

Run a bare AWG No.6 solid copper ground wire from the cabinet to a ⅝-inch by 8-foot (16 mm x 2.4 m) copperweld ground rod and clamp, as shown in the contract.

617.03.12 Photoelectric Controls

Wire photoelectric controls to meet the contract requirements.

Mount the control at the top of the standard with the photocell oriented toward the north sky or as directed.

Use a 3 AWG No. 14 signal cable in accordance with Subsection 703.05.1 between the photoelectric controller and the electrical service. Include the cost of the photoelectric control, if necessary, as part of the service assembly bid item.

617.03.13 Control Cabinet Pedestals

Locate the pedestal as specified or directed. Construct the pedestal, including the concrete work, as specified. Furnish a bare solid copper AWG No. 6 ground wire, ground rod clamp, and ⅝-inch x 8 feet (16 mm x 2.4 m) copperweld ground rod for the controller cabinet as part of this item.

617.03.14 Traffic and Pedestrian Signals

A. Optical Units. Affix a permanent label, indicating the date of installation, to the back of each Light Emitting Diode (LED) signal indication installed. The Project Manager must approve the label and method of attachment.

Install signal heads after all other signal equipment is placed and ready for operation, or cover the entire signal head with an opaque covering marked with the words “Out of Service”.

Use a continuous 7 conductor AWG No. 14 signal cable from the traffic signal side-of-pole terminal compartment mounted on the signal pole shaft to the end of mast arm signal indication. Use a separate continuous 5 conductor AWG No. 14 signal cable from the terminal compartment to the other signal indication closest to the terminal component. Use 5 conductor AWG No. 14 to the other signal heads as necessary. Include the cost of these cables in the price per signal standard. Cables run from the end of mast arm indication to the other signal indications are included in the cost of the signal heads. If not required for signal mounting, install a side-of-pole terminal compartment for wire termination. If not used for signal mounting, include the cost of the terminal compartment in the price per linear foot of signal cable.

Use ½-inch (M12) coarse thread stainless steel bolts to mount traffic signals, pedestrian signals, or terminal compartments to the side of signal poles.

B. Mounting Brackets. Plumb or level all elements, symmetrically arrange, and securely assemble. Conceal all conductors in the poles and assembly. At each signal location, construct a terminal compartment in the bracket system as shown in the contract.

Bracket mounted signals that are post top mounted must have a terminal compartment cast with an integral slip-fitter. Signal heads mounted on luminaire standards or other tall poles must have a side-of-pole terminal compartment to bolt securely to the pole.

C. Signal Head Mounting. Mount signal heads as shown in the contract. Use internally wired plumbing devices for mounting signal heads to mast arms. Use the standard mounting for all three-section mast arm mounted signals, unless 17.5 feet (5.3 m) of roadway clearance cannot be obtained. Use an elevator plumbizer, when necessary, to obtain the 17.5-foot (5.3 m) clearance.

Use an elevator plumbizer to mount all four and five section signals.

Provide positive lock rings and fittings for all signal heads. Use rings and fittings with serrated contacts.

Cooperate with Department personal to aim the signal heads after installation prior to the signal turn-on.

D. LED Retrofit. Replace the existing traffic signal lens and reflector assemblies or existing LEDs with LED modules. Install LED modules and assemblies per manufacturer guidelines and the requirements of this section.

617.03.15 Loops

Repair saw cuts through existing pavement markings as directed.

Clean the saw cut slot before placing the loop.

Make loop wire connections in pull boxes or signal standards using soldered, waterproof splices. Excess make-up wire, lead-in or loop wire coils are not permitted. Ensure a minimum of 3 feet (1 m) of insulated conductor is coiled neatly in the bottom of the pull box for each loop.

Tag loop wire in the pull box, or signal standard if spliced there, with a permanent wire marker indicating the approach, loop number, and “input” or “output”.

The Department will verify the following loop characteristics prior to accepting the loop.

- A resistance to ground of less than 100 Megohms indicates a faulty loop.
- An Inductance of less than 100 microhenries indicates a faulty loop.
- A resistance of more than 5 ohms indicates a faulty loop.

Repair faulty loops at Contractor expense.

617.03.16 Radio Antennas

Furnish and install suitable brackets for mounting the antenna as illustrated in the contract. Be responsible for providing proper fit of the antenna and associated assembly components.

Furnish and install a broadband (125 MHz to 1,000 MHz) flange-mounted surge suppressor utilizing a UL497B listed gas tube. Furnish an arrester that is multi-strike capable and has a maximum turn on time of 2.5 ns for a 2 kV/ns surge. Furnish an arrester with an operating temperature range of −50 to 120 °F. Install the surge suppressor in the lower right hand side of the controller cabinet below the incoming power panel or as directed by the Project Manager. Ensure the surge arrestor is grounded to the cabinet ground bar.

617.03.17 Pedestrian Push Buttons

Install the push button and sign on the crosswalk side of the pole with the arrow pointing in the direction of the crosswalk.

Use ¼-inch (M6) coarse thread stainless steel bolts to mount pedestrian push buttons to the side of signal poles.

A. Accessible Pedestrian Signals. Any additional hardware, control unit, signal cable or wiring required for operation of each accessible pedestrian signal must be included as part of the accessible pedestrian signals.

At new traffic signal installations, do not activate accessible pedestrian signals until the day of the scheduled signal turn-on. Department personnel from the traffic engineering section must be present before activation to program accepted sound/volume settings.

At existing traffic signal installations, do not install accessible pedestrian signals until Department personnel from the traffic engineering section are present. Contact the Traffic Signal Engineer at least 2 weeks prior to installation to schedule a representative from traffic engineering.

When voice messaging is required, submit a custom voice message detail sheet with the electrical material submittals.

617.03.18 Span Wire-mounted Signals

Install span wire suspended signals on overhead guys providing a sag of 5% of the total span distance.

Raise overhead guys with the signals attached, to the specified sag. Adjust the guy mounting height at either or both poles, or the sag, or the rake of steel poles so that the signals are at the specified height with the proper sag and the poles are plumb when completed. Do not pull guys beyond the specified sag.

617.03.19 Bonding and Grounding

Make metallic cable sheaths, conduit, and metal poles and pedestals mechanically and electrically secure to form a continuous grounded system. Use copper wire or strap of equal

cross sectional area to an AWG No. 6 conductor for bonding and grounding jumpers. Use a No. 6 copper bonding strap, to bond standards and pedestals, attaching it to an anchor bolt and all conduit. Use a bare copper AWG No. 6 solid wire connected between the grounding lug on the standard or pedestal and the bonding strap. Ground one side of the secondary circuit of series-multiple transformers.

Ground conduit and neutrals at service points in accordance with the NEC or this Section; except use AWG No. 6 conductor or equal for grounding.

Furnish and install nonferrous ground rods or approved equals of at least ⅝-inch x 8 feet (16 mm x 2.4 m) at each service point. Install ground rods in accordance with the contract and Code requirements. Bond the service equipment to the ground rod using a ground clamp and a bare AWG metal No. 6 solid copper wire or equal enclosed in a ¾-inch (19 mm) diameter schedule 80 plastic conduit.

617.03.20 Conduit and Pull Boxes

Refer to Section 616.

617.03.21 Field Test

Conduct the following tests on traffic signal and lighting circuits with the Project Manager present before completing the work:

1. Test each circuit for continuity;
2. Test each circuit for grounds;
3. Perform a megger test on each vehicle detector loop between the loop and ground before and after sealing. The megger readings must exceed 10 megohms; and
4. A functional test that demonstrates the system functions as specified.

617.03.22 Salvaging and Reinstalling Electrical Equipment

A. **Salvaging Electrical Equipment.** Remove, clean, salvage, and stockpile or re-install existing electrical equipment as specified.

Underground conduit, conductors, and foundations not reused are the Contractor's property and must be removed. The materials may, with written approval, be abandoned in place.

Replace all electrical equipment damaged or destroyed during salvage operations at Contractor expense.

B. **Reinstalling Salvaged Electrical Equipment.** Furnish and install all necessary materials and equipment to complete the new installation.

C. **Remove and Reset Existing Poles and Standards.** Remove the specified poles and standards, including their attachments from the existing locations and reset them at the specified new locations. Demolish the top of foundations to be abandoned to 2 feet (610 mm) below the finished grade. Backfill, compact and re-grade the area to the finished grade. Remove the existing wiring from the poles and standards and replace with new wiring, making all connections. Furnish 4 high strength anchor bolts, as specified, and 2 nuts and 2 washers for each bolt for the new foundation. Ensure the top 12 inches (305 mm) of the bolt is galvanized. Install a new foundation in accordance with Subsection 617.03.5 at the specified locations. Meet all the applicable Section 617 requirements for the reset installation.

617.03.23 Road Closure Gate Assemblies

Furnish and install road closure gates as shown in the contract. Include all necessary items and work required to erect the road closure gates as shown in the contract as part of this bid item. The cost of foundations, pull boxes, luminaire assemblies, service assemblies, conduit and

cables/conductors from the service assemblies to the road closure gate(s) are included under separate bid items.

Include the Type 3R cabinet mounted on the road closure gate and internal components thereof as part of this bid item. Furnish a dry type core and coil transformer with 120 volt primary / 12 volt secondary in accordance with UL standard 506. Size of the transformer is a nominal 2.79"(H) x 3.29"(W) x 3.97"(D).

Furnish and install gate arm lights that utilize red LEDs and have an operating range of 8.5 to 12 VAC (input voltage).

Furnish vehicular traffic signal heads in accordance with Subsection 703.08.

617.03.24 Overheight Detectors

Install and adjust the detectors on the poles following the manufacturer's recommendations.

Furnish the transmitter, receiver, 2 poles, anchor bolts, nuts, washers, all necessary wiring and connectors for this item.

617.04 METHOD OF MEASUREMENT

617.04.1 Lump Sum Basis

When a traffic signal and lighting system or portion thereof is specified in the contract on a lump sum basis, the system is measured by the lump sum.

617.04.2 Traffic Signals and Lighting

Measurement for traffic signals and lighting is made as follows:

1. Conduit and pull boxes are measured in accordance with Subsection 616.04.
2. Concrete foundations are measured by the cubic yard (m^3) based on plan dimensions. Deductions are not made for the concrete displaced by reinforcing steel, anchor bolts, and conduit. Foundation work includes backfill, furnishing reinforcing steel, electrical bonding, and restoring the surface around the foundation.
3. Cables, conductors, and treated timber poles are measured by the foot (m) in place. Unless otherwise specified, conductors and cables are measured from termination to termination.
4. The following items are measured by the unit:
    - Advanced warning flasher
    - Controller cabinet pedestals
    - Controllers
    - Detector loops
    - Detector loop amplifiers
    - Emergency pre-emption systems
    - Luminaire assemblies
    - Overheight detector
    - Other component parts as specified in the contract
    - Pedestrian push buttons
    - Pedestrian signals
    - Photoelectric controls
    - Remove and reset existing pole (foundation measured separately)
    - Road closure gate assemblies
    - Service and control assemblies
    - Signal standards
    - Standards
    - Traffic signals

617.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Cables	Foot (m)
Concrete	Cubic Yard (m^3)
Conductors	Foot (m)
Conduit and Pull Boxes	See 616.05
Controllers	Each
Controller Cabinet Pedestals	Each
Detector Loops	Each
Detector Loop Amplifiers	Each
Emergency Pre-emption Systems	Each
Luminaire Assemblies	Each
Overheight Detector	Each
Pedestrian Signals	Each
Pedestrian Push Buttons	Each
Photoelectric Controls	Each
Pull Boxes	Each
Road Closure Gate Assembly	Each
Remove and Reset Existing Pole	Each
Standards	Each
Service and Control Assemblies	Each
Signal Standards	Each
Traffic Signals	Each
Traffic Signal and Lighting System	Lump Sum
Treated Timber Poles	Foot (m)
Other Components as specified in the contract	Each

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract and to furnish a complete and operational system.

SECTION 618
TRAFFIC CONTROL

618.01 DESCRIPTION

This work is the furnishing, installing, and maintaining of traffic signs, barricades, lights, signals, pavement markings, and other specified traffic control devices. It includes flagging and pilot car operation and furnishing and applying water for dust control.

618.02 MATERIALS

Furnish materials in accordance with the contract, the MUTCD, and the following subsection requirements:

Advance Warning Arrow Panels 715.03
Flagger Ahead Warning Signs..... 715.05
Portable Sign Support Assemblies 715.02
Retroreflective Sheeting 704.01.10
Signs and Channelizing Devices 715.01
Temporary Striping Tape..... 714.01
Temporary Striping Tabs..... 714.02
Temporary Waterborne Traffic Paint 714.03
Warning Lights 715.04

Furnish work zone traffic control devices that meet the NCHRP 350 or the MASH crash test requirements.

618.03 CONSTRUCTION REQUIREMENTS

618.03.1 Purpose and Prosecution of Work Zone Traffic Control

Schedule construction and provide work zone traffic control to accomplish the following:

1. Provide the protection, safety, and convenience for motorists, bicyclists, pedestrians, and other roadway users;
2. Ensure the protection and safety of construction personnel;
3. Advance the project work in the most beneficial manner to the public; and
4. Provide mobility for highway users.

Provide work zone traffic control for all construction activities on the roadway and within the clear construction zone and other specified areas. The construction clear zone is the area within 30 feet (9.2 m) of the edge of a traffic lane.

Furnish work zone traffic control in accordance with the contract requirements, the MUTCD, and the approved traffic control plan.

618.03.2 Traffic Control Plan

The Detailed Drawings and the MUTCD provide traffic control requirements for the contract.

A. **Traffic Control Plan Requirements.** Furnish a traffic control plan addressing the proposed operations to take place a minimum of 2 weeks prior to beginning the associated construction activities. Address contingencies in the submitted plan. Deviations or modifications from the submitted traffic control plan may be made to address field conditions if approved by the Project Manager. Limit inconvenience to the traveling public as much as practicable and account for the safety of both the traveling public and project personnel. The Detailed Traffic Control Plan for the proposed activities must consist of the following:
   1. **Contract Specific Drawings.** Provide contract specific traffic control drawings that include proposed traffic control configurations. Provide drawings with the same level

of detail as in the MUTCD and the Detailed Drawings. Identify the type and location of work zone traffic control devices proposed for use.

2. **Special Features.** Identify the location and purpose of proposed flaggers, temporary signals, pilot car use, business access signs, authorized vehicle median crossings, temporary median crossings, interchanges, interstate crossovers and detours. Detours not identified in the contract are subject to the approval of the Project Manager.
3. **Sequencing Details.** Provide details for each phase in the sequence of operations and for each type of construction operation. At a minimum, include details for earthwork operations, gravel placement, paving, seal and cover, striping, bridge work, detours, permanent sign installation, guardrail work, temporary blunt end protection, temporary access breaks, equipment crossings, and any other work within the clear zone. Sequence the work such that equipment does not operate against the flow of traffic without the approval of the Project Manager.
4. **Continuous Traffic.** Provide details that ensure the continuous flow of traffic through the work zone.
    - Maintain access to and from the premises of adjacent property owners and approaches at all times.
    - Do not stop traffic in both directions at the same time unless approved by the Project Manager.
    - Maintain a minimum of one lane of traffic at all times.
    - Return traffic to normal two lane operation at night and on nonworking days.
    - Identify measures to provide suitable passage of mail delivery and scheduled school bus runs within the project limits.
    - Address traffic control measures for peak travel times on urban projects, signal replacements, and increased traffic due to public events on or near the project.
5. **Off-highway Vehicle (OHV) Separation.** Identify proposed measures and devices to keep articulated trucks, scrapers, and other OHVs separated from traffic. Separate OHVs from traffic by means of separate haul roads.

    Do not operate OHVs faster than 35 mph or the speed limit signed for the traveling public, whichever is lower. If any OHV operator violates this requirement or drives in an unsafe or erratic manner, upon written notice by the Project Manager, this driver must be removed from the project as an OHV operator.

    If a separate haul road is not physically possible, submit an alternate plan to the Project Manager for approval. In order to be considered, the plan must meet the following requirements at a minimum:
    - The traveling public has the right-of-way.
    - When an OHV approaches vehicles, the OHV must come to a complete stop until all vehicles pass, including traffic lines led by pilot cars.
    - Equip the OHVs with a back-up alarm, back-up camera, and warning light.
6. **Emergency Vehicles/Situations.** Identify proposed measures to manage traffic delays due to incidents within the project limits and to accommodate emergency vehicles into and through the project limits. These measures must be presented to any local governments, tribes, or jurisdictions affected by the project.
7. **Pedestrian Traffic Control.** Identify proposed measures and routes to maintain pedestrian traffic control if there are any pedestrian facilities within the project limits. Provide ADA compliant temporary measures for pedestrian facilities at all times. Do

not close pedestrian routes without Project Manager approval. If closures of pedestrian routes are required, identify the proposed measures to warn, direct, and guide pedestrian traffic.

8. **Certifications.** Submit a completed form CSB618_02 prior to placing traffic control devices. At the Project Manager's request, provide certification that each type of traffic control device in use or to be used on the project meets retro-reflectivity and NCHRP 350 or MASH requirements.
9. **Written Narrative.** Provide a WN that details the proposed traffic control configuration for the project's construction operations. The WN must consist of the following:
   - **a.** Supporting details and explanation for the traffic control configuration proposals.
   - **b.** Detailed descriptions of the proposed traffic control for each separate operation of work.
   - **c.** A description of the construction sequence of operations and how the traffic control plan will accommodate each sequence. Ensure that the traffic control sequence of operations corresponds with the project schedule as described in Subsections 108.03.2 and 108.03.3.
   - **d.** Schedule of maintenance of traffic control devices.

B. Traffic Control Plan Updates. Submit an updated traffic control plan that represents proposed activities. If the traffic control plan previously provided to the Project Manager is current and changes to traffic control operations are not anticipated, provide written notification to the Project Manager of this information. Failure to submit an updated traffic control plan on time and in the manner required renders the traffic control plan unacceptable. Submit updates to the traffic control plan to the Project Manager at the following times:

1. On the 1st of each month for projects located in the Billings, Glendive, or Great Falls districts. On the 15th of each month for projects located in the Butte or Missoula districts.
2. When changes to the original construction operation plan requires a change to the traffic control plan. Coordinate the revision of the traffic control plan with the submission of the project schedule updates per Subsections 108.03.2 and 108.03.3. If the traffic control is not proceeding consistent with the Contractor's most recent traffic control plan, the Project Manager may require that the Contractor submit an updated traffic control plan that accurately reflects the Contractor's construction operations. If a required updated traffic control plan is not received or operations are not being conducted as per the current traffic control plan, the Project Manager may issue a project shut down order. Submit an updated traffic control plan prior to continuing work. Shut down orders due to the failure to meet traffic control requirements will not be considered as justification for additional compensation or contract time.

618.03.3 Traffic Control Conference

Attend a work zone traffic control conference organized by the Project Manager before starting work that alters the public's use of any roadway. The provisions for traffic control proposed for each stage of construction will be reviewed.

618.03.4 Traffic Control Reviews

Designate personnel to be responsible for traffic control work and its continuous surveillance. The designees must be available 24 hours a day to respond to calls concerning damage to traffic

control devices from any cause. Provide the names and telephone numbers of the persons responsible for the surveillance.

The Project Manager and the designees will conduct periodic reviews of the traffic control throughout the work to ensure compliance with the traffic control plan. The reviews will be conducted at night, during adverse weather conditions, when construction work is active and inactive, and at other times as necessary.

618.03.5 Traffic Control General Requirements

Meet all traffic control plan requirements before starting work affecting the roadway. Use devices that are new or like new in condition.

Properly maintain, clean, and operate devices when in use. Immediately remove the devices when they are no longer applicable to the work.

Install traffic control devices in accordance with manufacturer's recommendations or instructions.

Immediately remove or cover the entire sign face of non-applicable signs. Use coverings that are opaque, non-reflective, and securely fastened to eliminate visibility of the sign face. Cover signs with shapes having a specific meaning, such as STOP and YIELD, from both sides in a manner that masks the shape. Use materials of sufficient durability to resist deterioration due to weathering and atmospheric conditions. Do not use tape, paper, garbage bags, or cardboard for the covering. Do not rotate signs.

Remove portable traffic control devices when not in use. Limit the number of portables towed at a single time as necessary for safe travel.

Immediately remove existing signs and other traffic control devices on the present traveled way or on connecting state or federal routes to be abandoned when they no longer apply. Ensure roadways are always appropriately signed. Turn removed signs over to the Department.

Provide functional traffic lanes with signing and channelizing appropriate to the roadway condition at the close of each work day.

For long-term stationary operations (greater than 3 days), remove pavement markings in the traveled way that are no longer applicable in accordance with Subsection 620.03.10. Minimize pavement scarring when removing pavement marking material. Do not paint over existing pavement markings with black paint or spray with asphalt as a substitute for removal or obliteration.

Provide the traffic an un-obscured view of the traffic control devices at all times.

Store or park construction equipment, vehicles, materials, and debris at least 10 feet (3 m) behind guardrail or outside the clear zone. When this is impractical, use approved warning devices and protective measures to delineate the item. Only equipment and materials for immediate use or incorporation into the work may be placed within the clear zone.

Store unused traffic control devices outside the clear zone.

Contractor furnished traffic control devices are the Contractor's property. Traffic control devices furnished by the Department or installed on a force account basis are the Department's property.

Repair or replace all damaged traffic control devices at Contractor expense.

If the Contractor fails to provide the required traffic control, the Project Manager will provide the work and deduct the costs from monies due or that may become due the Contractor.

618.03.6 Access Breaks

Submit a written proposal on the "Request for Access Break Approval" form, available from the Project Manager, for temporary breaks in Interstate access control or R/W fences for approval. See the form for access breaks requiring FHWA approval. Include all information requested on the form. Interstate access breaks used for non-interstate contracts are prohibited.

Provide a written narrative that describes how the traffic control plan addresses traffic safety and minimizes delay to the mainline traffic. Ensure the plan meets the MUTCD and the departments Detailed Drawings requirements.

Do not begin work on the access break until the Department has returned an approved proposal. Obtain the Project Manager's approval for all modifications to the original plan and submit the changes in writing. Excluding traffic control, assume all costs associated with construction, maintenance, removal of the access break, and restoration of the area once the access break is removed.

618.03.7 Crossing, Entering, and Using Roadways

A. General. Construct temporary approaches and crossings with 10H:1V side slopes and include drainage provisions.

Remove all temporary approaches and median crossings once the work is complete. Restore and re-seed disturbed areas.

Do not use areas within the R/W as borrow sources or disposal areas for the construction or restoration of temporary approaches.

Provide the means and traffic control devices to allow safe crossings whenever articulated trucks, scrapers, and other off-highway vehicles are crossing the roadway being used by traffic as included in the traffic control plan and approved by the Project Manager in advance of operations. Operate registered and licensed hauling units, such as dump trucks, belly dumps, side dumps, etc. with the flow of traffic. Do not operate any hauling units on roadway shoulders.

B. Controlled Access and Multiple-lane Roadways. Use frontage roads and interchanges for equipment access to controlled access highways whenever possible.

Do not stop the general traffic on one-way roadways for the convenience of haul units without Department approval. Use interchanges or a series of appropriate lane closures at authorized vehicle median crossings or temporary median crossings for haul-unit operations on one-way roadways.

Haul unit turning movements are restricted to right-turn movements only when there is access to the project by frontage roads or where left-turn movements by hauling units would pose a hazard to the traveling public.

The use of authorized vehicle median crossings or temporary median crossings will not be allowed unless stated in the contract. If the construction of temporary median crossings is allowed as part of the contract, their use will be subject to all requirements of Section 618.

Submit an updated traffic control plan detailing the use of authorized vehicle median crossings or the construction of temporary median crossings, including the following:

1. The distance between any 2 median crossings, including interchanges, authorized vehicle median crossings, and temporary median crossings must be at least 2 miles (3.2 km) unless a shorter distance is approved by the Department.
2. Median crossings must be at least 1,000 feet (305 m) from structures and have a minimum 1,500 feet (458 m) of sight distance at 3.5 feet (1.1 m) above the pavement.
3. Sign median crossings as specified in the contract.
4. When not in use, protect crossings through median barriers by one of the following methods:
   - **a.** Place an approved impact attenuator at each end of the barrier opening.
   - **b.** Close the inside lanes to traffic with a controlled lane closure.
   - **c.** Close the opening by replacing and pinning the median barrier.

C. Two-lane Roadways. Always provide at least one functional lane for traffic.

Meet Table 618-1 requirements.

TABLE 618-1
TRAFFIC CONTROL REQUIREMENTS FOR HAULING UNITS ENTERING OR CROSSING 2-LANE ROADWAYS

Average Daily Traffic (ADT)/Load Frequency	Traffic Control Requirement
less than 2,000 ADT	stop hauling units for traffic
2,000 to 5,000 ADT/ Less than 50 loads per shift	stop hauling units for traffic
2,000 to 5,000 ADT/ More than 50 loads per shift	provide flaggers to control traffic
more than 5,000 ADT	provide flaggers to control traffic

Limit the number of locations at which flagging is provided at roadway crossings, entrances or exits to:

1. One location per material source or plant site entrance or exit; or

2. Roadway crossings approved by the Project Manager in the Traffic Control Plan.

The Project Manager may adjust the ADT or load frequency at which flagging is required in Table 618-1. The Project Manager may add or reduce flagging locations to ensure the safety and mobility of the traveling public and workers within the construction limits.

Where flaggers are not required by Table 618-1, the Contractor may use flaggers and traffic control, with Project Manager approval, at the Contractor's expense.

618.03.8 Traffic Control at Drop-off Areas

When existing slopes are 3H:1V or flatter, temporarily fill constructed drop-offs within 30 feet (9.2 m) of the edge of travel lanes used by traffic to a 3H:1V slope or flatter at the close of work each day. Furnish and install, at Contractor expense, traffic control devices for slopes not temporarily filled to a 3H:1V or flatter.

When existing slopes are steeper than 3H:1V, temporarily fill constructed drop-offs within 30 feet (9.2 m) of the edge of travel lanes used by traffic that matches or is flatter than the existing slope at the close of work each day. Furnish and install at Contractor expense, traffic control devices for slopes not temporarily filled to match, or that are steeper than the existing slope.

Temporary filling of drop-offs protected by positive barriers is not required.

Determine device spacing using the following formula:

$$\text{Factor in Feet (m)} = \frac{(A \times C \times W)}{(S \times D)}$$

Where:

A = ADT adjustment
C = Degree of Curvature (metric radius factor)
W = Recoverable width, 4H:1V or flatter, in feet (m) from the drop-off to the far edge of the adjacent traffic lane(s) with the same direction of traffic
S = Posted speed in MPH (km/h)
D = Average drop-off depth in inches (mm)

Use the C factors in Table 618-2 for drop-offs outside of horizontal curves.

TABLE 618-2
C - FACTORS FOR DROP-OFFS ON THE OUTSIDE OF HORIZONTAL CURVES

Degree of Curve (English Radius)	C	Metric Radius	C
less than 2 (greater than 2,865 feet)	5,800	greater than 900 m	241,000
2 to less than 4 (2,865 feet to greater than 1,433 feet)	5,200	900 m to more than 450 m	218,000
4 to less than 6 (1,433 feet to greater than 955 feet)	4,900	450 m to more than 300 m	203,000
6 or greater (955 feet or less)	4,500	300 m or less	188,00

Use the C - factor for curves with a degree of curve less than 2 (greater than 900 m) for drop-offs on the inside of horizontal curves.

Use the ADT adjustment from Table 618-3.

TABLE 618-3
ADT ADJUSTMENT FACTOR

ADT	A
under 750	1.50
750 – 1,499	1.30
1,500 – 5,999	1.00
over 6,000	0.90

Round the computed spacing to the nearest 10 feet (3 m).

Use Table 618-4 to determine the device type using the spacing factor.

TABLE 618-4
TRAFFIC CONTROL DEVICE BASED ON SPACING FACTOR

Spacing Factor	Device Type
400 feet (122 m) or greater	Flexible guideposts or standard delineators
40 to 390 feet (12 to 119 m)	Type 2 object marker
20 to 30 feet (6 to 9 m)	Type C steady burn warning lights on alternate panels
Less than 20 feet (6 m)	Positive barrier, if 48 hours lapses before filling

Space devices at the spacing factor. If W is less than 14 feet (4 m), do not exceed spacing in feet that is double the posted speed in miles per hour.

Do not space Type 2 object markers less than 40 feet (12 m).

618.03.9 Traffic Control for Paving and Milling Operations

Provide flaggers at paving and milling machines. Locate the flagger 100 to 150 feet (30 to 46 m) upstream from the machines.

Meet the following requirements for night paving operations:

1. Place a 48 x 48-inch (1,220 x 1,220 mm) “NIGHT PAVING AHEAD” warning sign in advance of each warning sign series.
2. Ensure all personnel working on or adjacent to traveled lanes are wearing Class 3 apparel in accordance with Subsection 107.06.

Apply temporary striping in accordance with Subsection 620.03.5. Place temporary striping at the end of each working day in which a full width section is completed before opening to traffic.

Do not use lane closures in place of temporary striping. Traffic control beyond the end of the work day, unless ordered by the Project Manager, is at Contractor expense. The Project Manager may suspend paving operations if a lack of temporary striping results in lane closures longer than the length of a day's paving.

618.03.10 Reserved

618.03.11 Traffic Control for Seal Coat Operations

A. Two-lane Two-way and Multiple-lane Two-way Roadways. Place "LOOSE GRAVEL" (W8-7), "DO NOT PASS" (R4-1), and "SPEED LIMIT 35" (R2-1) signs, at the beginning of each work zone. Place the same sign combination for each direction of travel at 2-mile (3.2 km) intervals within the work zone. Remove "LOOSE GRAVEL" (W8-7) signs once loose cover material is swept. Leave remaining signs in place until pavement markings within the zone are completed.

Control traffic with pilot cars until initial sweeping is completed for a maximum of 72 hours. The 72-hour period associated with pilot car use for each section begins once the seal and cover has been placed and rolling is complete. For this work, a section is defined as the area of seal coat completed in each day of production.

Traffic control beyond these 72 hours, unless ordered by the Project Manager, is at Contractor expense.

B. Interstate Highways. Use lane closures and lane control devices for seal and cover operations on Interstate highways. Do not use pilot cars unless approved by the Project Manager.

Place "LOOSE GRAVEL" (W8-7) and "SPEED LIMIT 45" (R2-1) signs at the beginning of each work zone. Sign both sides of the roadway. Place the same sign combination at 2-mile (3.2 km) intervals within the work zone. Remove "LOOSE GRAVEL" (W8-7) and "SPEED LIMIT 45" (R2-1) signs once loose cover material is swept.

Traffic control beyond these 72 hours, unless ordered by the Project Manager, is at Contractor expense.

618.03.12 Traffic Control for Striping Operations

Provide the following traffic control for striping operations not performed under closed lane or pilot car situations.

1. Furnish and operate a shadow vehicle equipped with a truck-mounted attenuator in accordance with Subsection 618.02 conforming to appropriate test levels. Position the truck to follow within 150 to 1,000 feet (45 - 305 m) on pavement marking removal and application. When placing or removing traffic cones that protect the pavement markings, use a vehicle with a truck-mounted attenuator or follow with a shadow vehicle possessing a truck mounted attenuator.
2. Equip shadow vehicles with an arrow board facing rear-approaching traffic.
   - **a.** On multiple-lane roadways, place the arrow board display in lane shift mode (sequential arrow mode).
   - **b.** On two-lane two-way roadways, place the arrow board in a hazard warning mode not displaying the lane-shift mode
3. If peak hours are specified in the contract, provide the Project Manager a schedule of striping operations at least 48 hours prior to striping. Perform striping operations during off-peak hours in order to minimize impacts to the traveling public unless approved differently by the Project Manager.
4. Include all costs associated with this work in the striping bid item.

5. If requested by the Project Manager, provide a WN identifying the proposed traffic control devices to be used for striping operations. If the Contractor and Project Manager agree that additional traffic control devices not listed in items 1 through 3 are warranted; the additional traffic control devices will be measured and paid in accordance with Subsections 618.04 and 618.05.

Failure to properly notify the Project Manager or provide adequate traffic control renders the striping operation unacceptable and unauthorized. Unacceptable or unauthorized work will be addressed in accordance with Subsection 105.12.

618.03.13 Traffic Control Device Location and Installation

Lay out the standard distances for traffic control devices to within an accuracy ± 5%. The Project Manager may direct adjustments to the device locations to fit site conditions.

Display all signs with the legend not more than 5° (1-inch per foot) (25 mm per 305 mm) from the horizontal plane.

Display the signs at the required mounting height with the hinged signs closed or non-hinged signs removed when not applicable.

The bottom of signs mounted on barricades or other portable devices must be at least 1-foot (305 mm) above the shoulder of the travelled way.

Use only one type of reflective sheeting in each sequence or group of signs or devices.

Stabilize sign trailers to prevent movement by wind or passing vehicles.

Mount work zone traffic control signs to posts when they are to remain at the same location for more than 3 consecutive days. Trailer-mounted W20-7a (flagger ahead) signs with generators are excluded from this requirement.

Ensure the G20-1 (ROAD WORK NEXT (X) MILES) and G20-2 (END ROAD WORK) signs do not conflict with other construction signing. Remove these signs when directed.

Install work zone traffic control devices sequentially toward the work area beginning with the device located farthest from the work area. Remove sequentially in the opposite direction.

Use arrow boards in the sequential or flashing-arrow mode to supplement channelizing devices and standard signing when one or more lanes of a multiple-lane roadway are closed.

Do not use arrow boards in the sequential or flashing-arrow mode for lane closures or at flag stations on two-lane two-way roadways.

Do not use flexible guide posts in place of the specified hazard identification devices for shoulder drop-offs or other hazards adjacent to the travel lanes. Refer to Subsection 618.03.8.

Flexible reflectorized warning signs are acceptable for daylight hour use.

Do not use traffic cones for channelization devices.

Do not use steel barrels for work zone traffic control.

Ensure that construction zone and work zone speed limits signs comply with the desired minimum speed limit values in Table 618-5. The Project Manager may direct adjustments to the speed limits or device locations to fit the conditions.

Submit a written recommendation if the Contractor's proposed limits differ from those in Table 618-5. Give the locations and reasons for limits differing from those provided in Table 618-5. Reasons should be based upon the conditions of the roadway and the ability of traffic to flow safely and uniformly through the construction zone or activity area. The Project Manager will provide a written response to the recommendation, detailing the speed limit signs to be used.

TABLE 618-5
TRAFFIC CONTROL SPEED LIMITS IN CONSTRUCTION ZONES

Speed Limit	Activity Description
Existing	-Construction activities are 30 feet (9.2 m) beyond the edge of the traveled way and construction vehicles are not crossing the traveled way. -Construction activities suspended during winter shutdown or prolonged periods of time, based upon roadway conditions. -Holiday weekends and no work days when work is not in progress and PTW has not been impacted. -Interstate merging tapers. -Survey crew activities not on the PTW or parking shoulder.
65 mph	-Two-lane two-way traffic on interstates. -One-lane one-way traffic on interstates with no activities in closed lane.
55-65 mph	-One-lane one-way traffic on interstates with activities encroaching on closed lane. -Two-lane two-way non-interstate traffic traveling on non-impacted roadway surfaces when construction activities are suspended or not present, based upon roadway conditions.
45-55 mph	-Interstate crossovers. -Two-lane two-way non-interstate traffic traveling on impacted roadway surfaces when construction activities are suspended or not present, based upon roadway conditions. -Two and four-lane roadways with construction activities within the clear zone but not encroaching on the shoulders and/or driving lanes.
45 mph	-Seal coat operations on interstates, increased to 55 mph once initial brooming roadway is completed. -Interstate roadways with construction activities on shoulders.
35 mph	-Seal coat operations on two-lane two-way and multiple-lane two-way roadways, increased to 45 mph once initial brooming roadway completed. -In advance of flagging stations or temporary traffic signals. -Interstate and multiple-lane roadways with construction activities in closed lane(s), within the work zone only. -Two-lane two-way roadways with construction activities on shoulders.
25 mph	-Temporary diversions on graveled surfaces. -Pilot car queues. -Survey crew activities within the traveled way. (non-interstate) -Two or multiple-lane roadways in an urban area with construction activity in a lane, within the work zone only.

618.03.14 Flagging Operations

Provide flaggers that are currently certified by the Montana flagger training program, the ATSSA flagger program, or Idaho, Oregon, or Washington state flagger training programs. Flaggers are required to carry proof of flagger certification and present to the Project Manager when requested.

Provide flaggers that are competent and equipped as required in the Department's *Flaggers Handbook* furnished by the Department.

Maintain constant radio contact between flaggers at each end of a work zone and pilot vehicles when visual contact is not possible. Use two-way V.H.F. or U.H.F. FM radios, operable in the terrain.

Place the W20-7a (flagger ahead) warning sign signals so the LEDs are visible 1,000 feet (305 m) in advance of the sign. Place and operate the sign only when a flagger is at the flag station.

Provide a second flagger when more than 10 vehicles are stopped at a flag station 50% of the time to advise traffic of the delay. Place an additional W20-7a sign 500 to 1,000 feet (153 to 305 m) ahead of the average end of the stopped vehicle line.

A. Nighttime Flagging Requirements. Nighttime flagging operations are those that occur from sunset to sunrise. Provide the following enhancements when nighttime flagging is used:

1. **Illuminated Flagging Stations.** Use portable light plant(s) or portable balloon light(s) to illuminate flagging stations with a minimum luminance level of 10 foot-candles. Locate the illumination source so as not to create a hazard to the travelling public and to minimize glare to oncoming drivers. Shield light as necessary to prevent overflow onto adjacent properties. When requested by the Project Manager, use a luminance meter with a minimum accuracy of 5%, capable of measuring with a minimum resolution of 0.1 lux to take a luminance measurement at the flagging station. Take the measurement on a horizontal plane 3 feet (915 mm) above the roadway surface.
2. **Illuminated Flagger Paddles.** Flagging paddles must be of octagonal shape at least 18 inches (455 mm) wide with letters at least 6 inches (150 mm) high, fixed to a rigid handle. Use signs having red colored flashing LED lights inside the STOP face and amber colored flashing lights inside the SLOW face, having a flash rate of 50 to 60 flashes per minute. LED arrangement must display an octagonal shape for STOP and a diamond shape for SLOW. The power source must be fully enclosed within the pole section.
3. **Garments.** Use high visibility safety apparel that meets the Performance Class 3 requirements of the ANSI/SEA 107 publication entitled *American Standard for High Visibility Safety Apparel and Headwear*.
4. **Flashing Flagger Sign.** The W20-7a sign must be illuminated with amber LEDs in accordance with Subsection 715.05. Subsection 715.02 requirements apply for mounting the portable signs and the illumination power source.
5. **Temporary Transverse Portable Rumble Strips.** Place 3 temporary transverse portable rumble strips 3 to 4 feet (1 to 1.2 m) apart at the location of the W3-4 “Be Prepared to Stop” sign. Use temporary transverse portable rumble strips that meet the following:
   - **a.** Provide significant audible and vibratory alerts to drivers;
   - **b.** Dimensions are a minimum of 10 feet (3 m) long, 1-foot (305 mm) wide and ¾-inch (19 mm) thick;
   - **c.** Maintains position on roadway without the use of adhesives or fasteners;
   - **d.** Maintains rigidity with no curling;
   - **e.** A bevel on the leading edge within the range of 11-13 degrees;
   - **f.** Made of flexible polymer material with a non-slip surface;
   - **g.** Able to function on wet surfaces; and
   - **h.** Capable of being installed and removed without any auxiliary equipment or machinery.

618.03.15 Pilot Car Operations

Use pilot cars as specified. Equip the cars with amber flashing lights and the G20-4 sign designated in Part VI of the MUTCD. Mount the sign in a conspicuous position on the vehicle with the bottom sign edge at least 6 feet (1.8 m) above the ground.

Schedule and cycle pilot vehicles to depart each flag station at maximum 15-minute intervals.

618.03.16 Water for Dust Control

Furnish, haul, and apply dust control of water using tank trucks equipped with spray systems that uniformly distributes the water over the application area. Discontinue watering as directed.

618.04 METHOD OF MEASUREMENT

The contract quantities for traffic control devices, temporary pavement markings, flagging, and pilot car operation are an estimate only and may vary from the actual quantities used or required in the contract. No additional compensation is considered or allowed due to these quantity differences.

Signs and devices must meet standards outlined in the current ATSSA *Quality Guidelines for Temporary Traffic Control Devices* to be measured for payment. Failure to adequately maintain and clean traffic control devices in use renders the traffic control operation unacceptable.

The contractor, upon receiving written or verbal notification, will be given 24 hours to make the traffic control operation compliant. Traffic Control directly affecting the safety of the public must be attended to immediately. The Project Manager may deduct 10% of the daily traffic control units due to traffic control operations not meeting the requirements set forth in Section 618.

Failure to submit an updated traffic control plan on time and in the manner required renders the traffic control plan unacceptable. The Department may withhold 10% of each monthly progress estimate for failure to submit an updated traffic control plan on time and in the manner required. Payment withheld for violation of the traffic control plan requirements will be included in the next progress estimate following the Contractor's submission and the Project Manager's approval of the updated traffic control plan.

Providing the traffic control plan is incidental to and included in payment for the traffic control bid item.

618.04.1 Traffic Control - Units

Traffic control devices are measured by the units of traffic control devices used and accepted. A unit of traffic control device is the base value used for establishing the relative value of each type of traffic control device. The relative value of each traffic control device in units is shown in the Traffic Control Rate Schedule.

618.04.2 Traffic Control - Lump Sum

Traffic control is measured by the Lump Sum. Provide a written request for compensation resulting from a change in scope of work, differing site conditions or additional work. Quantities approved by any requested change will be measured by the units of traffic control devices used and accepted.

618.04.3 Flagging

Flagging is measured by the hour for the actual number of approved flagging hours provided on the project for each flagger used.

Travel time for flaggers to and from the project is not measured for payment.

618.04.4 Pilot Car Operation

Pilot car operation is measured by the hour for the approved number of hours of operation for each properly equipped pilot car.

618.04.5 Reserved

618.04.6 Items Not Eligible for Separate Payment

The following items are not measured or paid for separately:

- Amber flashing or strobe lights on equipment, vehicles, and hauling units;
- Impact attenuators for median barrier openings;
- Permits and costs relating to project access;
- Construction, drainage, maintenance, removal, restoration and reseeding of areas used for temporary roads, approaches, and crossovers;
- Radios for flaggers and pilot vehicles;
- Illumination of work areas;
- Reflectorized safety equipment, garments, and headgear;
- Vehicle-mounted arrow boards on stripers and shadow vehicles;
- Replacing temporary pavement marking tabs and tape destroyed by traffic;
- Temporary pavement marking tabs used for seal coat operations;
- Costs to clean and maintain installed traffic control devices;
- Devices not properly maintained;
- Devices placed beyond 1,500 feet (458 m) of the work termination point for that day;
- Adjustments or moving of devices that were initially installed improperly;
- Adjustments or moving of devices solely to aid contractor operations, such as temporarily relocating devices to allow equipment access;
- Additional traffic control costs resulting from corrective actions on items failing to meet contract requirements;
- Traffic Control at commercial pits; and
- Other miscellaneous materials and equipment required for proper traffic control that are not included in the Traffic Control Rate Schedule.

618.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Traffic Control	Unit
Traffic Control	Lump Sum
Temporary Pavement Markings	Mile (km)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

618.05.1 Traffic Control – Units

Traffic control devices are paid for at the contract unit price per unit of traffic control devices. The units of each type of traffic control device paid for are calculated by multiplying the measured quantity of each device by the value per each unit shown in the traffic control rate schedule.

Payment for traffic control devices is made for each setup directed by the Project Manager.

Replacing properly installed traffic control devices destroyed by traffic is paid for at the contract unit price per unit of traffic control devices.

Payment for barricades and drums includes the required ballast.

Payment for signs mounted on barricades is made only for the original mounting.

Payment for flashing arrow boards is made only for the actual hours of operation approved by the Project Manager. Payment includes the cost of operating the trucks or trailers on which the arrow boards are mounted.

Store devices in approved staging areas with a maximum of one staging area per 3-mile segment of roadway. Detail the staging areas in the traffic control plan submitted for the Project Manager's approval. All devices not stored in the approved staging areas will be paid for at Category #2 payment amounts.

Payment for traffic control devices will be made in accordance with one of the following two categories:

1. **Category #1 - Standard Installation.** The following movements constitute a "standard installation":
   - Initial device placement and setup.
   - Device relocation and setup requiring the device be loaded into, or hitched to, a truck or vehicle for movement to a new location.
2. **Category #2 - Adjustments.** The manual moving of a device, conducted by dragging, carrying, etc. of the device, required to move it to a new location of a traffic control operation.

Payment for traffic control devices will be paid for at the rates listed in Table 618-6 according to the category and device type.

TABLE 618-6
TRAFFIC CONTROL RATES BASED ON CATEGORY AND DEVICE TYPE

Category #	Device	Payment amount percent
1	All Category 1 devices	100
2	Type III barricades	25
2	All other Category 2 devices	50

618.05.2 Traffic Control – Lump Sum

Payment for all costs associated with performing traffic control is included in the lump sum bid for Traffic Control. Payment for quantities approved by any requested change will be in accordance with the Traffic Control Rate Schedule, and will be paid under Traffic Control - Fixed.

Partial payments for Traffic Control will be monthly based on the lump sum contract price at the rates listed in Table 618-7.

TABLE 618-7
TRAFFIC CONTROL - LUMP SUM PROGRESS PAYMENTS

Progress Estimate Payment	Percent Of Lump Sum Item
First partial payment after start of contract work	35
Estimate paying 25% of original contract amount	25
Estimate paying 50% of original contract amount	20
Estimate paying 75% of original contract amount	10
Final partial payment after Conditional final acceptance date	Remainder of traffic control contract price

SECTION 619
SIGNS AND DELINEATORS

619.01 DESCRIPTION

This work is furnishing, fabricating, erecting, removing, and resetting signs and delineators.

619.02 MATERIALS

Furnish materials in accordance with the Detailed Drawings and the following subsection requirements:

Delineators..... Detailed Drawings
Flexible Delineators..... 704.03
Signing Material 704.01

619.03 CONSTRUCTION REQUIREMENTS

619.03.1 Definitions

The following definitions apply to the signing work in the contract.

A. New. Signs designated “New” are to be furnished new and erected on new supports at the specified locations.

B. Reuse Sign Face. Signs designated “Reuse Sign Face” are to be removed from the existing supports and remounted on new supports at the specified locations.

C. Replace. Signs designated “Replace” are to be removed and replaced with the specified new signs, including new supports, at the existing or specified new locations.

D. Replace Sign Face. Signs designated “Replace Sign Face” are to be removed from the supports and replaced with the specified new signs using the existing supports.

E. Use As Is. Signs designated “Use As Is” are to be left in place.

F. Reset. Signs designated “Reset” are to be removed and reset at the specified locations using the existing sign faces and supports.

G. Remove. Signs designated “Remove” are to be removed, including the sign or sign assembly and sign supports.

Furnish new materials for signing work in accordance with Table 619-1.

TABLE 619-1
MATERIALS REQUIRED FOR SIGN WORK

	Alum. Sheeting/ Sign Face	Support (Post)	Breakaway	Foundation
New	X	X	X	X
Reuse Sign Face		X	X	X
Replace	X	X	X	X
Replace Sign Face	X			
Use As-is				
Reset			X	X
Remove				

Note. The materials mentioned above are based on planned operations. Meet the requirements of the contract. If no pay item exists for necessary materials, absorb the costs of these items in other signing components.

619.03.2 Design Calculations and Shop Drawings

The Department will furnish the sign design calculations for the project at the pre-construction conference. The furnished sign design calculations must include the calculations for

the specified guide signs, special design signs, and other signs shown in the Montana *Sign and Sign Materials* book but not include those signs in the FHWA *Standard Highway Signs Book*.

Submit Contractor approved (stamped) shop drawings and welding procedures for sign bridges, and overhead cantilever sign structures. Submit shop drawings on minimum size 11" x 17" sheets (A3 paper), welding procedures on 8½" x 11" (A4 paper) sheets.

The Department has 15 business days upon receipt of the drawings for drawing review. Drawings returned to the Contractor for corrections or additional information must be re-submitted within 15 business days of receipt.

After the structural steel shop drawings and welding procedures have been reviewed and checked by the Department, all required corrections will be returned to the Contractor who must make the corrections and re-submit 10 copies of the corrected drawings and welding procedures for final review and approval within 15 business days. All final drawings must be stamped "Approved" by the Department before fabrication begins.

Submit shop drawings and current approved weld procedures for tubular sign posts and structural steel sign posts.

The Department Inspector will compare the drawings and weld procedures to the posts during post inspection at the point of fabrication. Submit weld procedures for approval every 6 months or whenever they are changed or modified.

Submit shop drawings and welding procedures at one time in a complete package for the Department's initial and subsequent reviews. Individual parts of the submittals will not be accepted for review.

619.03.3 Fabrication and Erection

Fabricate the signs and sign legends before delivery to the project, except for signs too large to transport in one piece to the project.

Fabricate all signs using the hole spacing specified in the FHWA *Standard Highway Signs* book or the Detailed Drawings.

The lengths of poles and steel posts shown in the contract are estimated lengths. The Project Manager will furnish the required length of each pole and steel post prior to fabrication.

Locate and erect signs as specified or directed. The Project Manager may change sign locations due to field conditions. Erect signs so the sign face is vertical and aligned as specified. Sign supports must not project above the sign faces.

When necessary, use full width piano hinges for all folding signs. Ensure that hinges are capable of withstanding normal dead and live loads applied and be securely fastened by bolting or riveting to the sign. The hinge must meet the requirements of Subsection 704.01.13.

Submit 2 copies of the manufacturer's installation instructions for all sign post breakaway devices installed on the project to the Project Manager at least 15 calendar days prior to installation.

After the sign is installed and adjustments are made, jam the threads of the mounting bolts or use vandal resistant nuts for ground-mounted sign faces 25 square feet (2.3 m^2) and smaller.

The specified foundation depth for timber posts and poles is a minimum depth. Field cut the poles to the correct length or bury the extra length to provide the specified mounting.

Excavate or bore foundation holes for sign supports at least 8 inches (200 mm) larger than the largest diameter of post or pole placed in each hole.

Backfill foundation holes for timber posts and poles as follows:

- Combine and thoroughly mix the material excavated from the foundation with cement using a mix ratio of 10 parts excavated material to 1 part cement.
- Do not mix in the hole. Add water to make the soil-cement mixture.
- Place the sign post or pole in the hole without the sign attached.

- Backfill the hole with the soil-cement mixture in 8-inch (200 mm) maximum lifts.
- Compact each lift by hand tamping or using mechanical methods.
- Allow the foundation to cure for 7 days before mounting the sign face to the support.

Foundation holes for wooden sign supports may be backfilled with CLSM using the specifications for constructing foundations for steel sign posts as follows.

Construct foundations for steel sign posts with Class General concrete in accordance with Section 551. Finish foundations flush with the adjacent surfaces. Signs may be post mounted after the concrete has set 72 hours.

Weld metal joints and post breaks in accordance with Sections 556 and 624.

619.03.4 Inspection

The completed signs will be inspected at the fabricator's plant and on the project before they are installed. Defects including but not limited to cracks, tears, splits, crazing, gouges or curled edges of the background sheeting or legend are cause for rejecting the sign. The installed signs will be inspected at night for nighttime retro-reflectivity and readability. Adjust signs exhibiting specular reflection, as directed.

619.03.5 Sheet Aluminum Overlay

Meet the contract requirements for sheet aluminum overlays.

Install the sign legend and other components plumb and level. Match the color, shade, and type of existing reflective sheeting used as a background for partial overlays. Fully cover the existing legend and symbols with partial overlay backgrounds. Match the size of the existing sign with complete overlay backgrounds.

619.03.6 Replace, Reuse Sign Face, and Reset

Use new materials in accordance with Section 704 for that required over and above those materials salvaged from signs to be reset or reused.

Install breakaway devices on existing posts when specified.

Reset signs in accordance with Subsection 619.03.3.

Repair or replace all Contractor sign damage resulting from dismantling, moving, and resetting at Contractor expense.

With no exception, remount or reset within one hour all removed warning, regulatory signs and route markers. Re-install guide signs within 5 hours and only during daylight hours. Re-display warning, regulatory, and guide signs by dusk.

Erect the new sign and support before removing the existing sign being replaced. Do not display conflicting signs together. Do not obscure existing signs when placing new signs.

Re-erect existing multiple support signs to be removed and reset using the original post spacing.

619.03.7 Installation Date Tags and Route Markers

Install date tags and route identification tags on all highway signs before final acceptance.

Meet the contract requirements for design, color, and installation.

619.03.8 Delineators

Furnish and install new delineators at the locations specified and marked by the Project Manager. Remove delineators conflicting with new construction as specified.

Removed delineators are the Contractor's property.

619.03.9 Flexible Delineators

Install delineators as specified by the manufacturer's recommendations and at the locations shown in the contract or as directed by the Project Manager.

619.03.10 Acceptance

Signs and traffic guide devices are accepted for payment individually or in lots as completed work once installed.

Delineator posts with reflectors are accepted in lots of 100 or more units.

Guide, directional, and warning signs with a surface area of up to 10 square feet (0.93 m^2) on one side are accepted in lots of 25 or more.

Signs with a surface area of up to 30 square feet (2.8 m^2) on one side are accepted in lots of 5 or more.

Overhead structures and signs larger than 30 square feet (2.8 m^2) in sheeting area are accepted individually.

The Department will assume maintenance responsibility for signs and other traffic guide devices once accepted and in place.

Repair or replace signs and devices, at Contractor expense, that are damaged or destroyed by the Contractor's operations.

619.03.11 Permanent Barricade

Furnish and install permanent barricades as specified and shown in the Detailed Drawings.

619.03.12 Breakaway System

Furnish breakaway devices listed on the QPL and in accordance with Subsection 704.01.4(D). Install per manufacturer's recommendations.

619.03.13 Remove Signs

Remove foundation material left after removing the existing signs to at least 1-foot (305 mm) below ground-line. Backfill and compact the holes left from removal using clean material or crushed base. Do not cut off and leave existing posts in place.

Existing signs and supports specified for removal are the Contractor's property. Dispose of removed sign materials in accordance with local, state, and federal regulations. Disassemble and store signs specified to remain the Department's property at the designated location.

619.04 METHOD OF MEASUREMENT

619.04.1 Aluminum and Plywood Signs

Aluminum sheet, aluminum sheet increment, and plywood signs are measured by the square foot (m^2) of sign face.

619.04.2 Metal Posts

Metal posts are measured by the pound (kg). The pay weight is calculated by multiplying the nominal weight per foot (m) by the installed length of each post as noted in the Detailed Drawings. When applicable, the weight of the anchor sleeve will be added to the post weight.

If there is no breakaway system bid item, include with the post weight the weight of the base plates, fuse plate, and stub post or anchor sleeve including the embedment length.

619.04.3 Treated Timber Poles and Posts

Treated timber poles and posts are measured by the foot (m) in even 2-foot (610 mm) increments. When the measurement falls between increments, the measured length for payment is the next higher 2-foot (610 mm) increment.

619.04.4 Delineators

Delineators of each type specified are measured by the unit and include the reflector, mounting hardware, and post, complete in place.

Removal of existing delineators is not measured for payment.

619.04.5 Flexible Delineators

Flexible delineators of each type specified are measured by the unit.

619.04.6 Reset Signs

The reset of guide, warning, regulatory, and route marker signs is measured by the unit for each sign removed and reset in a new location.

Sign groups of 2 or more signs mounted on a single support or multiple supports are measured as a single sign.

When signs designated as “Reset” require new supports to achieve the proper mounting height, include the costs of the supports in the cost of reset signs.

When there is not a bid item in the contract for reset sign, this work is incidental to other items of the contract.

619.04.7 Remove Signs

The removal of guide, warning, regulatory, and route marker signs is measured by the unit for each sign removed including supports.

Sign groups of 2 or more signs mounted on a single support or multiple supports are measured as a single sign.

619.04.8 Replace Signs

New materials for signs designated “Replace” are measured in accordance with Subsections 619.04.1, 619.04.2, and 619.04.3.

Removal of existing signs designated “Replace” are measured in accordance with Subsection 619.04.7.

New materials for signs designated “Replace Sign Face” are measured in accordance with Subsection 619.04.1.

619.04.9 Reuse Sign Face

New material for supports for signs designated “Reuse Sign Face” is measured in accordance with Subsections 619.04.2 and 619.04.3.

Removal of existing signs designated “Reuse” is measured in accordance with Subsection 619.04.7.

619.04.10 Sheet Aluminum Overlay

Sheet aluminum for signs designated “Sheet Aluminum Overlay” is measured by the square foot (m^2) of sign face complete in place.

619.04.11 Breakaway System

A. **Square Tubular Steel Post.** Breakaway systems are measured per each and include the breakaway device and all associated hardware required to attach the breakaway device.
B. **Structural and Tubular Steel Posts.** Breakaway systems are measured per each and include the breakaway device, fuse plate, and all associated hardware required to attach the breakaway device. Include the cost of the concrete anchors to attach the breakaway to the foundation in the cost of the breakaway.

619.04.12 Permanent Barricade

Permanent barricade, as shown in the Detailed Drawings, is measured by the foot (m) of the barricade width and includes all materials for the barricade.

619.05 BASIS OF PAYMENT

Payment for the completed and accepted work is made under the following:

Pay Item	Pay Unit
Aluminum and Plywood Signs	Square Foot (m^2)
Breakaway System	Each
Delineator (Type and Design)	Each
Metal Sign Post	Pound (kg)
Permanent Barricade	Foot (m)
Remove Signs	Each
Reset Signs	Each
Sheet Aluminum Overlay	Square Foot (m^2)
Timber Sign Post	Foot (m)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work, including excavation and backfill, concrete foundation, miscellaneous hardware, welding, date tag and route identification tags and installation in accordance with the contract.

SECTION 620
PAVEMENT MARKING APPLICATION

620.01 DESCRIPTION

This work is the application of temporary striping, interim pavement markings, and final pavement markings.

620.02 MATERIALS

Furnish materials in accordance with the following subsection requirements:

Epoxy Traffic Paint 714.06
High Durability Waterborne Traffic Paint 714.05
Preformed Plastic Material 714.07
Reflective Glass Beads 714.08
Temporary Striping Tabs..... 714.02
Temporary Striping Tape..... 714.01
Temporary Waterborne Traffic Paint 714.03
Waterborne Traffic Paint 714.04

620.03 CONSTRUCTION REQUIREMENTS

620.03.1 General

Furnish a manufacturer's material certification or data sheet for the product to be used. Do not apply materials that do not meet the contract requirements. The Project Manager may request a manufacturer's sample or take field samples for testing. Furnish a material sample weighing at least 2 pounds (0.91 kg). Furnish temporary waterborne traffic paint, waterborne traffic paint, high durability waterborne traffic paint, epoxy traffic paint, and glass beads listed on the QPL.

620.03.2 Layout of Pavement Markings

The Project Manager will lay out the final pavement marking configurations and locations. Notify the Project Manager a minimum of 10 business days before striping in the permanent location is to begin.

Preserve all marking configurations and locations after the initial layout by the Department.

Apply the markings to within ± ¼-inch (6 mm) of the specified width.

Apply the centerline and shoulder lines within 0.30 feet (90 mm) of the true line. Ensure the stripe does not deviate by more than 0.15-foot in 500 feet (45 mm in 150 m).

Apply all other markings (words, symbols, stop bars, crosswalks, hash marks, and others) within 0.25 feet (75 mm) of the location marked by the Project Manager.

Apply words, symbols, letters, and/or numeral pavement markings free of gaps and fully solid.

The Project Manager will determine the accuracy of the applied markings.

Remove and replace out of specification pavement markings as directed at Contractor expense.

620.03.3 Equipment

Use equipment manufactured to apply the material type. Ensure the equipment prevents paint spray or bead loss outside the specified line width. Equip the pavement-marking machine with a flow meter and totalizer that measures paint quantities in gallons (L), to the nearest 0.1 gallon (0.1 L). Calibrate the flow meter before use on the project and when directed. Locate the flow meter in the flow line to the spray nozzles. Locate the totalizer where it can be easily read. Ensure the calibration adjustment is accessible without meter removal or using a calibration adjustment device.

Ensure the application equipment is acceptable to the manufacturer.

Submit calibration certificates from an independent agent for the paint tank. Re-certify the tank at the beginning of each year before using the equipment on Department contracts. The Project Manager may inspect the tank before each use and as determined necessary.

Stop bars, crosswalks, and words/symbols may be applied with hand-operated equipment.

Terminate marking application when the equipment fails to apply the markings in accordance with the contract requirements. Make equipment adjustments and resume striping.

For material paid by the gallon (L), quantities will be verified by measuring the equipment's paint tank(s), using tank stabs. The Project Manager will visually witness tank stabs at the beginning and end of each work shift, any time additional paint is added to the tank, at the beginning and end of each route/road segment on contracts with multiple route/road segments, at the beginning and end of each certified paint lot, and at other intervals as necessary.

Park the equipment on a level surface approved by the Project Manager for each tank measurement.

620.03.4 Surface Preparation and Weather Limitations

A. General. Prepare the surface to be painted in accordance with the paint manufacturer's recommendations. Remove loose material by sweeping and brooming no more than 2 days before striping. If not bid separately, the cost of this operation is included with the cost of the striping and is not measured separately for payment. Inform the Project Manager and modify, when required, the surface preparation to ensure optimal bonding of the marking to the surface and to provide the specified marking requirements.

Apply the material following the manufacturer's recommendations.

Apply pavement markings during daylight hours only. Obtain Project Manager approval to apply pavement markings any other time.

Grind all surfaces with existing epoxy pavement markings within 3 calendar days before applying the pavement markings.

Grinding is surface abrasion to provide a roughened surface free of loose paint chips, loose seal aggregate and surface debris. Grind to a depth that completely removes the existing pavement markings. Immediately stop grinding if the depth exceeds that of the existing pavement markings and make adjustments to meet the specified grind depth.

B. Concrete Surfaces. Prepare existing concrete surfaces in accordance with Subsection 620.03.4(A). Do not grind or apply final pavement markings on new concrete until 30 calendar days after it has been placed.

C. Removal Limits. Meet the following removal limits:

- Do not grind more than 1-inch (25 mm) wider than the existing stripe.
- Do not grind more than 4 inches (100 mm) from the beginning or end of the stripe being removed.

D. Disposal. Collect and dispose of all removed material and new traffic marking materials spilled during the work. Process, handle, transport, and dispose of the materials in accordance with the current applicable solid waste laws and regulations.

620.03.5 Temporary Striping

Temporary striping consist of the centerline markings for two-lane two-way roadways; lane line markings for divided four-lane Interstates, and centerlines and lane lines for two-way undivided three or more lane roadways. Divided roadways are roadways where the paved surface for each direction of travel is physically separated by an unpaved section.

Apply temporary striping for paving and milling operations in accordance to Subsection 618.03.9.

Remove, at Contractor expense, all temporary striping that conflicts with interim or final pavement markings. Remove conflicting temporary stripe(s) the same day the interim or final pavement markings are applied.

A. **Temporary Waterborne Traffic Paint.** Apply a 10 ± 1 mil (0.254 ± 0.025 mm) thick wet film immediately followed by applying at least 6.0 pounds per gallon (0.72 kg/L) of glass beads to temporary striping.
B. **Tape.** Follow the tape manufacturer's recommendations for road surface preparation and installation. Install the tape in accordance with the contract.
C. **Tabs.** Follow the tab manufacturer's recommendations for road surface preparation and installation. Install the tabs in accordance with the contract.

620.03.6 Interim Pavement Markings

Interim pavement markings consist of all longitudinal striping (centerlines, edge lines (shoulder lines), lane lines, etc.) and words and symbols identical to the final pavement marking configuration. Use the material specified in the contract.

Apply interim pavement markings no later than 10 calendar days after the application of temporary striping on intermediate lifts, and before opening to traffic on top lift. Do not apply interim pavement markings when the ambient air temperature is lower than 40 °F (4 °C).

Stripe newly constructed pavements, including partially completed sections. Apply the interim pavement markings matching the final pavement marking configurations and locations. Interim pavement markings placed prior to chip seal may be offset as approved by the Project Manager.

The Project Manager will suspend all remaining contract work if the interim striping is not applied within the time specified above.

A. **Waterborne Traffic Paint.** Apply a 16 ± 1 mil (0.406 ± 0.025 mm) thick wet film immediately followed by applying at least 8.0 pounds per gallon (0.96 kg/L) of Montana Type 1 or 2 glass beads.
B. **High Durability Waterborne Traffic Paint.** Apply a 16 ± 1 mil (0.406 ± 0.025 mm) thick wet film immediately followed by applying at least 8.0 pounds per gallon (0.96 kg/L) of Montana Type 1 or 2 glass beads.

620.03.7 Final Pavement Markings

Apply final pavement markings a minimum of 30 calendar days, and a maximum of 45 calendar days, after concrete is placed or after seal coat operations through initial sweeping are completed. When final pavement markings are the only remaining item of work on the project, contract time assessment will be suspended until either, beginning final pavement markings application, or 45 calendar days elapse after seal coat operations are completed or concrete placement is completed. The Project Manager may extend the 45 days due to holidays or inclement weather that prevent the application of final pavement markings.

Use the material specified in the contract.

A. **Epoxy or other Polymeric Traffic Paint.** Submit a copy of the manufacturer's instructions for surface preparation and material application.

   Include in the instructions:

   - Equipment requirements
   - Approved work methods and procedures
   - Material application range
   - Ambient & surface temperature requirements
   - Weather limitations
   - Precautions
   - All other requirements for successful application and material performance.

Do not place materials before furnishing complete instructions to the Project Manager.

Apply a 20 ± 2 mil (0.508 ± 0.051 mm) thick wet film immediately followed by applying at least 25 pounds per gallon (3 kg/L) of Montana Type 2 glass beads to the epoxy.

Ensure application equipment accurately meters the two components and produces and maintains the mixing head temperature, all meeting the epoxy manufacturer's specifications.

Immediately terminate striping application if the applied stripe(s) are less than 18 mils thick. Grind all 18-mil and thinner striping in accordance with Subsection 620.03.4 and replace the striping in accordance with the contract at Contractor expense. Correct all deficient striping before continuing with the remaining striping work. The Project Manager will identify deficient stripe thickness by comparing the tank quantities measured and used against the length, width, and application rate of the applied stripe.

Apply the pavement marking material when the pavement is dry and the ambient temperature is 40 °F (4 °C) and rising or follow the manufacturer's surface and temperature requirements, whichever is more restrictive.

B. Preformed Plastic Materials. Apply pavement markings up to 8 inches (200 mm) wide in a single application to the specified width. Apply pavement markings over 8 inches (200 mm) wide in 6 or 8-inch (150 or 200 mm) multiple applications and minimum fractional 4-inch (100 mm) applications.

Apply the marking material at the thickness specified in the contract.

Cut and true the marking material edges.

Apply inlaid plastic materials into the new asphalt pavement just before final compaction and roll it flush with the roadway surface during the final plant mix compaction.

620.03.8 Concrete Curbs

Use the material specified in the contract.

Apply curb paint during the application of the final pavement markings. Clean the concrete surfaces in accordance with the paint manufacturer's recommendations. Apply paint on concrete a minimum of 30 calendar days after the concrete has been placed.

Paint the tops and traffic sides of curbs at restricted parking locations as specified.

Apply yellow paint to the tops and traffic sides of all island curbs, median curbs, and other similar curbs.

Apply Type 1 or Type 2 reflective glass beads at a minimum rate of 8.0 pound per gallon (0.96 kg/L) immediately following the application of epoxy to concrete curbs.

620.03.9 Marking Protection

Furnish all traffic control necessary to protect markings until dry. Correct smeared or damaged markings at Contractor expense.

620.03.10 Marking Removal

Remove existing temporary and final pavement markings using any of the following:

- Sand blasting with air or water;
- High-pressure water;
- Steam or super-heated water; or
- Mechanically grinding, sanding, scraping, brushing.

Submit the method or methods to be used. The Contractor may submit written proposals for other removal methods. An approved method may be subsequently disapproved if it damages the marking surface or inadequately removes existing markings.

Remove all pavement markings that would conflict with newly applied striping or markings at contractor expense. Remove conflicting pavement markings the same day new markings are applied.

Remove sand or other material on the surface left by the removal as the work progresses.

Satisfactorily repair surfaces damaged by marking removal at Contractor expense.

620.04 METHOD OF MEASUREMENT

620.04.1 Temporary Striping Quantities

Temporary striping is measured by the mile (km) of stripe applied (centerline, whether pass or no pass, is measured once per application).

Only those pavement markings represented by a manufacturer's certification at the time of application, and actually used and witnessed on the project are eligible for payment.

620.04.2 Interim Pavement Marking Quantities

Interim pavement markings are measured by the gallon (L).

Only those pavement markings represented by a manufacturer's certification at the time of application, and actually used and witnessed on the project are eligible for payment.

Should the actual quantity measured by the Project Manager using tank stabs or totalizer exceed the quantity calculated using an application rate of 17 mils (0.431 mm) times the specified width (without applying the tolerance) times the length of line applied, the lesser quantity will be paid for.

620.04.3 Epoxy Traffic Paint

Epoxy is measured by the gallon (L). Only those pavement markings represented by a Manufacturer's Material Certification at the time of application, and actually used and witnessed on the project are eligible for payment.

Should the actual quantity measured by the Project Manager using tank stabs or totalizer exceed the quantity calculated using an application rate of 22 mils (0.559 mm) times the specified width (without applying the tolerance) times the length of line applied, the lesser quantity will be paid for.

620.04.4 Preformed Plastic Materials

Preformed plastic and thermoplastic pavement striping is measured by the foot (m).

Words and symbols are measured by the square foot (m^2).

620.04.5 Curb Painting

Painting curb is measured by the gallon (L).

620.04.6 Hand Painted Pavement Markings (Words and Symbols)

Hand painted pavement striping, words and symbols; stop bars, crosswalks, hash marks, and other striping not applied by a striping truck are measured by the gallon (L). Quantity measurements are based on flow meter/totalizer readings taken before and after each run or if a calibrated tank is used, tank measurements are taken before and after each run. Computerized quantity print outs will be compared against tank stabs and the quantity calculated based on the surface area times the application rate for the product used.

The amount of paint measured for payment is the difference between the startup readings and the end readings. Should the actual quantity measured by the Project Manager using tank stabs or totalizer exceed the quantity calculated using the application rate times the surface area applied, the lesser quantity will be paid for.

All readings that measure paint for payment will be taken by the Project Manager. Provide all necessary assistance to make the readings including sufficient notice before the paint work begins.

620.04.7 Removal of Pavement Markings

If bid separately, pavement striping removal is measured by the foot (m) based on a 4-inch (100 mm) width for the actual quantity of striping removed. Lines wider and narrower than 4 inches (100 mm) are converted to the equivalent linear feet (m) of 4-inch (100 mm) wide line.

Removal of words and symbols is measured by the square foot (m^2) and converted to the equivalent linear feet (m) of 4-inch (100 mm) wide line.

If not bid separately, removal of pavement markings is incidental to other items and is not measured separately for payment.

620.04.8 Line Control

Establishing line control for pavement markings is not measured for payment.

620.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	PayUnit
Curb Painting	Gallon (L)
Plastic Markings	Square Foot (m^2) or Linear Foot (m)
Remove Pavement Markings	Square Foot (m^2) or Linear Foot (m)
Striping	Gallon (L)
Temporary Striping	Mile (km)
Words & Symbols	Gallon (L)

Line control is not paid for separately, but is included in the cost of the pavement markings.

Interim stripe applied over temporary stripe is measured and paid for as interim stripe.

The quantity that is paid for marking materials is the lesser of the following quantities:

- Flow meter and totalizer;
- Calibrated tank and measuring device (tank stabs); and
- Surface area times the application rate specified.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 621
REMOVE, RESET, AND
ADJUST FACILITIES

621.01 DESCRIPTION

This work is removing, resetting, or adjusting facilities and items as specified.

621.02 MATERIALS

Use the materials specified in the contact. Materials not specified and used in the work must be equal and comparable to those found in the existing work.

Obtain the Project Manager's approval before using material substitutions.

621.03 CONSTRUCTION REQUIREMENTS

Be responsible for the condition and care of each facility from the time removal starts until resetting is completed.

Do not damage facilities when removing and resetting.

Lower or raise existing manholes, catch basins, inlets, water valve boxes, gas and water shut-offs, and similar structures to grade as specified or directed. Make adjustments without damaging adjacent structures.

Construct masonry tops for manholes to the specified line and grade before placing the ring and cover.

Restore existing facilities to a structurally solid condition as specified.

Make height adjustments to water valve boxes without using an extension if possible.

Adjust manholes, catch basins, inlets, water valve boxes, and other similar structures to temporary grade before placing base course material. Make final adjustment of structures to match the grade of the new pavement. Replace and set to grade cast iron rings and covers once the pavement is placed.

Backfill around structures in accordance with Section 604.

Backfill holes left by removed facilities.

Reusable materials from removed structures or facilities may be used to rebuild the work. Stockpile all removed material not reused as specified. The material is the facility owner's property.

621.04 METHOD OF MEASUREMENT

Remove, reset, and adjust facilities is measured by the unit.

621.05 BASIS OF PAYMENT

The item description for Remove and Reset is abbreviated to Reset.

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Reset Facilities	Each

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 622
GEOTEXTILES

622.01 DESCRIPTION

This work is furnishing and installing geotextiles.

622.02 MATERIALS

Furnish materials in accordance with the following subsections:

Permanent Erosion Control Geotextile ..... 716.01 and 716.05
Separation Geotextile..... 716.01 and 716.02
Stabilization Geotextile..... 716.01 and 716.03
Subsurface Drainage Geotextile Filter..... 716.01 and 716.04
Temporary Silt Fence Geotextile 716.06

622.02.1 Classification

A geotextile is defined as any permeable polymeric textile used with foundation, soil, rock, earth, or any other geotechnical engineering related material, as an integral part of a civil engineering project, structure, or system.

A. **Separation/Stabilization Geotextile.** Use to prevent mixing of a subgrade soil and an aggregate cover material.
   1. **Separation Geotextile.** Use separation geotextile for unsaturated firm subgrade conditions.
   2. **Stabilization Geotextile.** Use stabilization geotextile for soft, wet, saturated subgrade conditions.
B. **Subsurface Drainage Geotextile Filter.** Use against soil to allow long-term passage of water into a subsurface drain system while retaining the in situ soil.
C. **Permanent Erosion Control Geotextile.** Use as a filter between energy absorbing armor systems (riprap) and the in situ soil to prevent soil erosion and hydraulic uplift pressures.
D. **Silt Fence.** Use between the edge of construction disturbance and a water resource, and at a critical resource or R/W line that is adjacent to construction activity. Use silt fence to assist in sediment control by retaining some of the eroded soil particles and slowing the runoff velocity to allow particle settling.

622.02.2 Source Approval

Submit the following information regarding each geotextile proposed for use:

- Manufacturer's name and current address;
- Full product name/number;
- Geosynthetic material and structure; and
- Proposed geotextile use(s).

Submit a sample to the Project Manager for evaluation. Product acceptance is determined by comparing the average test results of all specimens within a given sample to the Minimum Average Roll Values (MARV) listed in Section 716.

Install geotextiles only after the material has been tested and accepted. Replace all geotextiles installed prior to acceptance that do not meet specifications at Contractor's expense.

622.02.3 Sampling

Cut a sample from the geotextile roll with the minimum dimensions of 4 feet (1.2 m) by the full width of the roll beyond the first wrap. After the sample and the required information have been submitted to the Project Manager, allow 30 calendar days for evaluation.

622.02.4 Identification, Shipment and Storage

Conform to ASTM D4873, *Standard Guide for Identification, Storage, and Handling of Geotextiles*. Clearly label each roll of geotextile shipped to the project with the name and address of the manufacturer, full product name/number, quantity, and roll number. For all permanent installations, submit a manufacturer's certificate of compliance signed by an authorized manufacturer's official. The certificate must attest that the geotextile meets all the MARV requirements specified in Section 716 as evaluated in accordance with the manufacturer's quality control program.

The Project Manager will reject materials that are mislabeled or misrepresented.

Wrap each roll with a material that protects the geotextile, including ends of the roll, from damage due to shipment, water, sunlight, and contaminants. Maintain the protective wrapping during periods of shipment and storage.

Do not damage the geotextile or wrapping when unloading or transferring from one location to another. Do not drag the rolls.

During storage, elevate geotextile rolls off the ground and adequately cover to protect them from the following:

- Site construction damage;
- Precipitation;
- Ultraviolet radiation including sunlight;
- Chemicals that are strong acids or strong bases;
- Flames including welding sparks, temperatures in excess of 140 °F (60 °C); and
- Mud, dirt, dust, debris and any other environmental condition that may damage the physical property values of the geotextile.

622.03 CONSTRUCTION REQUIREMENTS

622.03.1 General

Prepare the surface on which the geotextile is to be placed so that no damage occurs to the geotextile. Do not drive construction equipment on the geotextile. Dispose of material with defects, rips, holes, flaws, deterioration, or other damage. Do not use defective material in the work.

If sewn seams are used for seaming the geotextile, use thread that consists of high strength polypropylene or polyester. Do not use nylon thread. For erosion control applications, use thread that is resistant to ultraviolet radiation. Use thread that is of contrasting color to that of the geotextile itself.

For seams that are sewn in the field, provide at least a 10-foot (3 m) length of sewn seam for sampling by the Project Manager before the geotextile is installed. For seams that are sewn in the factory, provide samples as directed and witnessed by the Project Manager at random from any roll of geotextile that is used on the project.

For seams that are field sewn, use the same equipment and procedures for both the sampling and production seams. If seams are to be sewn in both the machine and cross-machine direction, provide samples of seams from both directions.

Submit the seam assembly description along with the sample of the seam. Include in the description the seam type, stitch type, sewing thread, and stitch density.

622.03.2 Separation/Stabilization Geotextile

Prepare the installation site by clearing, grubbing, and excavating or filling the area to the design grade. This includes removal of topsoil or vegetation. The Project Manager will identify soft spots and unsuitable areas during site preparation. Excavate these areas and backfill with approved granular material and compact as specified. Grade the area to be covered by the

geotextile to a smooth, uniform condition, free from ruts, potholes, and protruding objects such as rocks or sticks.

Spread the geotextile immediately ahead of the covering operation. Do not place geotextile over frozen material. Lay the geotextile smooth without wrinkles or folds on the prepared subgrade in the direction of construction traffic. Remove wrinkles and folds by pulling the geotextile taut as required. Use soil piles or the manufacturer's recommended method (as approved by the Project Manager) to hold the geotextile in place until the specified cover material is placed. Overlap, sew or join adjacent geotextile rolls and roll ends as shown in the contract or as directed by the Project Manager. Overlap in the direction shown in the contract. Overlap adjoining edges a minimum of 3 feet (0.9 m) or use sewn seams.

On curves, cut or fold the geotextile to conform to the curve. Fold or overlap in the direction of construction and hold in place using pins, staples, or piles of fill or rock.

Do not cover the geotextile until inspected for damage by the Project Manager. Repair or replace all damaged geotextile at Contractor's expense. Make repairs following the manufacturer's recommendation or use a patch of the same material placed over the damaged area, overlapped at least 3 feet (0.9 m) from the edge of any part of the damage. Sewing repairs are an acceptable alternative.

Place fill over the geotextile by dumping onto previously placed material and pushing the material into place. Do not operate any construction equipment directly on the geotextile under any circumstances. Place the fill material in uniform layers so that there is the minimum specified lift thickness between the geotextile and equipment tires or tracks at all times. The minimum thickness of the first lift is 8 inches (200 mm). Do not allow construction equipment to turn on the first lift of material above the geotextile. If the subgrade is very soft with an undrained shear strength less than 500 psf (25 kPa) minimize pile heights to less than 3 feet (0.9 m) and spread piles as soon as possible after dumping to minimize the potential for localized subgrade failure due to overloading of the subgrade.

Do not use sheepsfoot or studded compaction equipment on the first lift placed over the geotextile. Stop vibrator on compaction equipment if pumping occurs. Do not operate any construction equipment that results in rutting in excess of 3 inches (75 mm) on the first lift. If rutting exceeds 3 inches (75 mm), decrease the construction equipment size and/or weight or increase the lift thickness. Use only rubber-tired rollers for compaction if any foundation failures occur when placing subsequent lifts. Compact all lifts to the moisture and density requirements for earth embankment specified in Subsection 203.03.3. Do not blade material down to remove ruts. Fill any ruts or depressions with additional material and compact to the specified density.

622.03.3 Subsurface Drainage Geotextile Filter

Excavate trench in accordance with the contract. Do not allow large voids to occur in the sides and bottom of the trench. Grade the surface to be smooth and free of debris.

Place the geotextile loosely with no wrinkles or folds, and with no void space between the geotextile and the ground surface. Press the geotextile into the corners of the trench. Overlap successive sheets of geotextiles a minimum of 1-foot (0.3 m), with the upstream sheet overlapping the downstream sheet.

Place a sufficient width of geotextile to entirely cover the perimeter of the trench and allow for the required overlap. In trenches equal to or greater than 1-foot (0.3 m) width, after placing the drainage aggregate, fold the geotextile over the top of the backfill material in a manner to produce a minimum overlap of 1-foot (0.3 m). In trenches less than 1-foot (0.3 m) wide, but greater than 4 inches (100 mm) wide, overlap the geotextile the entire width of the trench. Where the trench is less than 4 inches (100 mm) wide, sew or otherwise bond the geotextile in

accordance with the manufacturer's recommendations, as approved by the Project Manager. All seams will be subject to the approval of the Project Manager.

If the geotextile is damaged during installation or aggregate placement, place a geotextile patch over the damaged area extending beyond the perimeter of the damaged area a distance of 1-foot (305 mm) or the specified seam overlap, whichever is greater.

Place the drainage aggregate immediately following geotextile placement. Cover the geotextile with a minimum of 12 inches (305 mm) of loosely placed aggregate prior to compaction. If a perforated collector pipe is to be installed in the trench, place a minimum of a 6-inch (150 mm) bedding layer of drainage aggregate below the pipe, with the remainder of the aggregate placed to the minimum required construction depth.

Compact all placed aggregate to a minimum of 95% of the maximum standard proctor density in accordance with MT 210.

622.03.4 Permanent Erosion Control Geotextile

Place the geotextile on a smooth graded surface approved by the Project Manager. Place the geotextile loosely and anchor it in place with sand bags, soil piles, or steel pins. Place the geotextile in such a manner that placement of the riprap does not stretch or tear the geotextile. Place the riprap from the bottom of the slope up to the top of the slope. After placement of the riprap, key the geotextile at least 18 inches (455 mm) into the ground at the top of the embankment. Do not key the geotextile in until all of the riprap has been placed on the slope. Secure the geotextile at the toe by lapping the material back and securing with riprap.

Limit atmospheric exposure to a maximum of 14 calendar days following lay down to minimize damage potential.

Place the geotextile with the machine direction parallel to the direction of water flow, which is normally parallel to the slope (downslope) for erosion control runoff and wave action, and parallel to the stream or channel in the case of stream bank and channel protection. Join adjacent geotextile sheets by either sewing or overlapping. Overlap seams of roll ends a minimum of 1-foot (305 mm) except where placed under water or on slopes 3H:1V or steeper. Overlap seams of roll ends placed under water or on slopes 3H:1V or steeper a minimum of 3 feet (915 mm). Overlap adjacent rolls a minimum of 1-foot (305 mm) in all instances. For slopes flatter than 3H:1V, use pins or staples to hold the overlap in place during placement of riprap. Pin the geotextile loosely so it can easily conform to the ground surface and give when riprap is placed. Do not use pins at overlaps for slopes 3H:1V or steeper.

Overlap successive sheets of the geotextile upstream over downstream, and/or upslope over downslope. In cases where wave action or multidirectional flow is anticipated, sew all seams perpendicular to the direction of flow.

Avoid damaging the geotextile as a result of the installation process. If the geotextile is damaged during installation, place a patch over the damaged area extending a minimum of 3 feet (915 mm) beyond the perimeter of the damaged area.

Begin riprap placement at the toe and proceed up the slope. Avoid stretching and subsequent tearing of the geotextile. Do not drop riprap and heave stone from a height of more than 1-foot (305 mm). Do not allow stones weighing more than 200 lbs (90 kg) to roll down the slope.

Do not drop slope protection and smaller sizes of stone material from a height exceeding 3 feet (915 mm), unless the Project Manager approves the procedure following a demonstration showing the geotextiles are not damaged by the procedure.

In underwater applications, key the geotextile in at the bottom of the slope. Develop and demonstrate to the Project Manager a method of underwater placement to secure the geotextile in place without damaging the geotextile. Place the geotextile and the backfill material in the

same day. Backfill all void spaces in the riprap with smaller stone to ensure full coverage of the geotextile.

After placement of the riprap, no grading of the slope is allowed if it results in movement of the riprap directly above the geotextile.

Replace any geotextile damaged during backfill placement as directed by the Project Manager at the Contractor's expense.

622.03.5 Silt Fence

Install silt fence in accordance with this specification and with the Detailed Drawings. The maximum cut or fill slope for a silt fence is 2H:1V. For cut or fill slopes steeper than 2H:1V, use alternative methods of soil stabilization BMPs.

Use fence posts at least 48 inches (1.2 m) in length. Drive fence posts a minimum of 18 inches (455 mm) into the ground. Use fence posts having a sufficient strength to resist damage during installation and to support the applied loads due to material build up behind the silt fence.

There are two types of silt fence installations:

1. **Unstabilized.** Silt fence supported with either wood or metal fence posts.
2. **Stabilized.** Silt fence supported with metal posts and with woven wire backing.

For stabilized silt fence, use woven wire having a maximum of 6-inch (150 mm) mesh spacing and a minimum of 14.5 gauge wire.

Excavate a trench at least 6 inches (150 mm) wide by 6 inches (150 mm) deep at the base of the silt fence. The vertical entrenchment component consists of burying the silt fence a minimum of 6 inches (150 mm) below the ground surface. Vertical and horizontal entrenchment of the silt fence consists of placing the silt fence in a "J" configuration in the trench extending a minimum of 6 inches (150 mm) below the ground surface and a minimum of 6 inches (150 mm) horizontally along the bottom of the trench. The initial silt fence installation requires only the vertical entrenchment component unless the Project Manager determines both vertical and horizontal entrenchment components are necessary. If the fence requires replacement due to failure from pullout or undercutting, the subsequent entrenchment must include both vertical and horizontal entrenchment components in a "J" configuration. Backfill the trench with the excavated material and compact.

Splice the geotextile with a sewn seam or overlap 2 sections of fence in accordance with the detailed drawings.

Place the posts at a minimum spacing of 4 feet (1.2 m) and at a maximum spacing of 8 feet (2.4 m). Securely fasten the silt fence geotextile to the upslope side of the fence post.

Place silt fence continuous and transverse to the flow. Follow the contours of the site as closely as possible. Place the fence so that water cannot run off and around the end of the fence.

Inspect all temporary silt fences immediately after each rainfall and at least daily during prolonged rainfall. Immediately correct any deficiencies at the Contractor's expense.

Make a daily review of the location of silt fences in areas where construction activities have altered the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness. Where deficiencies exist as determined by the Project Manager, install additional silt fence as directed by the Project Manager.

Repair or replace damaged silt fence promptly.

Remove sediment from behind the silt fence when it occurs to one-third the original height.

Leave the silt fence in place until the Project Manager directs to remove it. Either grade and seed, or remove the sediment deposits prior to removal of the fence.

622.04 METHOD OF MEASUREMENT

Geotextiles are measured by the square yard (m^2) as staked by the Project Manager, except silt fence, which is measured by the yard (m) of fence. Seams, excavated vertical faces, and laps, including any portion of geotextile keyed into the subgrade or fill material, are not measured for payment. For subsurface drainage filter geotextile, the entire drainage trench perimeter, and the top width, is measured for payment.

622.05. BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Geotextile, Erosion Control	Square Yard (m^2)
Geotextile Filter, Subsurface Drainage	Square Yard (m^2)
Geotextile, Separation/Stabilization	Square Yard (m^2)
Geotextile, Silt Fence	Yard (m)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 623
MAILBOXES

623.01 DESCRIPTION

This work is the removal, temporary reset and maintenance, and furnishing and installation of new mailboxes and crash-worthy supports at the specified locations or as directed.

623.02 MATERIALS

Use mailboxes listed on the QPL for Mailbox and Mailbox - Large. The mailbox carrier service door must be embossed with the following two statements: “U.S. MAIL” in a minimum of ½-inch (13 mm) high letters and “Approved By The Postmaster General” in a minimum of $^{3}/_{16}$-inch (4.8 mm) high letters.

Provide permanent address markings on the flag side of the mailbox at least 1-inch (25 mm) high and in contrasting color in neat, legible letters and numbers. If the mailboxes are grouped provide address numbers on the mailbox door.

Furnish a crashworthy mailbox support as shown in the Detailed Drawings, a mailbox support identified in the current edition of the AASHTO *Guide for Erecting Mailboxes on Highways*, or other commercially manufactured NCHRP 350 or MASH compliant crashworthy mailbox support.

Furnish a NCHRP 350 or MASH compliant crashworthy support for temporary resets of mailboxes. Do not use traffic control devices as mailbox supports. If multiple mailboxes are required at one location, furnish and install a multiple box support system in accordance with the current edition of the AASHTO *Guide for Erecting Mailboxes on Highways*.

623.03 CONSTRUCTION REQUIREMENTS

Coordinate with the U.S. Postal Service and mailbox owner prior to any activities impacting mailboxes. Reset and maintain all mailboxes specified by the project manager that are removed during construction. Temporary supports and locations must be approved by the Project Manager. Install permanent mailboxes and supports at the locations shown in the contract. Salvage existing mailboxes if requested by landowner. Dispose of non-salvaged mailboxes.

623.04 METHOD OF MEASUREMENT

Mailbox and support are measured as a unit. Removal, temporary resets, salvage, numbering, disposal, and maintenance are not measured for payment.

623.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item	Pay Unit
Mailbox	Each
Mailbox-Large	Each

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work in accordance with the contract.

SECTION 624
WELDING

624.01 DESCRIPTION

Weld in accordance with the current edition of the applicable *American National Standard Welding Codes*.

624.02 MATERIALS

Use welding electrodes in accordance with AWS and AASHTO.

624.03 CONSTRUCTION REQUIREMENTS

624.03.1 General

Contact the Project Manager 5 business days prior to anticipated work for scheduling of the Certified Welding Inspector (CWI).

1. Weld tubular members (including pipe piles and hand or pedestrian rails) to ANSI/AWS D1.1.
2. Weld on existing structures for repair or strengthening to ANSI/AWS D1.1.
3. Weld reinforcing steel to ANSI/AASHTO/AWS D1.5.
4. Weld bridge structural steel to ANSI/AASHTO/AWS D1.5.

624.03.2 Welder Qualifications

1. Have all welders certified by a CWI for each process or procedure performed. Obtain certifications prior to beginning welding for the project.
2. If Department staff is available, certification testing of welders will be provided by the Department at a cost of $60.00 per hour. This certification will be provided in Helena at this cost only once per person per project.
3. An outside agency will be allowed to administer the testing if conducted by an AWS CWI, and the process is in accordance with Department procedure.
4. The welder's qualification will remain in effect for an indefinite period unless the welder has not used the qualified welding process for a period exceeding 6 months or there is some specific reason to question the welder's ability. For the welder to remain qualified, a verification record (continuity) should be kept on file and updated by the Contractor for that welder documenting the performance of the given process and procedure during the previous 6 months.

624.03.3 Submittals

For all employees who will be welding on Department projects and who may have obtained certifications, submit 1 copy of certification record and continuity information to the Project Manager at least 30 calendar days prior to that individual welding. Include the following information:

1. Certifying agency, name, address, and phone number
2. CWI's stamp and number
3. CWI's signature
4. Date tested
5. Code under which the test was given, (e.g. AWS D1.1-96)
6. Positions qualified
7. Base metal designation, (e.g. A-36, A252)
8. Backer use
9. Process used
10. Manipulation type
11. Electrode type, (e.g. 7018)
12. Diameter of electrode
13. Operator's name
14. Operator's employer at the time of the test

624.04 METHOD OF MEASUREMENT

Welding is not measured separately but is incidental to the items being welded.

624.05 BASIS OF PAYMENT

Welding is not paid for separately but is included in the cost of the item welded and includes all materials and resources necessary to complete the work.

SECTION 701

AGGREGATES

701.01 AGGREGATE FOR CONCRETE

These specifications describe the quality and size of aggregate for hydraulic cement concrete pavements and bases, highway bridges, and incidental structures.

The following test methods are used to evaluate the quality of aggregates for concrete:

Coal and Light Particles ..... AASHTO T 113
Clay Lumps ..... AASHTO T 112
Fineness Modulus of Fine Aggregate ..... AASHTO M 6
Mortar-making Properties ..... AASHTO T 71
Organic Impurities ..... AASHTO T 21
Sieve Analysis for Fine and Coarse Aggregate ..... MT 202
Sulfate Soundness ..... AASHTO T 104 or ASTM C88
Wear Test ..... MT 209
Combining Aggregate Gradations ..... MT 215

When wear factors are specified in the contract, the term “aggregate surfacing” includes the coarse aggregate for concrete.

701.01.1 Fine Aggregates for Concrete

A. General Requirements. Fine aggregate is natural sand having hard, strong, durable particles meeting the gradation requirements in Table 701-2.

Other approved inert material with similar characteristics or combinations of the above materials may be used, if the materials meet these specifications.

Do not mix or store in the same pile fine aggregate from different sources or use alternately in the same class of construction or mix without the Project Manager’s written permission.

The deleterious substances and soundness specified in Subsections 701.01.1(B) and (C) below will be waived for aggregate used in structures or portions of structures not exposed to weather.

B. Deleterious Substances. Meet the deleterious material limits in Table 701-1.

TABLE 701-1
LIMITS ON DELETERIOUS MATERIAL
IN FINE AGGREGATE

Material	Maximum % By Wt.
Coal and lightweight pieces	1.00
Clay lumps	1.00

Ensure that the material does not contain other deleterious material.

C. Soundness. When fine aggregate is subjected to 5 cycles of the sodium or magnesium sulfate soundness test, the total corrected loss cannot exceed:

- 10% by weight for the sodium sulfate.
- 15% by weight for the magnesium sulfate.

D. Organic Impurities. Aggregate subjected to the colorimetric test for organic impurities and producing a color darker than the standard will be rejected unless the aggregates pass the mortar strength test specified in Subsection 701.01.1(E). Do not use aggregates showing a darker color than that of samples originally approved for the work until tested

to determine whether the increased color indicates a harmful quantity of deleterious material.

E. Mortar-making Properties. The fine aggregate, when mixed with Type I or II cement and tested using the mortar making property test, must develop at 7 days, a minimum compressive strength of 95% of the strength developed by a mortar made with the same cement in accordance with AASHTO T 71.

F. Grading. The gradation requirements listed in Table 701-2 are the outer acceptance limits for use from all supply sources. The gradation must be uniform from any one source and not change from the low to the high gradation limits.

The fineness modulus of samples taken from proposed sources must be a minimum 2.50 and a maximum 3.10 when tested in accordance with AASHTO M 6. Fine aggregate from a source with a fineness modulus variation greater than ± 0.20 from the design fineness modulus of the sample may require a concrete mix redesign. Applying the 0.20 variation does not permit the fineness modulus to be less than 2.50 or more than 3.10.

TABLE 701-2
TABLE OF GRADATIONS - FINE AGGREGATE FOR CONCRETE

Percentage By Weight Passing Square Mesh Sieves	
Sieve Size	**Percent Passing**
⅜-inch (9.5 mm)	100
No. 4 (4.75 mm)	95-100
No. 8 (2.36 mm)	80-100
No. 16 (1.18 mm	50-85
No. 30 (0.600 mm)	25-60
No. 50 (0.300 mm)	5-30
No. 100 (0.150 mm)	0-10
No. 200 (0.075 mm)	0-3

A maximum 45% of the fine aggregate can be retained between any two consecutive sieves.

701.01.2 Coarse Aggregate for Concrete

A. General Requirements. Coarse aggregate is crushed stone, gravel, or blast-furnace slag having hard, strong, durable pieces, free from adherent coatings. Other approved inert materials with similar characteristics or combinations of the above materials may be used, provided they are in accordance with the contract.

The limits for deleterious material and soundness specified in Subsection 701.01.2(B) and (C) will be waived for aggregate used in structures or portions of structures not exposed to the weather.

B. Deleterious Substances. Meet the deleterious material in accordance with Table 701-3.

TABLE 701-3
LIMITS ON DELETERIOUS SUBSTANCES
IN COARSE AGGREGATE

Substance	Maximum % By Wt.
Coal and lignite	1.00
Clay lumps	0.25
Soft fragments	5.00
Thin or elongated aggregate having a length greater than five times average thickness.	15.00
Material passing the No. 200 (0.075 mm) sieve	1.00[1]

Notes:1. In crushed aggregates, if the material finer than the No. 200 (0.075 mm) sieve consists of fracture dust essentially free from clay or shale, the maximum limit may be increased to 1.5%.

Ensure that the material does not contain other deleterious material.

C. Soundness. When the coarse aggregate is subjected to five cycles of the sodium or magnesium sulfate soundness test, the total percentage loss cannot exceed 12 and 18% by weight respectively.

D. Percentage of Wear. Furnish coarse aggregate having a wear factor not exceeding 40%.

E. Reserved.

F. Grading. Furnish 1½-inch (37.5 mm) aggregate in accordance with Table 701-4 for No. 4 to 1½-inch (4.75 to 37.5 mm), furnished in two separate sizes respectively meeting the gradations for No. 4 to ¾-inch (4.75 to 19 mm) and ¾ to 1½-inch (19 mm to 37.5 mm) size material.

Furnish ¾-inch (19 mm) aggregate meeting the gradations for No. 4 to ¾-inch (4.75 to 19 mm) material.

Furnish coarse aggregate uniformly graded between the limits in accordance with Table 701-4.

The aperture shape used for coarse aggregate acceptance has no relation to the size and shape of the aperture or screen type used in producing the material.

TABLE 701-4
TABLE OF GRADATIONS - COARSE AGGREGATE FOR CONCRETE

Percentage By Weight Passing Square Mesh Sieves Designated Sizes				
Sieve Size	**No. 1**	**No. 2**	**No. 3**	**No. 4**
	No. 4 to 1½″ (4.75 to 37.5 mm)	**No. 4 to ¾″ (4.75 to 19 mm)**	**¾″ to 1½″ (19 to 37.5 mm)**	**No. 4 to ½″ (4.75 to 12.5 mm)**
2-inch (50 mm)	100		100	
1½-inch (37.5 mm)	95-100		90-100	
1-inch (25 mm)		100	20-55	
¾-inch (19 mm)	35-70	90-100	0-15	100
½-inch (12.5 mm)				90-100
⅜-inch (9.5 mm)	10-30	20-55	0-5	40-70
No. 4 (4.75 mm)	0-5	0-10		0-15
No. 8 (2.36 mm)		0-5		0-5

Note: Nos. 1, 2, 3, and 4 correspond to AASHTO/ASTM designations 467, 67, 4, and 7, respectively.

701.01.3 Optimized Gradations for Concrete

Optimizing a gradation by combining two or more sizes of aggregate is allowed and may be required for specific classes of concrete. Meet all the specifications listed in Subsections 701.01.1 and 701.01.2 for fine and coarse aggregate respectively except for the gradation requirements. Furnish a combined gradation in accordance with MT 215. If the combined gradation in the mix design submittal is approved, adhere to the tolerances listed in Table 701-5 during concrete production. The tolerances will be placed on the combined percent passing each sieve as defined in MT 215.

TABLE 701-5
OPTIMIZED GRADATION REQUIREMENTS

Sieve Size	Production Tolerance
No. 4 or greater (4.75 mm or greater)	± 5%
No. 8 to No. 30 (2.36 mm to 0.600 mm)	± 4%
No. 50 (0.300 mm)	± 3%
No. 100 (0.150 mm)	± 2%
No. 200 or lesser (0.075 mm or lesser)	± 1.5%

Perform quality control gradations as necessary to control the production of aggregate and concrete. The combined aggregate gradation tests must meet the mix design target gradation and the tolerances listed above.

Do not target a combined percent passing of more than 2.0% on the #200 sieve.

701.02 AGGREGATE FOR SURFACING

701.02.1 General Requirements

The following test methods are used to evaluate the surfacing aggregate quality:

Fracture ..... MT 217
Liquid Limit, Plastic Limit, Plasticity Index ..... MT 208
Micro-Deval..... MT 233
Sand Equivalent..... MT 213
Sieve Analysis For Fine And Coarse Aggregate ..... MT 202
Sulfate Soundness..... AASHTO T 104 or ASTM C88
Wear Test ..... MT 209

Passing wear test results are mandatory for Department approval of sources. Micro-Deval or sulfate soundness tests may be used by the Department for source approval. If Micro-Deval is used and the test fails, the Department will conduct the sulfate soundness test. If the sulfate soundness test fails the Contractor may not use the source to produce coarse surfacing aggregate.

Meet the following Micro-Deval requirements:

- Coarse Aggregate, 18.0% loss maximum for acceptance.

Meet the following sulfate soundness requirements:

- When coarse aggregate is subjected to 5 cycles of the sodium or magnesium sulfate soundness test, the total corrected loss cannot exceed 12 and 18% by weight respectively.

If the test results indicate the aggregate does not meet the requirements, the Contractor may make a written request for an independent laboratory to retest the material in question. The Contractor and the Department must agree upon the choice of the independent laboratory before release of the sample for testing. The Department will maintain and provide the original sample

in the event of a retest. The independent laboratory results will be averaged with the results provided by the Department and the averaged results will be binding on both parties for acceptance of the material in question. The Contractor must pay the cost of duplicate testing if the average results in a failing test. The Department will pay the cost of duplicate testing if the average results in a passing test.

Furnish aggregate that does not contain wood and other plant material.

Do not use scoria (fired clay commonly found in conjunction with burned coal in the lignite fields of the State) as aggregate. Sources of scoria are common but not limited to Daniels, Sheridan, Roosevelt, McCone, Dawson, Prairie, Wibaux, Custer, Fallon, Rosebud, Treasure, Bighorn, Powder River, and Carter Counties.

That portion of the aggregate retained on the No. 4 (4.75 mm) sieve is coarse aggregate, and that passing the No. 4 (4.75 mm) sieve is fine aggregate.

When wear factors are specified in the contract, the term “aggregate surfacing” includes all aggregates specified in Subsections 701.02.4 through 701.02.9.

The Department has 30 calendar days from receipt of the test sample to furnish the test results. Contract time will be increased working day for working day, for each day the test results are delayed beyond the 30-day review period, if the Departments delay affects the Contractor’s operation as shown on the current work schedule. Contract time will not be extended if the delay occurs from November 16th through April 15th, unless the Contractor is being charged contract time under Subsection 108.07.3.

701.02.2 Select Surfacing

Furnish select surfacing, including added binder or blending material in accordance with Table 701-6.

TABLE 701-6
TABLE OF GRADATIONS - SELECTED SURFACING

Percentage By Weight Passing Square Mesh Sieves						
Sieve Size	**Grade 1**	**Grade 2**	**Grade 3**	**Grade 4**	**Grade 5**	**Grade 6**
4-inch (100 mm)	100					
3-inch (75 mm)		100				
2½-inch (63 mm)			100			
2-inch (50 mm)				100		
1½-inch (37.5 mm)					100	
1-inch (25 mm)						100
No. 200 (0.075 mm)	15 max.	15 max.	15 max.	15 max.	15 max.	15 max.

For material passing the No. 40 (0.425 mm) sieve, the liquid limit must not exceed 30, and the plasticity index must not exceed 6.

701.02.3 Sand Surfacing

Furnish sand surfacing in accordance with Table 701-7.

TABLE 701-7
TABLE OF GRADATIONS - SAND SURFACING

Percentage By Weight Passing Square Mesh Sieves					
Sieve Size	**Grade 1**	**Grade 2**	**Grade 3**	**Grade 4**	**Grade 5**
1½-inch (37.5 mm)	100				
1-inch (25.0 mm)		100			
¾-inch (19.0 mm)			100		
½-inch (12.5 mm)				100	
No. 4 (4.75 mm)					100
No. 10 (2.00 mm)	65 min.	65 min.	65 min.	50 min.	50 min.
No. 200 (0.075 mm)	20 max.	20 max.	20 max.	20 max.	20 max.

For material passing the No. 40 (0.425 mm) sieve, the liquid limit must not exceed 25, and the plasticity index must not exceed 0.

701.02.4 Crushed Base Course Type "A"

Furnish crushed base course Type "A", including added binder or blending material in accordance with Table 701-8. Glass cullet meeting Subsection 701.11 requirements may be used as blending material.

TABLE 701-8
TABLE OF GRADATIONS - CRUSHED BASE COURSE TYPE "A"

Percentage By Weight Passing Square Mesh Sieves		
Sieve Size	**Grade 5A**	**Grade 6A**
2-inch (50 mm)	100	
1½-inch (37.5 mm)	94-100	100
¾-inch (19.0 mm)	70-88	74-96
⅜-inch (9.5 mm)	50-70	40-76
No. 4 (4.75 mm)	34-58	24-60
No. 40 (0.425 mm)	6-30	6-34
No. 200 (0.075 mm)	0-8	0-8

Meet the following requirements for crushed base course Type "A":

1. For material passing the No. 40 (0.425 mm) sieve, the liquid limit must not exceed 25, and the plasticity index must not exceed 6;
2. Dust ratio limitations do not apply;
3. A wear factor not exceeding 50% at 500 revolutions;
4. Furnish binder meeting Subsection 301.02.2 requirements; and
5. At least 35% by weight of the aggregate retained on the No. 4 (4.75 mm) sieve has at least one mechanically fractured face.

701.02.5 Crushed Base Course Type "B"

Furnish crushed base course Type "B", including added binder or blending material in accordance with Table 701-9.

TABLE 701-9
TABLE OF GRADATIONS - CRUSHED BASE COURSE TYPE "B"

Percentage By Weight Passing Square Mesh Sieves			
Sieve Size	**Grade 1**	**Grade 2**	**Grade 3**
2-inch (50 mm)	100		
1½-inch (37.5 mm)		100	
1-inch (25 mm)	50-80		100
No. 4 (4.75 mm)	20-50	25-55	30-60
No. 10 (2.00 mm)			20-50
No. 200 (0.075 mm)	8 max.	8 max.	8 max.

Meet the following requirements for crushed base course Type "B":

1. For material passing the No. 40 (0.425 mm) sieve, the liquid limit must not exceed 35, and the plasticity index must not exceed 10;
2. Dust Ratio: The portion passing the No. 200 (0.075 mm) sieve must not exceed two-thirds of the portion passing the No. 40 (0.425 mm) sieve;
3. A wear factor not exceeding 50% at 500 revolutions;
4. Up to 5% by weight of material one grade larger than that being produced is allowed. For example, when producing 1½-inch (37.5 mm) material, up to 5% of the total weight of material produced may be 2-inch (50 mm) material;
5. Furnish binder meeting Subsection 301.02.2 requirements; and
6. At least 20% by weight of the aggregate retained on the No. 4 (4.75 mm) sieve must have one mechanically fractured face.

701.02.6 Crushed Top Surfacing Type "A"

Furnish crushed top surfacing Type "A", including added binder or blending material in accordance with Table 701-10.

TABLE 701-10
TABLE OF GRADATIONS - CRUSHED TOP SURFACING TYPE "A"

Percentage By Weight Passing Square Mesh Sieves					
Sieve Size	**Grade 1**	**Grade 2**	**Grade 3**	**Grade 4**	**Grade 5**
1-inch (25 mm)	100				
¾-inch (19.0 mm)		100			
⅝-inch (16.0 mm)			100		
½-inch (12.5 mm)				100	
⅜-inch (9.5 mm)					100
No. 4 (4.75 mm)	40-70	40-70	40-70	40-70	50-80
No. 10 (2.00 mm)	25-55	25-55	25-55	25-60	35-70
No. 200 (0.075 mm)	2-8	2-8	2-8	2-8	2-8

Meet the following requirements for crushed top surfacing Type "A", including added binder or blending material:

1. Dust Ratio: the portion passing the No. 200 (0.075 mm) sieve cannot exceed two-thirds of the portion passing the No. 40 (0.425 mm) sieve;
2. For material passing the No. 40 (0.425 mm) sieve, the liquid limit must not exceed 25, and the plasticity index must not exceed 6;

3. The composite aggregate does not contain adherent films of clay and other matter that prevents thorough coating with bituminous material. Bituminous material must remain adhered to the material upon contact with water;
4. When the aggregate is to be bituminized, both the material source and the composite aggregate must not show cracking or disintegration;
5. Do not remove intermediate sizes from the material during production, unless authorized in writing;
6. Have a wear factor not exceeding 50% at 500 revolutions; and
7. At least 35% by weight of the aggregate retained on the No. 4 (4.75 mm) sieve must have at least one mechanically-fractured face.

701.02.7 Crushed Top Surfacing Type "B"

Furnish crushed top surfacing Type "B", including added binder or blending material in accordance with Table 701-11.

TABLE 701-11
TABLE OF GRADATIONS - CRUSHED TOP SURFACING TYPE "B"

Percentage By Weight Passing Square Mesh Sieves			
Sieve Size	**Grade 1**	**Grade 2**	**Grade 3**
1½-inch (37.5 mm)	100		
1-inch (25 mm)		100	
¾-inch (19.0 mm)			100
½-inch (12.5 mm)			
No. 4 (4.75 mm)	40-80	40-80	40-80
No. 10 (2.00 mm)	25-60	25-60	25-60
No. 200 (0.075 mm)	8-20	8-20	8-20

Meet the following requirements for crushed top surfacing Type "B", including added binder or blending material:

1. Dust Ratio: the portion passing the No. 200 (0.075 mm) sieve cannot exceed two-thirds of the portion passing the No. 40 (0.425 mm) sieve;
2. For material passing the No. 40 (0.425 mm) sieve, the liquid limit must not exceed 35, and the plasticity index must not be below 6 or above 12;
3. A wear factor not exceeding 40% at 500 revolutions; and
4. At least 35% by weight of the aggregate retained on the No. 4 (4.75 mm) sieve must have one fractured face.

701.02.8 Crushed Cover Aggregate - Cover Material

Furnish cover material in accordance with Table 701-12.

TABLE 701-12
TABLE OF GRADATIONS - COVER MATERIAL

Percentage By Weight Passing Square Mesh Sieves		
Sieve Size	**Type 1**	**Type 2**
½-inch (12.5 mm)		100
⅜-inch (9.5 mm)	100	40-100
No. 4 (4.75 mm)	0-15	0-8
No. 200 (0.075 mm)	0-2	0-1

Meet the following requirements:

1. The composite aggregate must not have adherent films of clay, vegetable matter, frozen lumps, and other extraneous matter that prevents thorough coating with bituminous material. Bituminous material must remain adhered to the material upon contact with water. No combination of shale, clay, coal, and soft particles can exceed 1.5%;
2. The aggregate must have a wear factor not exceeding 30% at 500 revolutions; and
3. A minimum of 70% by weight of the coarse aggregate must have at least one fractured face.

701.02.9 Aggregate for CTB

Furnish aggregate for CTB; including added blending material in accordance with Table 701-13.

TABLE 701-13
TABLE OF GRADATIONS - AGGREGATE FOR CTB

Percentage By Weight Passing Square Mesh Sieves	
Sieve Size	**Percent Passing**
¾-inch (19.0 mm)	100
No. 4 (4.75 mm)	40-70
No. 10 (2.00 mm)	25-55
No. 200 (0.075 mm)	4-12

Meet the following requirements:

1. For material passing the No. 40 (0.425 mm) sieve, the liquid limit must not exceed 30, and the plasticity index must not exceed 7; and
2. The material used to produce the aggregate must have a wear factor not exceeding 50% at 500 revolutions.

701.03 AGGREGATE FOR BITUMINOUS MIXTURES

701.03.1 General Requirements

The following test methods will be used to evaluate the quality of aggregate to be bituminized:

TABLE 701-14
AGGREGATE REQUIREMENTS

Coarse Aggregate (No. 4 (4.75 mm) And Larger)	
Angularity (MT 217 or ASTM D5821)	See Table 701-15
Wear (MT 209 or AASHTO T 96)	40% max
	30% max[1]
Flat and elongated particles (ASTM D4791) (3:1 ratio; by mass; No. 4 (4.75 mm) and larger)	20% max.
Absorption (AASHTO T 85)[2]	2.5% max
Fine Aggregate (All Material Passing No. 4 (4.75 mm))	
Angularity (AASHTO T 304 Method A)	45% min.
Sand equivalent (MT 213 or AASHTO T 176)	45% min.

Notes:
1. For ⅜-inch (9.5 mm) mixes only.
2. For warm mixes only.
3. As determined by alternate method No. 2.

All aggregate must be non-plastic when tested in accordance with MT 208 or AASHTO T 89 and T 90.

Passing wear test results are mandatory for Department approval of bituminized material aggregate sources. Micro-Deval or sulfate soundness tests may be used by the Department for source approval. If Micro-Deval is used and the test fails, the Department will conduct the sulfate soundness test. If the sulfate soundness test fails the Contractor may not use the source to produce coarse aggregate to be bituminized.

Meet the following Micro-Deval requirements:

- Coarse Aggregate, 18.0% loss maximum for acceptance.

Meet the following sulfate soundness requirements:

- When coarse aggregate is subjected to 5 cycles of the sodium or magnesium sulfate soundness test, the total corrected loss cannot exceed 12 and 18% by weight respectively.

If the test results indicate the aggregate does not meet the requirements, the Contractor may make a written request for an independent laboratory to retest the material in question. The Contractor and the Department must agree upon the choice of the independent laboratory before release of the sample for testing. The Department will maintain and provide the original sample in the event of a retest. The independent laboratory results will be averaged with the results provided by the Department and the averaged results will be binding on both parties for acceptance of the material in question. The Contractor must pay the cost of duplicate testing if the average results in a failing test. The Department will pay the cost of duplicate testing if the average results in a passing test.

Furnish aggregate that does not contain wood and other plant material.

Do not use scoria (fired clay commonly found in conjunction with burned coal in the lignite fields of the State) as aggregate to be bituminized. Sources of scoria are common but not limited to Daniels, Sheridan, Roosevelt, McCone, Dawson, Prairie, Wibaux, Custer, Fallon, Rosebud, Treasure, Bighorn, Powder River, and Carter Counties.

The portion of the aggregate retained on the No. 4 (4.75 mm) sieve is defined as coarse aggregate, and that passing the No. 4 (4.75 mm) sieve is defined as fine aggregate.

The Department has 30 calendar days from receipt of the test sample to furnish the test results. Contract time will be increased, working day for working day, for each day the test results are delayed beyond the 30-day review period, if the Departments delay affects the Contractor's operation as shown on the current work schedule. Contract time will not be extended if the delay occurs from November 16th through April 15th unless the Contractor is being charged contract time under Subsection 108.07.3.

701.03.2 Aggregate for Plant Mix Surfacing

Furnish aggregate for plant mix surfacing, including hydrated lime when required, in accordance with following.

TABLE 701-15
GRADE S MIXTURE DESIGN AND PRODUCTION REQUIREMENTS

¾-inch (19 mm), ½-inch (12.5 mm) and ⅜-inch (9.5 mm) Nom. Max. Aggregate Size														
20 Year Design ESALs[1]		**Number of Compactive Gyrations**			**% of Rice**			**Coarse Agg Angularity**	**VMA %**			**VFA %**	**VTM % (Air Voids)**	**DP (Dust to effective binder ratio)[2]**
Total (million)	Daily	Initial (N_{ini})	Design (N_{des})	Max (N_{max})	Max @ N_{ini}	Max @ N_{des}	Max @ N_{max}	1 face / 2 face	Min @ N_{des} (¾")	Min @ N_{des} (½")	Min @ N_{des} (⅜")	Range @ N_{des}	Range @ N_{des}	Range (P0.075/ Pbe)
≤ 0.3	≤ 41	7	75	115	91.5	96 to 96.6	98	75/ -	≥ 13.0	≥ 13.5	≥ 15.5	70 to 80	3.4 to 4.0	0.6 to 1.4
0.3 to <10	41 to <1370				90.5			85/80				65 to 78		
≥ 10	≥1370				89			95/90						

Notes:

1. If ESAL's are not specified in the contract, use the 0.3 to 10 million ESAL design requirements in Table 701-15 to develop the mix design, unless otherwise directed by the Project Manager.
2. In addition to meeting the DP requirement at mix design, report the D/A for the mix design target asphalt content.

Table 701-16
GRADE S AGGREGATE DESIGN REQUIREMENTS

¾-inch (19 mm), ½-inch (12.5 mm) and ⅜-inch (9.5 mm) Nominal Maximum Aggregate Size							
Percent By Weight Passing Square Mesh Sieves							
Sieve	Gradation Limits						
	¾-inch (19.0 mm)		½-inch (12.5 mm)		⅜-inch (9.5 mm)		
	Min	Max	Min	Max	Min	Max	Job Mix Tolerance
1-inch (25 mm)	100						
¾-inch (19 mm)	90	100	100				
½-inch (12.5 mm)		90	90	100	100		± 7
⅜-inch (9.5 mm)				90	90	100	± 7
No. 4 (4.75 mm)						90	± 7
No. 8 (2.36 mm)	23	49	28	58	32	67	± 6
No. 16 (1.18 mm)							± 6
No. 30 (0.600 mm)							± 4
No. 50 (0.300 mm)							± 4
No. 100 (0.150 mm)							± 2
No. 200 (0.075 mm)	2	8	2	10	2	10	± 1.5

Notes: Percentage or Quantity of hydrated lime will not be subtracted from the aggregate gradation

TABLE 701-17
HAMBURG WHEEL TRACK REQUIREMENTS

PG Binder Grade	Water Bath Temperature	Not To Exceed 0.5-inch (13 mm) Rut in Number of Passes	
		Produced Plant Mix	Mix Design
PG 58-28	111 °F (44 °C)	10,000 Passes	15,000 Passes
PG 64-22 and PG 64-28	122 °F (50 °C)	10,000 Passes	15,000 Passes
PG 70-28	133 °F (56 °C)	10,000 Passes	15,000 Passes

TABLE 701-18
GRADE S SPECIFICATIONS

¾-inch (19 mm), ½-inch (12.5 mm) and ⅜-inch (9.5 mm) Nominal Maximum Aggregate Size							
Property	**Job Mix Target Limits**			**Job Mix Tolerance**	**Start-Up Job Mix Range [3]**		
	¾-inch (19 mm)	**½-inch (12.5 mm)**	**⅜-inch (9.5 mm)**		**¾-inch (19 mm)**	**½-inch (12.5 mm)**	**⅜-inch (9.5 mm)**
VMA	13.0 to 17.0	13.5 to 18.0	16.1 to 18.4	± 0.6	12.4 to 17.6	12.9 to 18.6	15.5 to 19.0
VFA	65 to 80			± 5.0	60 to 85		
VTM @ N_{des} [1]	3.4 to 4.0			± 1	2.4 to 5.0		
D/A [2]	0.6 to 1.4			±0.2	0.6 to 1.4		
Commercial Plant Mix Requirements							
VMA	12.4 to 17.6	12.9 to 18.6	15.5 to 19.0	N/A	N/A		
VFA	60 to 85			N/A	N/A		
VTM [1]	2.4 to 5.0			N/A	N/A		
D/A	0.6 to 1.4			N/A	N/A		

Notes:
1. Choose the design and production air voids target to be the lowest value, within the range in Table 701-16 inclusive of 3.4 and 4.0, such that all other criteria are met.
2. Percentages or quantities of hydrated lime will not be subtracted from the aggregate gradation.
3. Start-up job mix range only applies to production before initial target set. Tolerances do not apply to start up job mix range.

701.04 FOUNDATION AND BEDDING MATERIAL FOR STRUCTURES

701.04.1 Bedding Material

Furnish bedding material for minor drainage structures and culvert foundations. Glass Cullet meeting Subsection 701.11 requirements may be used as blending material.

Furnish bedding material that is reasonably free of clay, silt, and other deleterious material in accordance with Table 701-19.

TABLE 701-19
TABLE OF GRADATIONS - BEDDING MATERIAL

Percentage By Weight Passing Square Mesh Sieves	
Sieve Size	**Percent Passing**
1½-inch (37.5 mm)	100
No. 4 (4.75 mm)	24-60
No. 200 (0.075 mm)	12 maximum

701.04.2 Foundation Material

Foundation material is one or more aggregate material courses to provide a stable foundation for culvert and drainage structure installations in unstable areas.

Use shot rock, pit-run aggregate, crushed aggregate, or any combination of these materials. The largest rock or rock fragment allowed may be as great in dimension as the thickness of the lift being placed. In the top 1-foot (305 mm) of the foundation, the largest rock or rock fragment cannot exceed 8 inches (200 mm). Use well-graded material in the top 1-foot (305 mm) of foundation material. A maximum 40% by weight of the foundation material must pass a No. 4 (4.75 mm) sieve.

701.04.3 Granular Bedding Material

Furnish granular bedding material in accordance with Table 701-4 No. 2.

701.05 FILTER MATERIAL

Furnish filter material in accordance with Table 701-20.

TABLE 701-20
TABLE OF GRADATIONS - FILTER MATERIAL

Percentage By Weight Passing Square Mesh Sieves		
Sieve Size	**No. 1**	**No. 2**
2-inch (50 mm)		100
1½-inch (37.5 mm)		95-100
¾-inch (19.0 mm)		35-70
⅜-inch (9.5 mm)	100	10-30
No. 4 (4.75 mm)	95-100	0-5
No. 8 (2.36 mm)	80-100	
No. 16 (1.18 mm)	50-85	
No. 30 (0.60 mm)	25-60	
No. 50 (0.30 mm)	5-30	
No. 100 (0.15 mm)	0-10	

701.06 RIPRAP

Furnish stone that is hard, durable, and angular in shape, resistant to weathering and water action, free from overburden, spoil, shale, structural defects, and organic material.

Each stone must have its greatest dimension not greater than 3 times its least dimension.

Do not use rounded stone or boulders from a streambed source as riprap. Do not use shale or stone with shale seams.

The stone will be accepted based on visual analysis, the Department's riprap evaluation form, or both. Submit samples before placing the riprap.

701.06.1 Handlaid Riprap

Furnish stone or rock fragment at least 3 inches (75 mm) thick, a minimum .5 cubic foot (0.014 m^3) in volume, weighing at least 75 pounds (34 kg), excluding rock spalls.

Extend all stones and fragments through the revetment, except spalls used to chock larger stones and fill voids between the larger stones.

701.06.2 Random Riprap

Furnish the specified random riprap in accordance with Table 701-21.

TABLE 701-21
TABLE OF GRADATIONS - RANDOM RIPRAP

Class	Weight Of Stone	Equivalent Spherical Diameter[1]	% Of Total Weight That Must Be Smaller Than Given Size
I	100 pounds (45 kg) 60 pounds (27 kg) 25 pounds (11 kg) 2 pounds (0.90 kg)	1.05 feet (320 mm) 0.88 feet (270 mm) 0.66 feet (200 mm) 0.27 feet (80 mm)	100 70-90 40-60 0-10
II	700 pounds (318 kg) 500 pounds (227 kg) 200 pounds (91 kg) 20 pounds (9.0 kg)	2.00 feet (610 mm) 1.79 feet (545 mm) 1.32 feet (400 mm) 0.61 feet (190 mm)	100 70-90 40-60 0-10
III	2,000 pounds (09 kg) 1,400 pounds (35 kg) 700 pounds (318 kg) 40 pounds (18 kg)	2.82 feet (860 mm) 2.53 feet (770 mm) 2.00 feet (610 mm) 0.77 feet (235 mm)	100 70-90 40-60 0-10

Note 1. Based on unit weight of 165 pounds per cubic foot (2,675 kg/m^3).

701.06.3 Grouted Riprap

Furnish stone for grouted riprap in accordance with Subsection 701.06.2.

701.07 BANK PROTECTION

Furnish rock that is hard, dense, and durable. Use either quarried rock or natural coarse gravel. Rock may be obtained from adjacent roadway excavation. Do not use rock obtained from streambeds.

Furnish the specified bank protection in accordance with Table 701-22.

TABLE 701-22
SIZE REQUIREMENTS - BANK PROTECTION

Type	1	2	3	4
Nominal thickness	24-inch (610 mm)	18-inch (455 mm)	12-inch (305 mm)	Coarse gravel
Overall thickness including bedding	30-inch (760 mm)	24-inch (610 mm)	18-inch (455 mm)	As specified in the contract
Largest rock permissible	¼ cubic yd. (0.19 m^3)	⅛ cubic yd. (0.09 m^3)	1 cubic ft. (0.03 m^3)	⅛ cubic ft. (0.003 m^3)
Smallest rock permissible	$^1/_{10}$ cubic ft. (0.003 m^3)	$^1/_{10}$ cubic ft. (0.003 m^3)	1½-inch (38 mm)	$^3/_{16}$-inch (5 mm)

701.08 SAND-GRAVEL CUSHION

Furnish sand-gravel cushion for concrete slope protection in accordance with Subsection 701.04.1 for bedding material except that all the material must pass a 1½-inch (38 mm) sieve.

701.09 BACKFILL FOR METAL BIN-TYPE RETAINING WALLS

Furnish backfill for the bins specified by the bin manufacturer. If not specified, use a gravel-type soil with 95% passing the 2-inch (50 mm) sieve and not more than 10% passing the No. 200 (0.075 mm) sieve. The material must have a plasticity index not exceeding 10.

701.10 DRAIN AGGREGATE

Furnish drain aggregate that is rounded to sub-rounded aggregate in accordance with Table 701-23.

TABLE 701-23
TABLE OF GRADATIONS - DRAIN AGGREGATE

Percentage By Weight Passing Square Mesh Sieves	
Sieve Size	**Percent Passing**
6-inch (152 mm)	100
¾-inch (19 mm)	0-10
No. 4 (4.75 mm)	0-5

701.11 GLASS CULLET FOR SOIL-AGGREGATE FILLER

When requested and approved as an aggregate blending material, furnish and blend Glass Cullet in accordance with AASHTO M 318. Meet the following requirements for the glass cullet and the blended product:

A. Furnish glass cullet containing no more than 5% cullet originating from non-beverage container glass. Furnish the Project Manager certification that the cullet meets this limit before it is used. If the cullet exceeds this limit, submit a laboratory test plan that meets the requirements of the appendices of AASHTO M 318. Approval of the cullet will be based on the approved testing plan and the test results;

B. Have the glass cullet tested to ensure it meets the physical properties and deleterious substances requirements in AASHTO M 318. Furnish the Project Manager copies of the test results before using the glass cullet;

C. Produce a glass cullet/aggregate blended product that meets all requirements for the specified aggregate; and

D. Limit the glass cullet content to no more than 10% of the total blended product.

701.12 DIGOUT AND SUB-EX REPLACEMENT MATERIAL

If crusher reject material is used for digout and sub excavation replacement material, meet the gradation requirements in Table 701-24.

TABLE 701-24
DIGOUT AND SUB-EX REPLACEMENT MATERIAL (CRUSHER REJECT)

Percentage By Weight Passing Square Mesh Sieve	
Sieve size	**Percent Passing**
4-inch (100 mm)	100
No. 4 (4.75 mm)	0-50
No. 200 (0.075 mm)	8 maximum

701.13 BRIDGE END BACKFILL

Furnish Bridge End Backfill in accordance with Table 701-25.

TABLE 701-25
TABLE OF GRADATIONS – BRIDGE END BACKFILL

Sieve Size	Percentage By Weight Passing Square Mesh Sieves		
	Type 1[1]	Type 2	Type 3
4-inch (100 mm)		100	100
2-inch (50 mm)	100	60-100	Modified AASHTO Soil Class A-1-a
1-inch (25 mm)	60 – 80		
½-inch (12.5 mm)	40 – 60		
⅜-inch (9.5 mm)		25-65	
No. 4 (4.75 mm)	20 – 40		
No. 10 (2.00 mm)		10-30	
No. 40 (0.425 mm)	5 – 20		
No. 200 (0.075 mm)	0 – 8	0-8	0-8

Note 1. Provide a minimum of 35% of the material retained on the No. 4 (4.75 mm) sieve having at least 1 mechanically fractured face.

SECTION 702
BITUMINOUS MATERIALS

702.01 BITUMINOUS MATERIALS

A. Furnish bituminous materials in accordance with following tables.

Cationic Emulsified Asphalt ..... AASHTO M 208[1], Table 1
Emulsified Asphalt ..... AASHTO M 140[1], Table 1
High Float Emulsions..... Table 702-5
Medium Curing Liquid Asphalt (MC) ..... Table 702-4
Performance Graded Asphalt Binder ..... Table 702-2
Polymer-Modified Cationic Emulsified Asphalt... Table 702-3

Note 1. Cement mixing test does not apply when SS-1 or CSS-1 emulsion is used for spray or tack application.

Meet the requirements for bituminous materials in accordance with the contract.

B. Polymerize CRS-2P emulsions using at least 3% polymer by weight (mass) of the asphalt binder.

702.02 TESTING AND ACCEPTANCE

Bituminous materials are accepted on the test results of samples selected and tested by the Department or its authorized representative. Collect samples in accordance with Subsection 402.03.2 and tested using the applicable AASHTO method. The Project Manager may permit using bituminous materials before the test results are available, if the test results of material previously furnished by the refiner have consistently been satisfactory. The use of bituminous materials before receipt of the test results as permitted by the Project Manager does not waive the Department's right to accept or reject materials under these specifications.

Asphalt cement penetration is sampled and accepted in accordance with Subsections 402.03.2 and 402.03.5(B).

TABLE 702-1
BASIS FOR ACCEPTANCE OF BITUMINOUS MATERIALS

Sample Tested	Specification Limits[1]		Remarks
	Test Results Within Limits	Test Results Outside Limits[2]	
Original sample	accept material	test retained sample	Retained samples may be tested by the Department at any time.
Retained sample	accept material	accept material at reduced price or reject	

Notes:
1. See specification for bituminous materials.
2. Pay adjustments will be applied under QA.

If test results of both the original and retained samples are not within the tolerance limits, the average of the two values will determine the basis for acceptance of the material.

Exception: If either of the two test values are outside the applicable ASTM Repeatability Range, then the test value numerically nearest the specification requirement will be used as the basis for acceptance. In the event a material fails more than one test requirement, that requirement with the greatest violation will determine the basis for acceptance. See Subsection 402.03.5(C) for the method of calculating price reductions.

TABLE 702-2
SPECIFICATION FOR PERFORMANCE GRADED ASPHALT BINDER[1]

Property		Test Method: AASTHO	Requirements by Performance Grade			
			58-28	**64-22**	**64-28[2]**	**70-28[2]**
Original						
Flash point, °C		T 48	230 min.	230 min.	230 min.	230 min.
Rotational viscosity, Pa·s	135 °C	T 316	3.0 max.	3.0 max.	3.0 max.	3.0 max.
Dynamic shear, kPa (g*/sin δ, 10 rad./sec)		T 315	1.00 min.	1.00 min.	1.00 min.	1.00 min.
Test temperature			58 °C	64 °C	64 °C	70 °C
RTFO residue		T 240				
Mass change, %		T 240	1.00 max.	1.00 max.	1.00 max.	1.00 max.
Dynamic shear, kPa (g*/sin δ, 10 rad./sec.)		T 315	2.20 min.	2.20 min.	2.20 min.	2.20 min.
Test temperature			58 °C	64 °C	64 °C	70 °C
Ductility, cm	25 °C	T 51[2]	-	-	30 min.	30 min.
Pav residue		R 28	100 °C, 20 hrs, 300 psi			
Dynamic shear, kPa (g* · sin δ, 10 rad./sec.)		T 315	5000 max.	5000 max.	5000 max.	5000 max.
Test temperature			19 °C	25 °C	22 °C	25 °C
Creep stiffness, mPa		T 313	300 max.	300 max.	300 max.	300 max.
Test temperature			−18 °C	−12 °C	−18 °C	−18 °C
M-value		T 313	0.300 min.	0.300 min.	0.300 min.	0.300 min.
Direct tension, % strain		T 314	-	-	-	-

Notes:
1. For Performance Graded Asphalt Binders not shown in Table 702-2, refer to AASHTO M 320, Table 1.
2. Pull rate is established at 5 cm/minute.

Use PG 64-28 asphalt cement if not specified elsewhere in the contract.

TABLE 702-3
LAYTEX OR POLYMER MODIFIED CRS-2 EMULSIFIED ASPHALT

Property	Test Method	CRS-2P
Viscosity at 122 °F (50 °C), sec.	AASHTO T 59	70-400
Sieve, %	AASHTO T 59	0.3 max.
Settlement, 5 days, %	AASHTO T 59	5 max.
Demulsibility, %	AASHTO T 59	40 min.
Storage stability test, 1 day, %	AASHTO T 59	1 max.
Particle charge	AASHTO T 59	Positive
Ash content, %	AASHTO T 111	0.2 max.
Tests on residue by evaporation:		
% residue[1]	AASHTO T 59	65 min.
penetration, 100 g, 5 sec. at 77 °F (25 °C), dmm	AASHTO T 49	90-250
ductility at 77 °F (25 °C), 5 cm per minute, cm	AASHTO T 51	75 min.
elastic recovery, %	AASHTO T 301	58 min.

Note 1: AASHTO T 59 residue by evaporation will be used to obtain samples for all residue testing requirements. AASHTO T 59 is modified by deleting Note 8.

TABLE 702-4
SPECIFICATION FOR MEDIUM CURING LIQUID ASPHALTS

	MC-30		MC-70		MC-250		MC-800		MC-3000	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Kinematic viscosity at 140 °F (60 °C), centistokes[1]	30	60	70	140	250	500	800	1600	3000	6000
Flash point (tag, open-cup), °F (°C)	100 (38)	—	100 (38)	—	150 (66)	—	150 (66)	—	150 (66)	—
Water, %	—	0.2	—	0.2	—	0.2	—	0.2	—	0.2
Distillation test: distillate, percentage by volume of total distillate to 680 °F (360 °C)										
to 437 °F (225 °C)	—	25	0	20	0	10	—	—	—	—
to 500 °F (260 °C)	40	70	20	60	15	55	0	35	0	15
to 600 °F (315 °C)	75	93	65	90	60	87	45	80	15	75
Residue from distillation to 680 °F (360 °C) volume percentage of sample by difference	50	—	55	—	67	—	75	—	80	—
Tests on residue from distillation:										
Penetration, 100 g, 5 sec. at 77 °F (25 °C), dmm	120	250	120	250	120	250	120	250	120	250
ductility[2], 5 cm/min, cm	100	—	100	—	100	—	100	—	100	—
solubility, %	99	—	99	—	99	—	99	—	99	—
Spot test	negative for MC-3000 only									

Notes:

1. As an alternate, Saybolt-Furol viscosities may be specified as follows:
   Grade MC-70 - Furol viscosity at 122 °F (50 °C) - 60 to 120 sec.
   Grade MC-30 - Furol viscosity at 77 °F (25 °C) - 75 to 150 sec.
   Grade MC-250 - Furol viscosity at 140 °F (60 °C) - 125 to 250 sec.
   Grade MC-800 - Furol viscosity at 180 °F (82.2 °C) - 100 to 200 sec.
   Grade MC-3000 - Furol viscosity at 180 °F (82.2 °C) - 300 to 600 sec.
2. If the ductility at 77 °F (25 °C) is less than 100, the material will be acceptable if its ductility at 60 °F (15.5 °C) is more than 100.

TABLE 702-5
SPECIFICATIONS FOR HIGH FLOAT EMULSIONS

Grade	HF-100	
	Min.	Max.
Tests on emulsions:		
Viscosity Saybolt Furol at 122 °F (50 °C), sec.	50	400
Storage Stability 24 hr., %	—	1
Sieve Test, %	—	0.1
Demulsibility, 50 mL 5.55 g/L CaCl2, % by mass	30	—
Distillation:		
Residue, %	65	—
Oil Distillate, by volume of emulsion, %	—	2
Tests on residue from distillation test:		
Penetration at 77 °F (25 °C), 100 g, 5 sec., dmm	100	170
Ductility at 77 °F (25 °C), 5 cm per min., cm	40	—
Solubility, %	95.5	—
Float Test at 140 °F (60 °C), sec.	1200	—

SECTION 703
LIGHTING & SIGNAL MATERIALS

703.01 GENERAL

Furnish all electrical equipment that meets the contract and the following requirements:

1. NEMA;
2. The NEC;
3. The standards of the ASTM;
4. ANSI; and
5. All state and local laws or ordinances that may apply.

References to the above codes or standards are the current editions of the code, order, or standard at the time the contract is let and governs throughout the life of the contract.

Furnish galvanized parts in accordance with ASTM A153, B695 (Class 50), or other applicable ASTM galvanizing specifications. Galvanize the top 12 inches (305 mm) of anchor bolts. Galvanized bolts and nuts must thread together without damaging the coating.

703.02 CONDUIT

703.02.1 Plastic Conduit

Furnish rigid polyvinyl chloride (PVC) in accordance with UL 651, or continuous length high density polyethylene (HDPE) in accordance with UL 651B, schedule 80, 150 °F (66 °C) wire rated, direct bury type.

703.02.2 Steel Conduit

Furnish galvanized rigid steel conduit and fittings of mild steel in accordance with UL 6 and ANSI C 80.1.

703.03 PULL BOXES

703.03.1 Concrete Pull Boxes

Furnish concrete pull boxes, extensions, and covers made of reinforced concrete. Use Class General concrete in accordance with Section 551. Use reinforcing steel in accordance with Section 555.

Meet the pull box size and details specified in the contract.

Inscribe reinforced concrete covers for signal systems and/or lighting systems with the words “ELECTRIC”. Furnish a steel cover designed to withstand AASHTO HS-20 loads for pull boxes subject to vehicular traffic loads.

Furnish metal frames and covers for boxes or vaults formed in the concrete. Inscribe covers with the wording specified in the contract. Ensure gasket surfaces form a true plane. Install a ⅛-inch (3 mm) one-piece neoprene gasket on the frame or cover for the seal.

703.03.2 Composite Pull Boxes

Furnish pull boxes and covers made of polymer concrete with fiberglass reinforcement. Furnish pull boxes having continuous fiberglass cloth reinforcement on the inside and outside perimeters. Furnish covers having a minimum of 2 layers of fiberglass cloth reinforcement.

Ensure the pull boxes and covers comply with all test provisions of the most current ANSI/SCTE 77 for tier 15 applications. Furnish pull boxes and covers that have been tested and certified by a nationally recognized third party independent testing firm such as UL or Intertek Testing Services verifying that the boxes and covers meet all test provisions of the ANSI/SCTE 77.

Furnish pull boxes that have markings showing the tier 15 rating labeled or stenciled on the inside and outside of the box. Furnish covers that have markings showing the tier 15 rating

embossed in the top surface of the cover. Furnish covers having pull slots rated for a minimum pull out of 3,000 pounds (1,360 kg).

Furnish ⅜ x 7-inch (M10 x 178 mm) lag thread hex head bolts to secure the cover to the pull box.

703.04 STANDARDS AND POSTS

703.04.1 General

Furnish standards fabricated and inspected in accordance with Section 556 and designed to the 1994 AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals*.

Use a minimum luminaire dead load of 77 lb (35 kg), and a minimum luminaire projected area of 3.3 square feet (0.3 m^2) for design purposes. Use a design wind velocity for all standards of 90 miles per hour. Include on the shop drawings the following reaction data at the base of the pole, reported as reactions normal to the standard global coordinate system:

- Moment X (MX) Ft.-Lb.
- Moment Y (MY) Ft.-Lb.
- Torsion Z (MZ) Ft.-Lb.
- Shear force X (VX) Lb.
- Shear force Y (VY) Lb.
- Axial load (P) Lb.

Fabricate all standards from steel. Meet the standard manufacturer's requirements for the anchor bolt placement in the foundation.

703.04.2 Type 1 Signal Standards

Furnish standards in accordance with the contract.

Furnish a cast aluminum base with an internal ground lug and handhole with removable cover. Plumb bases with factory-made shims.

Furnish 4 high strength steel anchor bolts with each base. Furnish "L" shaped anchor bolts with a minimum 6 inches (150 mm) of the bolt threaded at the top. Furnish a nut and washer with each anchor bolt for the base.

Follow the manufacturer's recommendations for anchor bolt size.

All accessories welded to the shaft must be factory-welded to the shaft before galvanizing

703.04.3 Type 2 and 3 Signal Standards

Furnish a single steel section shaft formed into a round, continuous taper with a single, automatic electrically welded seam, or an approved equal.

Show the type of steel used for the shafts on the shop drawings.

Furnish 4 high-strength steel anchor bolts with each shaft. Furnish each anchor bolt with 2 nuts and 2 washers over and under the shaft base to adjust rake and plumb.

All accessories welded to the shaft must be factory-welded before galvanizing.

Furnish rain tight metal covers for the top of Type 2A and 3A signal standards.

703.04.4 Type 10 Luminaire Standards

Shafts must be a single section formed into a round, continuous taper with a single, automatic electrically welded seam, or approved equal. Steel shafts must be a minimum No. 11 Manufacturers Standard Gauge.

Show the type of steel on the manufacturer's shop drawings.

Furnish rain-tight metal covers for the top of each shaft.

Shafts not mounted on transformer bases must have a handhole with removable cover and an internal grounding lug, as shown in the contract. Locate the handhole in the same quadrant as the mast arm.

Shafts mounted on transformer bases do not require a handhole or grounding lug.

The shaft base (anchor or breakaway) to be used is specified in the contract.

The shaft base plate must be a one-piece plate circumferentially welded to the shaft for anchor and breakaway base types.

For anchor bases, the base plate must attach directly to the anchor bolts. Furnish each anchor bolt with 2 nuts and 2 washers for plumbing and raking the shaft.

For breakaway bases, the plate must be attached to a breakaway device that attaches to the anchor bolts.

Use breakaway bolt couplings unless they do not function with the approved luminaire standard. The bolt coupling must meet the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* requirements.

Use frangible transformer bases where bolt couplings cannot be used. Transformer bases must have an access door, grounding lug, and factory-made shims for plumbing. Provide each anchor bolt with one nut and one washer.

Furnish 4 high strength steel anchor bolts with each shaft. Furnish “L” shaped anchor bolts with a minimum 6 inches (150 mm) of the bolt threaded at the top. Size the anchor bolt in accordance with the shaft manufacturer’s recommendations.

Anchor bolts used with breakaway bolt couplings must project out of the foundation the length recommended by the coupling manufacturer. Furnish the breakaway bolt coupling, washer, nut and bolt covering that enclose the area between the base plate and foundation.

Anchor bolts used with transformer bases must project at least 3 inches (75 mm) from the foundation.

Provide a mounting base where the mast arm connects to the shaft. Provide an opening in the base for running wire from the shaft to the mast arm.

All accessories welded to the shaft must be factory-welded before galvanizing.

703.04.5 Mast Arms - Signal and Luminaire

Traffic signal mast arms up to 50 feet (15.2 m) in length must be single tapered members. Traffic signal mast arms over 50 feet (15.2 m) long may be two piece tapered members.

Luminaire mast arm ends must have a 2-inch (50 mm) slip-fitter tenon at least 6 inches (150 mm) long.

All accessories welded to the mast arm must be factory-welded before galvanizing.

Mast arm lengths and mounting heights are shown in the contract.

703.04.6 Welding Steel

Meet the requirements of Section 624 and the following:

Ensure that all Nondestructive Testing is performed by personnel qualified in conformance with the American Society for Nondestructive Testing Recommended Practice *No. SNT-TC-1A* to minimum Testing Level II for the individual methods. Provide ASNT certifications and procedures before testing. Meet all the applicable AASHTO and AWS welding inspection requirements including those modified as follows:

1. **Circumferential Weld Splices.** Perform radiographic testing or ultrasonic testing as approved by the Project Manager meeting AWS D1.1, Structural Welding Code, Section 6.
2. **Longitudinal Seams.** Inspect 100% of all full penetration groove welds using radiography or testing may be by ultrasonic test methods AWS D1.1, Structural Welding

Code Ultrasonic, Section 6, both of the above test methods to be approved by the Project Manager before use.

Randomly test 25% of all partial penetration welds and fillet welds per component using magnetic particle test methods.

3. **Base Connection Welds.** Randomly inspect 25% of all base connection welds and all fillet welds using magnetic-particle testing specified in AWS D 1.1, Structural Welding Code, Section 6.

703.04.7 Reserved

703.04.8 Finish

Furnish standards galvanized inside and out. A primer finish is not acceptable. Use stainless steel or zinc, cadmium, or galvanized coated fasteners. Provide galvanized nuts, washers, and shims for anchor bolts.

703.04.9 Wire Protection

Use insulated bushings or grommets to prevent wire abrasion at all wire openings and inlets.

703.04.10 Inspection

All standards will be inspected at the project before they are erected and may be inspected where fabricated.

703.05 CONDUCTORS AND CABLE

703.05.1 Conductors

Furnish conductors of solid or stranded copper of the gauge shown in the contract.

Insulation for conductors must be Type THW, XHHW, USE, RHH, RHW, THWN, or THHN.

All insulation must be designed for 600 volts and meet NEC requirements.

703.05.2 Signal Cable

Furnish cable in accordance with the IMSA specification No. 19-1 or 20-1.

Individual conductors must be stranded copper.

703.05.3 Detector Loop Shielded Cable

Use detector loop shielded cable as a lead-in between the loop pull box and the loop detector as specified.

Furnish with an aluminum-polyester shield with two AWG No. 14 stranded, tinned, polyethylene-insulated copper conductors, a stranded and tinned copper AWG No. 18 or 16 drain wire, all encased in a black polyethylene jacket meeting IMSA specification No. 50-2.

703.05.4 Emergency Preemption Detector Cable

Use cable recommended by the manufacturer for the emergency preemption system.

703.05.5 Communication Cable

Furnish BJFC 6 pair AWG No. 19 copper cable in accordance with REA specification PE 39.

703.05.6 50-Ohm Coaxial Cable

Furnish ⅜ or ½-inch (10 or 13 mm), super flexible, low loss, foam filled, watertight, coaxial cable. Furnish coaxial cable with the following characteristics:

1. Impedance of 50 ohms, ± 1 ohm.
2. Maximum attenuation of 13.0 dB/100 m at 900 MHz.
3. Outer conductor of bonded aluminum tape and an overall braid of tinned copper with an inner conductor of copper-clad aluminum.
4. Foam polyethylene dielectric.
5. UV protected black polyethylene jacket.

6. Minimum bending radius of 1-inch (25 mm) for installation, 4 inches (100 mm) for repeated bending, for ⅜-inch (10 mm). Minimum bending radius of 2 inches (50 mm) for ½-inch (13 mm) cable.

Furnish coaxial cable that is compatible with type “N” connector.

703.06 SERVICE AND CONTROL ASSEMBLY

Furnish cabinets meeting NEMA Type 3, 3R, or 12, made of aluminum or NEC-grade steel having a hinged, lockable door.

Include a terminal strip having the number of attaching points for the required conductors with the service and control assembly. Ensure the terminal strip has the capacity equal to an AWG No. 6 conductor.

703.07 CONTROL EQUIPMENT

703.07.1 Flasher

Furnish a solid-state dual circuit, plug-in type electronic flasher producing between 50 and 60 flashes per minute with equal on-and-off time intervals meeting all NEMA Type 3 requirements and conforming to part 4B-18 of the MUTCD.

703.07.2 Loop Detectors

Furnish two channel loop detectors of the rack mount type.

The loop detectors must be solid-state digital using external power. The front panel must contain sensitivity controls, mode selector switch, and an actuation indicator LED.

The loop detectors cannot not use more than 150 MA of current at 24 volts DC. The output must be by relay and plug mounted. The relay must be normally energized providing fail-safe functioning should the power fail. Furnish loop detectors in accordance with all NEMA temperature requirements. Use a 44 pin edge card connector to make all electrical connections.

703.08 TRAFFIC AND PEDESTRIAN SIGNALS

A. **Optical Units.** Furnish vehicular signal indications which utilize LEDs in accordance with the latest issue of the I.T.E. Vehicle Traffic Control Signal Heads specification. Furnish 12-inch (305 mm) circular and arrow signal indications that have clear polycarbonate lenses. The lens must be diffused or the module must have some other method of achieving the appearance of an incandescent lamp (smooth and non-pixilated). Furnish bi-modal “green/yellow” arrow indications that utilize LEDs.

   Furnish pedestrian signal indications which utilize LEDs in accordance with the latest issue of the I.T.E Pedestrian Traffic Control Signal Indication specification and the MUTCD. Furnish 16 x 18-inch (405 x 455 mm) pedestrian indications that utilize LEDs for the “UPRAISED HAND” symbol, the “WALKING PERSON” symbol and the countdown display. Furnish indications that have the countdown display and pedestrian displays in the same housing. Furnish indications with a countdown display that is at least 9 inches (225 mm) in height. Furnish indications that have filled in symbols to give the appearance of an incandescent indication. Furnish indications that are compatible with the pedestrian signal housing.

   Supply LED indications that have a guarantee to be replaced or repaired if a signal indication fails to function as intended due to workmanship or material defects within the first 60 months of operation. Furnish LED indications that work with a conflict monitor utilizing NEMA-plus functions, specifically dual indication.

B. **Signal Housing.** Assemble the signal head housing sections together in a watertight assembly. Each section must house an individual optical unit complete with a one-piece hinged door, a mounting for the lens and other optical system parts, watertight gaskets, and a non-corrodible door-lock.

Construct the optical system so the individual components swing open for access or removal. Ensure sections are interchangeable and constructed so sections can be added or removed. Each section must have a round opening in the bottom and top to receive a 1½-inch (38 mm) supporting pipe frame. The housing, including the doors and end plates must be die-cast aluminum, clean and smooth, free from flaws, cracks, blow holes, or other imperfections. Hinges, pins, lens clips, and locking devices must be non-corroding metal.

Mount a terminal block inside at the back of the housing. Wire all sockets with a white wire connected to the socket shell and a black wire to the bottom or end terminal of the socket. Connect these wires to the terminal block mounted in the housing.

The terminal block must have studs to terminate all field wires and lamp wires independently. Permanently identify the terminals.

Use paint in accordance with Section 710. Factory-enamel signal heads and fittings black or dark olive-green as to not require painting in the field. Apply one coat of primer and two coats of enamel to signal heads and other components, including the outside of visors and backplate backs.

Use the same color for like components in the same intersection.

Furnish with each section of each vehicle signal head, a removable tunnel visor (open bottom) of the appropriate size made from at least 0.050-inch (1.3 mm) thick aluminum. Factory apply two coats of flat black enamel to visor interiors, in accordance with this subsection.

C. Backplates. Furnish and install back plates on all traffic signal heads to form a 5-inch (130 mm) border around the signals. Make backplates from at least 0.058-inch (1.5 mm) sheet aluminum. Factory apply 2 coats of flat black enamel to front faces of backplates, in accordance with Subsection 703.08(B). Furnish backplates with a 2-inch (50 mm) wide yellow strip of Type IX retro-reflective sheeting. Apply the sheeting around the outer edge of the backplate.

D. Mounting Brackets. Mount signal heads using brackets made from 1½-inch (38 mm) standard steel pipe and malleable iron or brass pipe fittings. The slip fitter must fit over a 4-inch (103 mm) standard pipe. Provide each slip-fitter with two rows of three set screws in each row to plumb the assembly. Provide cadmium plated set screws.

Provide each compartment with a terminal block with twelve terminals, each with 2 pressure type connectors. Size each connector to accommodate at least 5 No. 14 conductors.

Provide the terminal compartment with an access opening to the terminal block with a rain-tight cover. All slip-fitters and terminal compartments must be made of non-frangible metal.

E. Optically-programmed Traffic Signals. The traffic signals must be optically-programmed and visible only to a specific area of the intersection. Meet all other contract requirements for construction or signal heads.

Use LED programmable visibility modules for optically-programmed signals that are compatible with the signal heads.

703.09 LOOPS

Furnish preformed and prefilled detector loops constructed from conduit. Use one continuous length of stranded No. 12 XHHW or stranded No. 14 THHN or TFFN conductor from the pull box, through the loops and returning back to the pull box. Construct loops using continuous ⅜-inch (9.5 mm) conduit for No. 14 conductor or ¾-inch (19 mm) conduit for No. 12 conductor.

Completely fill the conduit with hot rubberized asphalt or an approved flexible sealant to prevent incursion of moisture, and to set the turns of wire firmly in place.

Encase lead-in wires in a non-conductive 2,250 psi (15,500 kPa) flex hose constructed with a seamless extruded polyester fiber braid reinforcement and a non-conductive, seamless extruded urethane non-perforated jacket. Fill the lead-in hose completely with hot rubberized asphalt or flexible sealant. Twist wires in all lead-ins a minimum of 2 turns per foot (305 mm) for the entire length of the lead-in. Attach lead-ins to loop heads with a schedule 80 CPVC tee and a CPVC adapter bushing. Supply loops with sufficient lead-in to reach adjacent pull boxes. Use a continuous conductor without splices throughout the entire loop and lead-in hose.

703.10 PEDESTRIAN PUSH BUTTONS

Furnish tamper-proof pedestrian push buttons using a piezo type switch meeting ADA requirements. The push button must be flush with the housing and be at least 2 inches (50 mm) in the smallest dimension. The push button housing must be weatherproof, and electrically insulated to prevent shock under all weather conditions. Furnish a dark olive green housing back plate to fit the pole curvature and, when required, provide saddles to make a near fit. Furnish push button signs shown in the contract.

703.10.1 Accessible Pedestrian Signals (APS) (Tactile Push Buttons)

Furnish APS that include the pedestrian pushbutton and housing combination. The pushbutton must be in accordance with Subsection 703.10. The housing must have a locator tone to indicate the location of the button. The volume of the locator tone must be adjustable by digital means and must automatically adjust to ambient noise level. The volume over ambient noise level must be adjustable in increments of 5 decibels (dB). The button must have a raised arrow, which can be adjusted to point toward the appropriate crosswalk. The button and housing combination must also provide feedback that a call for service has been placed. The feedback must be in the form of a lit LED and an audible indication. The accessible signal must also provide vibro-tactile information, in the form of the button vibrating during the appropriate Walk signal. The pedestrian signals must operate without any additional equipment in the signal cabinet, or additional signal conductors from the cabinet.

When voice messaging is required, provide accessible pedestrian signal stations with custom voice messages that provide location information on a button push, and street crossing message when the appropriate walk signal activates. The voice messages will be in the following format:

- Voice on location (VOL): Wait to cross (Street to be crossed) at (Intersecting Street).
- Walk Message: (Street name being crossed). Walk sign is on to cross (Street name to be crossed).

703.11 LUMINAIRES

Furnish and install luminaires and lamps meeting these specifications and the contract requirements.

Wire all luminaires for 240-volt operation.

Furnish and install clear high pressure sodium vapor lamps having a 24,000 hour rated life.

Meet the following wattage and initial lumens requirements:

1. 200 Watt: 22,000 initial lumens.
2. 250 Watt: 27,500 initial lumens.
3. 400 Watt: 50,000 initial lumens.

Ballasts and luminaire must be integral, with the ballast providing −20 °F (−29 °C) starting capacity. Multiple ballasts must be 240 volt regulated lag type, 0.90 power factor, with an operating range of ± 10%. Starting and open circuit volt-amperes must not exceed operating values.

Furnish the unit with an independent, replaceable starting board.

The luminaire assemblies must be slip-fitter type, end mounted on a 2-inch (50 mm) pipe tenon.

Furnish ANSI/IES full-cutoff (flat lens), medium, type III distribution luminaires.

703.12 PHOTOELECTRIC CONTROLS

Furnish photoelectric control units of the twist-lock type.

Furnish units that turn on at 1.3 ± 0.5 foot candles, have a turn-on/off ratio in the range of 1:2 to 1:5, and are rated for a minimum of 1,000 watts at 120 volts.

Incorporate a time delay mechanism into the control preventing operation during brief light condition changes.

Provide a fail-safe that leaves the load on or becomes energized if the control fails.

703.13 RADIO ANTENNAS

703.13.1 Master Antenna

Furnish an omnidirectional antenna with the following specifications:

1. Frequency range of 890 MHz to 960 MHz;
2. Gain of 6 dBd;
3. Impedance of 50 ohms;
4. Termination with a type “N” connector, and;
5. Wind survival rating of 125 mph (200 kph).

703.13.2 Yagi Antenna

Furnish a yagi antenna for mounting on traffic signal poles as shown in the detailed drawings that meets the following specifications:

1. Frequency range of 896 MHz to 960 MHz;
2. Front to back ratio of 20 dB;
3. Nominal gain of 10 dBd; and
4. Bandwidth of 90 MHz.

Furnish an antenna that withstands wind speeds of 100 mph (160 kph), plus a 1.3 gust factor. Construct the antenna of rust resistant, corrosive free materials. Provide an antenna that has ⅜-inch (10 mm) coaxial cable meeting Subsection 703.05.6 integrally attached by the manufacturer.

703.14 CLASS 4 TREATED TIMBER POLES

Furnish the pole length and place as specified in the contract.

Furnish ANSI Class 4 poles as specified in the contract. Full length pressure-treat poles with a 5% solution of pentachlorophenol or copper napthenate (CuN) in accordance with AWPA Standards and Commodity specification D and use category 4A.

703.15 OVERHEIGHT DETECTOR

An overheight detector consists of a transmitter and receiver each mounted on an adjustable metal pole. Furnish detectors meeting the following requirements:

- Operating voltage: 115 AC ± 10%
- Operating temperature range: −40 °F (−40 °C) to 130 °F (54 °C)
- Detector beam: infrared or visible-red LEDs
- Alarm output adjustment: 5 to 30 second duration

Ensure the detector can discern the vehicles direction of travel and is able to detect vehicles traveling between 2 mph (3.2 km/h) and 90 mph (145 km/h).

The transmitter and receiver must mount on metal poles that permit adjusting the detector height from 10 to 16 feet (3.1 to 4.9 m).

SECTION 704
SIGNING MATERIALS

704.01 MATERIAL FOR SIGNS

704.01.1 Sheet Aluminum

Use aluminum alloy in accordance with the Aluminum Association alloy AA5052-H38 or AA6061-T6 requirements. Meet the sheet thickness requirements listed in Table 704-1.

TABLE 704-1
SINGLE POST MOUNTING

Sign Size Inches (mm)	Thickness Inches (mm)
Regulatory Series Without Back Bracing	
0 to 33 (0 to 838) wide, inclusive	0.080 (2)
34 to 41 (864 to 1,041) wide, inclusive	0.100 (2.54)
42 to 51 (1,067 to 1,295) wide, inclusive	0.125 (3.17)
Warning Series Without Back Bracing	
30 x 30 (762 x 762) or smaller	0.080 (2)
36 x 36 (914 x 914)	0.080 (2)
48 x 48 (1,219 x 1,219)	0.100 (2.54)
60 x 60 (1,524 x 1,524)	0.125 (3.17)
Delineator Reflectors	
All sizes	0.063 (1.6)
All Signs With Back Bracing	
Maximum Back Brace Spacing Thickness	**Thickness Inches (mm)**
≤ 32 (813)	0.080 (2)
≤ 40 (1,016)	0.100 (2.54)
≤ 50 (1,270)	0.125 (3.17)

Use the sheet thickness shown in the regulatory series for the route marker series, using the widest point on the cut-out shield for the width dimension. Make all signs not listed above from 0.080-inch (2 mm) thick sheeting.

704.01.2 Aluminum Sheet Increment

Construct aluminum sheet increment signs using AA5052-H38 or AA 6061-T6 sheet aluminum (thickness in Subsection 704.01.1) fastened to an extruded T-section (AA6063-T6) back brace with $^{3}/_{16}$-inch (5 mm) blind rivets. Use the back brace and rivet spacing shown in the Detailed Drawings. Use extruded T-sections weighing a minimum 0.88 pounds per linear foot (1.3 kg/m) with a minimum moment of inertia about the neutral axis of 0.40 inches^4 (166.5 mm^4).

704.01.3 Plywood

Use douglas fir meeting the *Commercial Standard 45 for Douglas Fir plywood*, B-B high density overlay, 60/60 with plastic overlay, both sides, ¾-inch (19 mm) thick. Do not use plywood on multiple post installations.

704.01.4 Aluminum and Steel Posts

A. General. Furnish posts meeting the contract requirements. Treat steel post field cuts and holes with one coat of metal primer and two coats of aluminum paint. Coat galvanized posts meeting AASHTO M 111 specifications.

B. Steel Posts.

1. **Structural Steel.** Furnish structural steel posts having a nominal weight exceeding 3 pounds per foot (4.5 kg/m) meeting ASTM A36 requirements. Bid these posts as "steel structural sign posts". Paint the posts meeting the Detailed Drawing requirements.
2. **Steel U Sign Posts.** Furnish steel posts formed into a "flying U" shape having a nominal weight exceeding 3 pounds per foot (4.5 kg/m) meeting AASHTO M 281. Bid these posts as "steel U sign posts".
3. **Tubular Steel Posts.** Furnish round tubular steel posts meeting ASTM A53 Type E or S, Grade B requirements. Furnish square or rectangular tube posts meeting ASTM A500 or A501 requirements. Painted or galvanized posts are acceptable. Meet ASTM A123 requirements for galvanizing. Paint the posts in accordance with the Detailed Drawing.
4. **Square Tubular Steel Posts.** Ensure that all square tubular perforated and non-perforated steel post telescoping devices meet the velocity change criteria of the current AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*. Furnish square tubular steel sign posts, anchor posts, anchor sleeves, and splice sleeves meeting one of the following requirements:
   - **a.** ASTM A653 Grade A steel in 10 or 12 gauge having a 33,000-psi (22.7 MPa) minimum yield strength and a 45,000-psi (31 MPa) minimum tensile strength.
   - **b.** ASTM A570, steel in 12 or 14 gauge having a 60,000-psi (41.4 MPa) minimum yield strength and a 75,000 (51.7 MPa) minimum tensile strength. Use ASTM A307 Grade 2 bolts and nuts. Ensure the sign posts, sleeves, anchor posts, auxiliary fittings and anchor sleeves have $^{7}/_{16}$-inch (11 mm) diameter holes or knockouts on 1-inch (25 mm) centers on all four sides. The permissible pole straightness variation is $^{1}/_{16}$-inch in 3 feet (1 mm/m) with the corner radius being $^{5}/_{32}$-inch (4 mm) ± $^{1}/_{64}$-inch (0.4 mm).

   Coat the post with Type 2 aluminum paint at a minimum 0.75 ounces per square foot (228 kg/m^2) of surface area, measured by triple spot testing under AASHTO T 213. Follow with a chromate conversion coating, and a thin acrylic or polymer resin film; or a triple coating of hot dipped zinc weighing 0.60 ± 0.15 ounces per square foot (183 kg ± 4.3 kg/m^2) in accordance with AASHTO M 120, followed by a chromate conversion coating 15 ± 5 micrograms per square inch (645 mm^2), and a clear organic coating 0.2 ± 0.1 mils (0.005 mm ± 0.0025 mm) thick on the outside surface. Provide double in-line application of a full zinc-based organic coating 1.2 ± 0.6 mils (0.003 mm ± 0.0015 mm) thick tested in accordance with ASTM B117 on the inside surface.

C. Aluminum U Posts. Furnish aluminum posts made of AA6061-T6 alloy extruded to a U-channel in accordance with ASTM B209.

D. Breakaways.

1. **Structural and Tubular Steel.** Furnish frangible bolt devices and reduced section (or perforated) fuse plates. Use devices commercially manufactured and designed in accordance with AASHTO's current edition of *Standard Specifications for Structural Steel Support for Highway Signs, Luminaires and Traffic Signals*, crash tested and approved for use by FHWA.

2. **Square Tubular Steel Posts.** Furnish slip base breakaway devices in accordance with the Detailed Drawings. Ensure the breakaway device meets the velocity change criteria in accordance with AASHTO's current edition of *Standard Specifications for Structural Steel Support for Highway Signs, Luminaires and Traffic Signals*, for both single tube and telescoping installations.

704.01.5 Reserved

704.01.6 Treated Wood Posts and Poles

Timber poles are specified by the top diameter. Meet Table 704-2 top diameter limits:

TABLE 704-2
TIMBER POLE - TOP DIAMETER LIMITS

Specified Top Diameter inch (mm)	Diameter Limits inch (mm)	
	Min.	Max.
3 (75)	3 (75)	4 (100)
4 (100)	4 (100)	5 (130)
5 (130)	5 (130)	6 (150)
6 (150)	6 (150)	7 (180)

Furnish posts and poles 10 feet (3 m) in length or less free of crooks and sweeps greater than ¾-inch (19 mm) from the post centerline. The maximum offset from centerline for posts and poles longer than 10 feet (3 m) is ¾-inch (19 mm) plus $^{1}/_{16}$-inch (2 mm) per additional foot of length. The centerline is defined as a straight line from the center of the tip to the center of the butt. Gain and chamfer posts and poles in accordance with the Detailed Drawings. Perform all machining before treatment. Full length pressure-treat all timber posts and poles in accordance with Subsection 706.04.1, regardless of length.

Treat round posts and poles in accordance with AWPA *Standards for Commodity* specification B and use Category 4A, regardless of length. Supply round posts and poles meeting the AWPA minimum penetration requirements specified for natural posts and poles, with a penetration of at least ⅜-inch (9 mm). Posts and poles must have sufficient sapwood to provide the ⅜-inch (9 mm) minimum penetration.

Gain each post and pole on the sign face at least 2 inches (50 mm) in width in accordance with the Detailed Drawings.

Use construction grade 2 x 4-inch (38 x 89 mm actual thickness), pressure treated in accordance with Subsection 706.04, in S4S for back bracing.

704.01.7 Reserved

704.01.8 Overhead Structures

Furnish overhead sign structures in accordance with AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*, including fatigue requirements in Section 11.

Include fatigue design requirements for all sign structures as follows:

- Design life: 50 years
- Fatigue Category: 1
- Galloping: cantilevered structures only
- Truck-Induced gusts: posted speed limit
- Natural wind gusts

704.01.9 Concrete

Use Class General concrete in accordance with Section 551 for steel sign post foundations. Hand mixing is not allowed. Add an air entraining agent to all foundation concrete.

704.01.10 Retro-reflective Sheeting

A. General. Furnish the type of retro-reflective sheeting and color specified in the contract.

Use traffic control sheeting in accordance with ASTM retro-reflective sheeting on the traffic control devices specified in Table 704-3.

The following traffic control devices in the traffic control rate schedule require ASTM designated retro-reflective sheeting as specified. Provide orange sheeting that is fluorescent. All other sign colors need not be fluorescent:

TABLE 704-3
ASTM RETRO_REFLECTIVE SHEETING REQUIREMENTS

Traffic Control Rate Schedule Group No.	Specification	Type
1-15, 18 (sign panel), 19, 25 (panel) and all other work zone sign faces (e.g. flag person paddles, pilot car signs, etc.)	ASTM D4956	XI, X, IX VIII, VII or VI
17, 23, 27, 28 and all cones and tubular markers	ASTM D4956	III or V

Reflective sheeting may only be overlaid on reflective sheeting of the same color. Remove any existing legend prior to overlaying.

B. Letters - Direct Applied. Furnish letters, numerals, symbols, and borders from Type III sheeting, permanently adhered to the sign face reflective sheeting.

Apply the letters, numerals, symbols, and borders following the sheeting manufacturer's recommendations. Follow the size, series, and spacing in the FHWA's *Standard Alphabets* proportion and spacing requirements.

Use finished pieces that are clean cut, free of ragged borders.

C. Acceptance. Submit manufacturer's certification that the retro-reflective sheeting used meets the designated ASTM type retro-reflective requirement specified.

The Department may take sheeting samples for analysis and testing. The Project Manager may visually compare the sheeting's diffuse day color in the field using standard color charts and test the signs retro-reflectivity using a retro-reflectometer.

Replace rejected material at Contractor expense.

704.01.11 Reserved

704.01.12 Paint

Use paints in accordance with Section 710.

704.01.13 Hardware

A. Miscellaneous. Use bolts, washers, nuts, lock washers, incidental hardware, and angles for erecting aluminum sheet and plywood signs that are:

1. Galvanized in accordance with ASTM A153 or ASTM B633; or
2. Aluminum alloy in accordance with ASTM B211 for alloy 2024-T4.

B. Hinges. Use only non-rusting hardware of like material. When mounting on Aluminum sheeting for folding signs, use hinges that are:

1. Aluminum alloy in accordance with ASTM B211 for alloy 2024-T4; or
2. Stainless steel in accordance with ASTM A276.

704.02 FABRICATION OF SIGNS

704.02.1 Aluminum Signs

Provide a reflectorized sheet background. Clean rust, white rust, oil, and dirt from the aluminum sheeting. De-grease the sheeting using vapor or alkaline de-greasing agent following the de-greasing agent manufacturer's recommendations. De-grease, acid or alkaline etch, rinse, and dry the sheeting as recommended by the etching solution manufacturer.

Treat the etched sheeting with a light, tight adherent chromate conversion coating before applying the reflective sheeting. This coating must not leave a powdery residue and may leave a silvery iridescence to pale yellow appearance. Coat in accordance with ASTM B449, Class 2, 10 to 35 milligrams thick per square foot (0.093 m^2). Hot air dry the sheeting once coated. Apply and seal the reflectorized sheeting on the prepared aluminum sheeting following the reflective sheeting manufacturer's recommendations. Apply legends and borders in accordance with Subsection 704.01.10(B).

Color the blind rivet heads to match the sign face. Apply background material to the sheet aluminum before fabricating the sign. Butt the sheet increments together to produce a joint that meets the specified tolerances limits.

Do not use water to float the reflective sheeting or legends into place during fabrication.

704.02.2 Plywood Signs

Provide a reflective background. Seal all wood edges, including interior joints, before fabrication using one coat of exterior aluminum paint followed by one coat of enamel, colored to match the reflective background sheeting. Apply the reflective sheeting and seal the edges following the sheeting manufacturer's recommendations.

A. Screen-processed Legend and Borders. Screen process or reverse-screen process the legend and borders on reflectorized backgrounds meeting the contract requirements. Use the process and paints recommended by the sheet manufacturer.

B. Reflective Sheeting Legend and Borders. Cut the legend and borders from Type III sheeting.

Do not splice legend characters. Apply legends following the sheeting manufacturer's recommendations. Do not use water to float the reflective sheeting or legend into place during fabrication.

C. Demountable Reflective Legend and Borders. Fabricate demountable legend in accordance with Subsection 704.01.10(B). Furnish the letter type specified in the contract. Letters cannot be spliced. Make borders and median sections in the longest pieces possible. Butt all joints with no overlap.

704.02.3 Inspection and Acceptance

Completed signs will be inspected where fabricated for acceptance. Signs will be rejected for defects including, but not limited to cracks, tears, splits, crazing, gouges and curled edges of background sheeting or legends.

704.03 FLEXIBLE DELINEATORS

Furnish delineator material that is impact resistant within a temperature range of −30 to +130 °F (−34.4 to +54.4 °C). Ensure the material from which the vertical tube post is fabricated flexes upon impact and results in little or no damage to impacting vehicles. Use a delineator that is ultra violet stabilized and resistant to ozone and hydrocarbons. Ensure the delineator design allows for quick and easy removal and replacement of delineator tube with only the use of common hand tools. Use delineators that are listed on the QPL and in accordance with NCHRP 350 or MASH requirements.

Ensure the delineator is flexible, self-erecting to original position and capable of withstanding numerous impacts from a direction without splitting, breaking or detachment from the base or the surface to which the base is attached.

Use delineators with a minimum height of 36 inches (915 mm) and width configuration that allows a minimum of 46.5 square inches (300 cm^2) of retro-reflective sheeting to be affixed at the top of the post. Place retro-reflective sheeting completely within the top 9 inches (230 mm) of the delineator. Ensure color, area and configuration of retro-reflective sheeting equals that required by the standard drawings for the type of delineator specified. Use a post color that matches the attached sheeting.

Provide the mounting as specified in the contract.

A. Surface Mount Flexible Delineators. Ensure base material is flexible, high impact composite material with a maximum of 72 square inches (464 cm^2) surface area and capable of being mechanically attached to the mounting surface.

B. Driveable Flexible Delineators. Ensure anchor is made of rigid materials and cannot collapse or buckle when driven into dense soil. Metallic materials must be galvanized. Ensure anchor is driveable with manual or common installation tools.

SECTION 705
GUARDRAIL

705.01 GUARDRAIL

Furnish metal beam and cable guardrail materials in accordance with the contract.

705.01.1 Steel Beams and Fittings

Furnish steel beam guardrail in accordance with AASHTO M 180, Class A, Type 1 requirements. Supply rail in lengths that place the splices on posts. Shape rail to be erected on curve radii less than 150 feet (45.75 m) before erecting.

Use ASTM A307 bolts with ASTM A563, Grade A or better nuts. Use ANSI B27.2, Type A plain steel washers.

Galvanize all bolts, nuts, washers, and fittings in accordance with ASTM A153 or B695 (Class 50).

Furnish rounded end sections, buffer sections, and terminal connectors in accordance with AASHTO M 180, Class B, Type 1.

705.01.2 Wood Posts and Blockouts

Furnish wood posts and blockouts made from Douglas fir, Hemlock, Ponderosa Pine, Spruce, Larch, Southern Yellow Pine, or Lodgepole pine. Furnish posts that are straight, sound, free from defects, and meet the dimensions specified in the contract.

Meet the Western Wood Products Association requirements or equivalent grading rules for No. 2 grading or better in accordance with ASTM D245.

Ensure the posts surfaces do not vary more than 1-inch (25 mm) from a straight line connecting the ends. Saw the wood posts before treating. Ensure the wood posts and blockouts are seasoned to accept the specified treatment in accordance with Subsection 705.03.1.

Other acceptable blockouts may be manufactured from recycled plastic or recycled plastic with wood fibers provided they meet the requirements of Subsection 606.03.1.

Use only one type of blockout in each run of guardrail.

705.01.3 Concrete Posts

Furnish precast concrete posts in accordance with the contract. Use Class General concrete or concrete of equal strength in accordance with Section 551. Manufacture, transport, and handle guardrail posts in accordance with Section 554. Use reinforcing steel in accordance with Section 711.

705.01.4 Lightweight Concrete Guardrail Posts

Lightweight aggregates may be used in manufacturing guardrail posts.

Produce both fine and course aggregates for lightweight concrete by expanding, calcining, or sintering blast furnace slag, clay, diatomite, shale, or slate.

Meet AASHTO M 195 aggregate requirements. Use separate fine and course aggregate. Use fine aggregate in the No. 4 (4.75 mm) to 0 size. Use course aggregate of either ¾-inch (19.0 mm) to No. 4 (4.75 mm) or ½-inch (12.5 mm) to No. 4 (4.75 mm).

Meet a minimum compressive strength of 3,000 psi (20.7 MPa) (equal to Class General concrete) with a maximum absorption of 15% by volume and a maximum unit weight of 115 pounds per cubic foot (1,864 kg/m^3). Aggregate pre-wetting may be required.

Use reinforcing steel in accordance with Section 711. Steel size and shape is specified in the contract.

The AASHTO M 195 Freeze-Thaw test is not required.

705.01.5 Steel Posts

Furnish steel posts for cable guardrail in accordance with the contract. Spot paint all bruised, broken, scaled, or damaged coating on steel posts with two coats of cold galvanizing compound following the paint manufacturer's recommendations.

Furnish minimum 6-foot (1830 mm) long steel guardrail posts for steel beam guardrail.

Ensure that steel guardrail posts and associated hardware meets the AASHTO *Guide to Standardized Highway Barrier Hardware* (Task Force 13 Report).

705.02 WIRE ROPE AND CONNECTING HARDWARE

Furnish wire rope and hardware for cable guardrail in accordance with the contract.

705.03 WOOD TREATMENT AND PAINTING

705.03.1 Wood Treatment

Furnish wood posts and blocks pressure treated in accordance with Subsection 706.04.1 using commodity specification A with retention specifications from commodity specification B, use category 4B. Chamfer and perform other required framing and boring of bolt holes before post treating. Plug drill holes used for determining preservative penetration depth with tight fitting treated wood plugs.

705.03.2 Painting

Use paint and perform painting in accordance with the contract.

SECTION 706
TREATED AND UNTREATED TIMBER

706.01 STRUCTURAL TIMBER AND LUMBER

Furnish timbers and lumber being:

A. Standard sawn Douglas fir or Larch.

B. Graded under the current West Coast Lumber Standard Grading Rules or the Western Lumber Grading Rules.

C. Grade stamped by an American Lumber Standards certified inspection agency.

The recommended design values under the rules for grading timbers and lumber grades cannot be less than those shown in the contract for the required minimum timber stress.

Note the grade, the grading rule, and the recommended design stress value for that rule on the shop drawings for each size.

Use only pieces of sound wood free from all decay.

When untreated timber is specified, it must show at least 85% heartwood on the girth, measured where the least amount of heartwood occurs on any girth. When treated timber is specified, there are no heartwood requirements and the sapwood amount is not limited.

706.02 RESERVED

706.03 POLES AND POSTS

Furnish the poles and posts in accordance with the contract.

706.04 TREATED TIMBER AND LUMBER

Furnish structural timber and lumber treated with a wood preservative specified as follows.

706.04.1 Treating

Furnish timber and lumber that is pressure treated meeting the preservative retention and penetration requirements found in AWPA Standards U1 and T1, Commodity Specification A, B or D, use category 4A, appropriate for the application of material.

Use one of the following preservatives:

- 5% by weight solution of pentachlorophenol meeting AWPA Standards P35 using solvent meeting AWPA P9 Type A
- CCA, Type C meeting AWPA Standard P23.
- CuN solution meeting AWPA Standard P36 using solvent meeting AWPA P9 Type A.

Treated timber or lumber to receive paint must permit the paint to adhere to the treated surface without discoloration.

Meet AASHTO M 133 requirements for all preservatives and their sampling and testing methods.

Treat injuries, cuts, and holes in wood after treatment with three applications of copper naphthenate solution containing a minimum of 2% copper metal or with CCA meeting AWPA M4 requirements.

706.04.2 Incising

Mechanically incise timber and lumber as specified in Section 8 of Commodity Specification A, part 12 of AWPA Standard T1 having a nominal thickness of 2 inches (actual 38 mm thickness) or greater before treating.

Incise timber and lumber 3 inches (63 mm actual thickness) thick or greater on all four sides. Incise timber and lumber less than 3 inches (63 mm actual thickness) thick on the wide faces only, unless otherwise specified. Ensure incision depth and pattern for all material are dense enough to achieve uniform depth of penetration as specified in Section 8 of Commodity Specification A, part 12 of AWPA standard T1. Incise Intermountain Douglas Fir then treat to

refusal with preservative and retention requirements meeting AWPA standards listed in 706.04.1. Refusal being specified as the pressure and temperature shall be maintained constant or be increased within a range with good practice for the material being treated until the quantity of preservative absorbed in each of any two consecutive half hours in not more than 2% of the amount already injected. 1½-inch (38 mm actual dimension) center-matched material used for flumes, boxes, etc., does not need to be incised.

Ensure incised wood meets the penetration and retention requirements appropriate for identified Use Category Commodity Specification.

706.04.3 Inspection

Wood products will be inspected in accordance with MT 404. Only wood products with worm holes and any staining due to fungus will be inspected in the white along with the moisture content of Intermountain Douglas Fir. For inspecting wood in the white a minimum of 72 hours advanced notice must be given and must be traceable from inspection in the white to inspection of the treated product. If stain is present in the wood use only material with blue stain. The correct moisture content for Intermountain Douglas Fir is 22% ± 2% and the method to obtain this moisture content is outlined in the AWPA standards.

The acceptance of any material or finished members by the Inspector does not prevent their rejection if found defective. Replace rejected material and work at Contractor expense.

SECTION 707
JOINT MATERIALS

707.01 CONCRETE JOINT FILLERS

707.01.1 Concrete Pavement

A. **Expansion Joint Filler.** Furnish expansion joint filler Type II cork in accordance with AASHTO M 153.
B. **Joint Sealing Material.** Furnish sealing material for all types of pavement joints that is a hot-poured thermoplastic rubber or rubber asphalt compound in accordance with AASHTO M 324, furnished in one grade only. Use ready-mixed, cold applied joint fillers for sealing concrete pavement joints only with the Project Manager's prior written approval.

707.01.2 Concrete Structures Other than Pavement

A. **Expansion Joint Filler.** Furnish Type II cork pre-formed expansion joint filler in accordance with AASHTO M 153.
B. **Expansion Joint System.** Furnish expansion joint system in accordance with the contract.
C. **Silicone Joint Seal.** Furnish silicone joint seal in accordance with the contract.
D. **Fabric Reinforced Neoprene Joint Seal.** Furnish fabric reinforced neoprene joint seal in accordance with the contract.
E. **Expansion Joint Asphalt Plug.** Furnish expansion joint asphalt plug in accordance with the contract.

707.01.3 Concrete Curbs, Gutters, and Sidewalks

Use preformed expansion joint filler for concrete curbs, gutters, and sidewalks in accordance with AASHTO M 213.

707.02 CULVERT SEALERS

707.02.1 Rubber Gaskets

Furnish ring gaskets in accordance with ASTM C1619.

707.02.2 Flexible Joint Sealers

Furnish flexible joint sealants in accordance with ASTM C990.

707.03 SHEET COPPER, RUBBER, AND PLASTIC WATERSTOPS

707.03.1 Sheet Copper

Furnish sheet copper for waterstops in accordance eith ASTM B152 for copper sheet, strip, plate, and rolled bar, Type ETP with a nominal weight of 16 ounces per square foot (5 kg/m^2) ± 8%.

707.03.2 Rubber

Furnish molded or extruded rubber waterstops having a uniform cross section, free from porosity or other defects, and meeting the nominal dimensions specified in the contract. An equivalent standard shape may be furnished if approved. The waterstop may be compounded from natural rubber, synthetic rubber, or a blend of the two, together with other materials that produce a finished waterstop in accordance with the contract. Reclaimed material cannot be used. Furnish a manufacturer's certificate showing the material composition and the values for the designated properties in Table 707-1. Furnish samples when requested.

TABLE 707-1
PROPERTIES AND TEST METHODS - FINISHED RUBBER WATERSTOP

Property	Federal Test Method Standard No. 601	Requirement
Hardness (shoredurometer)	3021	60 to 70
Compression set	3311	30% max.
Tensile strength	4111	2,500 psi (17 Mpa) min.
Elongation at breaking	4121	450% min.
Tensile stress at 300% elongation	4131	900 psi (6 Mpa) min.
Water absorption by weight	6631	5% max.
Tensile strength	7111	80% min. after aging original

707.03.3 Plastic

Furnish plastic waterstops manufactured from virgin PVC plastic or other material in accordance with Table 707-2.

TABLE 707-2
PROPERTIES AND TEST METHODS - FINISHED PLASTIC WATERSTOP

ASTM Standard	Property	Requirement
D2240	Hardness	78 ± 3
D638	Tensile strength, min.	2000 psi (14 MPa)
D638	Ultimate elongation, min.	300%
D746 procedure B	Low temperature brittleness at −37 °C	no failure

Furnish for approval, a drawing or catalog cut of the waterstop intended for use, and a written certificate from the manufacturer that the waterstop meets the specifications.

SECTION 708
CONCRETE, PLASTIC, AND FIBER PIPE

708.01 REINFORCED CONCRETE PIPE

708.01.1 General

Use cement in reinforced concrete pipe in accordance with AASHTO M 85 for portland cement.

Furnish reinforced concrete pipe produced by a manufacturing plant that has been approved by the Department before the contract award date.

The bid tabulations specify only the span dimension to the nearest inch (mm), of pipe arch culverts as shown in the Detailed Drawings for the culverts. The contract show both span and rise dimensions.

The Department will inspect and approve the equipment and methods for manufacturing, protecting, curing and storing pipe before fabrication.

Meet AASHTO M 55 requirements for reinforcement in circular or elliptical pipe.

Use Type V cement unless otherwise specified in the contract.

708.01.2 Circular Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

Furnish pipe in accordance with AASHTO M 170, except that part 12.4 does not apply. Use a minimum wall B pipe.

708.01.3 Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe

Furnish pipe in accordance with AASHTO M 206 with Class A-III pipe strength requirements.

708.01.4 Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe

Furnish pipe in accordance with AASHTO M 207.

708.01.5 Flared End Terminal Sections and Tee Risers

Furnish flared end terminal sections and the riser of tee sections in accordance with AASHTO M 170 Class III pipe.

708.02 CONCRETE PRESSURE PIPE

Furnish reinforced concrete low head pressure pipe in accordance with ASTM C361.

708.03 PERFORATED CONCRETE PIPE

Furnish perforated concrete pipe in accordance with AASHTO M 175.

708.04 POROUS CONCRETE PIPE

Furnish porous concrete pipe in accordance with AASHTO M 176.

708.05 PVC GRAVITY SEWER AND DRAIN PIPE

708.05.1 Pipe

Furnish gravity pipe 4-inch through 12-inch (100 - 300 mm) nominal diameter produced by continuous extrusion and having self-extinguishing characteristics. The PVC plastic must have a cell classification of 12454-B, 12454-C, or 13364-B [minimum tensile modulus of 500,000 psi (34.5 MPa) as specified in ASTM D1784]. Meet ASTM D3034 requirements for pipe and fittings. Meet a minimum Standard Dimension Ratio (SDR) of 35.

Furnish perforated pipe in accordance with ASTM D2729.

Furnish pipe with nominal laying lengths of 12.5 feet (3.8 m), except for connections to manholes, inlets, and other appurtenances.

Ensure each pipe length is marked with nominal size, PVC cell classification, SDR, and ASTM designation.

708.05.2 Pipe Joints

Each pipe length must have a bell end. The bell must have an elastomeric rubber gasket in a retaining groove to provide a watertight joint when the pipe is joined. The rubber gasket must maintain a watertight joint under all service conditions including expansion, contraction, settlement, and pipe deformation movements. Make the joint connections following the pipe manufacturer's recommendations.

708.05.3 Appurtenance Joints

Make all connections to manholes, inlets, or other appurtenances watertight using rubber gaskets, waterstops, or non-shrink portland cement grout for grouted joints.

708.06 PVC PRESSURE WATER PIPE

708.06.1 Pipe

Furnish pressure PVC water pipe 4-inch through 12-inch (100 mm - 300 mm) nominal diameter in either Class 150 with a dimension ratio (DR) of 18 or Class 200 with a DR of 14 in accordance with AWWA Specification C-900. Pipe sections must be marked with diameter, code designation, DR, pressure class, and AWWA specification.

708.06.2 Pipe Joints

Each manufactured length of pipe must have an integral bell with an elastomeric gasket in a retaining groove that provides a watertight joint when joined.

708.07 CORRUGATED POLYETHYLENE DRAINAGE PIPE

Furnish heavy duty corrugated polyethylene drainage pipe or tubing and fittings in accordance with AASHTO M 252 (Type S – non-perforated or Type SP – perforated) requirements for nominal diameters 3 through 10 inches (80 - 250 mm) and AASHTO M 294 for nominal diameters 12 through 48 inches (300 - 1200 mm).

708.08 HIGH DENSITY POLYETHYLENE PIPE

Furnish and install polyethylene pipe and fittings manufactured from a PE 3408, PE 3608, or PE 4710 resin in accordance with ASTM D3350. Molded and fabricated butt fusion fittings must meet ASTM D3261 and have at least the same pressure rating as the pipe.

708.08.1 Pressurized Polyethylene Pipe

Furnish pressure rated polyethylene pipe less than or equal to 2-inch (50 mm) diameter in accordance with ASTM D2737. Use a class 200 with a DR of 7 for polyethylene pipe.

708.08.2 Solid Wall Polyethylene Pipe

Furnish solid wall polyethylene pipe greater than 2-inch (50 mm) in diameter in accordance with ASTM F714.

SECTION 709
METAL PIPE

709.01 DUCTILE IRON AND STEEL WATER PIPE

709.01.1 Ductile Iron Pipe

Furnish ductile iron pipe in accordance with AWWA C 151 for the pipe class specified in the contract.

Use mechanical or slip-on joints in accordance with AWWA C 111 (ANSI A 21.11). Construct the joints to provide electrical conductivity using bronze shims, or gaskets with metallic shims molded into the gasket.

709.01.2 Steel Water Pipe

Furnish steel pipe in accordance with AWWA C 200 Standard for Water Pipe, 6 inches (150 mm) and larger.

Field weld joints and bends in accordance with AWWA C 206. Meet AWWA C 203 requirements for shop and field coatings.

709.02 CORRUGATED STEEL PIPE AND PIPE ARCHES

Furnish corrugated steel pipe that is lock seam helically corrugated pipe or continuously welded seam corrugated pipe.

Furnish corrugated steel pipe and pipe arches and coupling bands in accordance with AASHTO M 36 (excluding projection bands under 9.1.3) and the following:

A. When pipe is cut and to be rejoined, matchmark cut pipe ends and rejoin the matching ends during installation.

B. When using corrugated locking bands, re-roll the pipe ends forming at least two annular corrugations. Unraveling of lock seams due to re-rolling pipe ends is a defect and the pipe will be rejected.

Repair zinc or aluminized pipe coating damaged by re-rolling using a zinc rich paint. Apply the paint to provide a minimum 0.005 inch (0.13 mm) thickness.

If flanges are provided on the pipe ends, the coupling may be made by interlocking the flanges with a preformed channel band or other band incorporating a locking channel in accordance with AASHTO M 36. These bands may be used only on pipes with diameters up to and including 36 inches (900 mm).

The coupling bands or devices other than those specified in AASHTO M 36 require the Project Manager's approval before use.

Meet the following additional requirements for syphon and irrigation pipe installations:

1. Use lock seam helically corrugated pipe, or welded seam helically corrugated pipe;

2. Continuously weld lock seams from end to end of each lock seam helically corrugated pipe section for syphon installations. Perform the welding after re-rolling the ends;

3. For irrigation installations using lock seam helically corrugated pipe, weld the lock seams as specified above or fabricate by inserting a $^{3}/_{16}$-inch (5 mm) diameter continuous rubber chord meeting pipe industry standards into the lock seam during fabrication, in accordance with AASHTO M 36; and

4. Construct watertight field joints. Make the connection using a 10½-inch (267 mm) wide "hugger" type band. Hugger bands must have O-ring gaskets. Lubricate and install gaskets and coupling bands following the manufacturer's recommendations.

The Project Manager may direct the fabricator to conduct a water-tightness test, witnessed by an Inspector, on the type or types of pipe and coupling devices to be furnished. Submit the test method to the Project Manager for approval before testing. Alternate test methods may be required.

709.03 STEEL STRUCTURAL PLATE PIPE AND PIPE ARCHES

Use galvanized corrugated steel structural plates and fasteners for constructing pipe in accordance with AASHTO M 167.

Bevel the end plates of structural steel pipe plate arches as specified in the contract.

Meet AASHTO M 167 requirements for allowable tolerance in span and rise for pipe arches.

Submit a supplier's itemized statement of the plate sizes for each shipment for field inspection of the plates. Department inspection will include examining pipe for deficiencies in the lengths of sheets used and evidence of poor workmanship. Samples may be taken for chemical analysis and weight of spelter coating.

709.04 BITUMINOUS COATED CORRUGATED STEEL PIPE AND PIPE ARCHES, AND STEEL STRUCTURAL PLATE PIPE AND PIPE ARCHES

Meet AASHTO M 243 pipe coating requirements except as modified below:

- Clean and dry the surface to be coated before applying the bituminous coating. Apply coating with the ambient air temperature at least 50 °F (10 °C) and rising. Coat the full circumference of the pipes outside and the bottom up to one third of the vertical height of the pipes inside circumference. Provide a coat thickness of at least 0.05 inch (1.3 mm).

709.05 PRE-COATED, GALVANIZED STEEL CULVERTS AND UNDERDRAINS

Meet AASHTO M 245, M 246 and Subsection 709.02 for irrigation and syphon pipe installations.

Provide a minimum 0.010-inch (0.25 mm) coating for both inside and outside surfaces in accordance with AASHTO M 246, Section 7.

709.06 CORRUGATED STEEL PIPE FOR UNDERDRAINS

Furnish pipe and coupling bands in accordance with AASHTO M 36. The class of underdrain in AASHTO M 36 is the Contractor's option.

Furnish semi-circular underdrain and coupling bands in accordance with AASHTO M 36 and the Detailed Drawings. Furnish nuts, caps, screws and other parts galvanized in accordance with ASTM A153 or B695 (Class 50). Furnish screens and caps for semicircular underdrains in accordance with the Detailed Drawings.

Furnish bituminous coated underdrains in accordance with AASHTO M 190. Nuts, bolts and screens must not be coated.

709.07 CORRUGATED ALUMINUM PIPE AND PIPE ARCH CULVERTS

Furnish corrugated aluminum pipe and pipe arch culverts in accordance with AASHTO M 196, and the modifications to AASHTO M 36 specified in Subsection 709.02.

709.08 CORRUGATED ALUMINUM PIPE FOR UNDERDRAINS

Furnish corrugated aluminum pipe for underdrains in accordance with AASHTO M 196.

709.09 SEAMLESS STEEL PIPE

Furnish seamless steel pipe in accordance with ASTM A53.

709.10 COPPER PIPE

Furnish copper pipe and tube in accordance with ASTM B88, Type K.

709.11 SLOTTED CORRUGATED STEEL PIPE

Furnish slotted corrugated steel pipe that is commercially fabricated with the grate and steel pipe an integral unit. Pressure or fusion weld the grate spacer bars to the bearing bar. Meet ASTM A36 requirements for grating materials galvanized after fabrication.

709.12 TYPE II ALUMINIZED CORRUGATED STEEL PIPE

Furnish pipe and coupling bands fabricated from material in accordance with AASHTO M 274. Ensure the prefabricated pipe and coupling bands are in accordance with Subsection 709.02.

SECTION 710
PAINTS

710.01 PIGMENTS, VEHICLES, AND THINNERS

Ensure all materials from which paints are made and formulated are in accordance with the following specifications:

Aluminum Pigments	ASTM D962
Black Synthetic Iron Oxide Pigment	ASTM D769
Bone Black Pigment	ASTM D210
Calcium Carbonate Pigments	ASTM D1199
Carbon Black Pigment	ASTM D561
Chrome Oxide Green Pigment	ASTM D263
Chrome Yellow and Chrome Orange Pigments	ASTM D211
Lampblack Pigments	ASTM D209
Liquid Paint Driers	ASTM D600
Magnesium Silicate Pigments	ASTM D605
Mica Pigment	ASTM D607
Ochre (Ferrous Earthy Pigments)	ASTM D85
Petroleum Spirits (Mineral Spirits)	ASTM D235
Raw and Burnt Sienna Pigments	ASTM D765
Raw and Burnt Umber Pigments	ASTM D763
Red and Brown Iron Oxide Pigments	ASTM D3722
Titanium Dioxide Pigments	ASTM D476
Yellow Iron Oxide Pigment-hydrated	ASTM D768
Zinc Dust (Pigment)	ASTM D520
Zinc Oxide Pigments	ASTM D79

710.02 PAINTS AND ENAMELS

A. General. Follow the paint manufacturer's recommendations including but not limited to storage, application, thinning, safety precautions, and film thickness unless otherwise specified.

Furnish all paints under this section free of lead, or zinc chromate unless specified.

Provide the manufacturer's MSDS. Supply the paint in the original container labeled with the manufacturer's name, address, paint type, formula identification, date of manufacture, and lot or batch number.

Paints for structural steel where multiple coats are applied must be produced by the same manufacturer. Provide the Project Manager certified test results from an independent testing facility showing the following paints supplied meet the applicable requirements.

B. Paints for Miscellaneous Metals. Use the following paints on metal unless otherwise specified.

1. **Reserved.**
2. **Aluminum Epoxy Paint.** Furnish aluminum epoxy paint that is a self-priming, two-component, high build, aluminum filled epoxy mastic. The paint must adhere to metal surfaces and existing painted surfaces when the surface is prepared following the paint manufacturer's recommendations.

   Apply the coating following all the manufacturer's recommendations to produce a minimum 5 mil (0.125 mm) dry film thickness.

   Meet Table 710-1 minimum paint composition requirements.

TABLE 710-1
ALUMINUM EPOXY PAINT COMPOSITION

	Composition
Solids	90% ± 2% by volume (ASTM D2697)
Pigment	19% by volume
Vehicle	66% by volume
Percent non-volatile vehicle	74%
Nominal VOC	0.74 pounds per gallon (89.1 g/L)

The mixed paint must weigh between 11 to 12 pounds per gallon (1.3 to 1.4 kg/L) when measured in accordance with ASTM D1475 at 75 ± 2 °F (24 ± 1 °C).

The mix ratio of the two components must be 1:1 by volume and have a minimum pot life of 4 hours at 75 °F (24 °C) when thinned following the manufacturer's recommendations.

3. **Epoxy Paint for Pipe Pile.** Furnish epoxy paint that is a two-component, self-priming epoxy coating in accordance with Table 710-2.

TABLE 710-2
EPOXY PAINT FOR PIPE PILE REQUIREMENTS

	Requirement
Drying Time at 75 °F (24 °C) To Touch To Cure	 2 hours max. 10 days max.
Pot Life at 70 °F (21 °C)	12 hours min.
Abrasion resistance (ASTM D4060; CS-17 wheel, 1,000 Gram load, 1,000 cycles)	170 mg loss, max.
Direct impact resistance (ASTM D2794)	60 inch-pounds (6.8 N-m) minimum

Additional requirements:

a. **Salt Fog.** No blistering, cracking, or film delamination when tested in accordance with ASTM B117 for 1,500 hours; and
b. **Moisture Condensation Resistance.** No blistering, cracking, or film delamination when tested in accordance with ASTM D2247 for 1,000 hours at 100 °F (37 °C).

4. **Equipment Enamel.** Furnish equipment enamel that is formulated using Federal Specification TT-E-489b, Class A, spray or brush consistency in accordance with the contract. Match the appropriate color chip, available from the Materials Bureau. Meet the thinner requirements of Federal Specification TT-T306. Use at a maximum rate of 1 pint per gallon (0.12 L/L) when required.
5. **White, Yellow, and Black Enamel.** Furnish water resistant enamels made from synthetic gums capable of brush application to vertical metal surfaces without running, streaking, or sagging.

Meet Table 710-3 requirements.

TABLE 710-3
ENAMEL PAINT REQUIREMENTS

	White	Yellow	Black
Coarse particles and skins retained on No. 325 sieve (0.045 mm), max.	0.50%	0.50%	0.50%
Nonvolatile matter, min.	85%	85%	85%
Dry to touch at 70 °F (21 °C) time in hours, max.	5	5	5
Dry hard at 70 °F (21 °C) time in hours, max.	24	24	24
Toughness, Kauri reduction test at 75 °F (24 °C), min.	150%	150%	150%
Hiding power, square feet per gallon (m^2/L) by Pfund cryptometer model E,	300	450	
Black plates, min.	(7.3)	(11)	

Meet federal test method standard No. 141C for whitening, dulling, or change in color, brushing, flowing, covering, and leveling properties.

The white enamel must be equal in brightness to rutile (Type IV) titanium dioxide pigment.

Yellow enamel must match standard color sample for D-2 yellow guardrail paint. Black enamel must be jet black and cover completely in one coat.

6. Zinc Phosphate Paint. Zinc phosphate paint may be used as a primer or finish coat unless otherwise specified. Provide the finish paint color specified in the contract and match the appropriate color chip, available upon request. The paint must:

a. Be well ground;
b. Show no skinning in a freshly opened, full can;
c. Not cake or settle in the container;
d. Readily break up with a paddle to a smooth, uniform consistency;
e. Brush easily, possess good leveling qualities; and
f. Dry to a hard uniform finish.

Meet Table 710-4 requirements.

TABLE 710-4
ZINC PHOSPHATE PAINT REQUIREMENTS

	Requirement	
	Min.	**Max.**
Pigment[4]	56.5%	58.5%
Vehicle[5]	41.5%	43.5%
Pigment Composition:		
Zinc phosphate	60.0%	—
Titanium dioxide (Rutile)[6]	13.0%	—
Calcium carbonate	21.4%	—
Vehicle Composition:		
Alkyd phthalic resin (50% Solids)	52.4%	—
Raw linseed oil	26.2%	—
Mineral spirits	17.2%	—
Driers and additives	4.2%	—
Finished Paint:		
Consistency (Krebs-Stormer)[1]	70 KU	83 KU
Weight [2], pounds per gallon (g/mL)	12.6 (1.51)	—
Dry to touch[3]		8 hours
Dry to handle[3]		16 hours
Dry film thickness, mil (mm)	1.0 (0.025)	—

Notes:
1. By ASTM D562
2. By ASTM D1475
3. Federal Test Method Standards 141C Method 4061.2
4. Federal Test Method No. 141-Method 4021
5. Federal Test Method No. 141-Method 4051
6. ASTM D1394

710.02.1 Paint Coating Systems for Structures

A. Epoxy Zinc Rich Primer. Meet AASHTO M 300 Type I or II requirements, excluding those in Section 4.7.

B. Intermediate Coat. Use a two-component polyamide epoxy in accordance with Table 710-5.

TABLE 710-5
STRUCTURES - INTERMEDIATE COAT REQUIREMENTS

	Requirement
Drying time @ 50 °F (10 °C)	
to touch	4 hours max.
tack free	24 hours max.
cure	14 days max.
Pot Life @ 50 °F (10 °C)	10 hours min.
Abrasion resistance (ASTM D4060, CS-17 wheel, 1,000 cycles)	224 mg max. loss
direct impact resistance	120 inch-pounds (13.6 N-m) minimum

Additional requirements:

1. **Salt Fog.** No blistering, softening, cracking or film delamination when tested in accordance with ASTM B117 for 1,000 hours; and
2. **Moisture Condensation Resistance.** No blistering, rusting or delamination when tested in accordance with ASTM D2247 for 1,000 hrs. at 100 °F (37 °C).

C. Finish Coat. Provide urethane paint in accordance with Table 710-6.

TABLE 710-6
STRUCTURES - FINISH COAT REQUIREMENTS

	Requirement
Drying time @ 50 °F (10 °C) to touch tack free cure	 10 hours max. 24 hours max. 14 days max.
Pot life @ 50 °F (10 °C)	10 hours min.
Abrasion resistance (ASTM D4060, CS-17 wheel, 1,000 cycles)	224 mg. max. loss
Impact resistance	120 inch-pounds (13.6 N-m) minimum

Additional requirements:

1. **Salt Fog.** No blistering, softening, cracking or film delamination when tested in accordance with ASTM B117 for 1,000 hours; and
2. **Moisture Condensation Resistance.** No blistering, rusting or delamination when tested in accordance with ASTM D2247 for 1,000 hours at 100 °F (37 °C).

710.03 POWDER COATING PREQUALIFICATION AND CERTIFICATION

Provide certified test results of the tests shown in Table 710-7 for powder coated material. Submit certified test results and samples for approval. Only coatings approved are permitted to be used.

TABLE 710-7
CERTIFIED TEST RESULTS

Test Name	**ASTM Designation**	**Specification Limits**
Salt spray test	D1654 (B117)	rating number minimum 6 (from Table 1) after 1000 hours
Impact test	D2794	80 inch-pounds (9.0 N-m) minimum
Cross hatch adhesion test	D3359	5A or 5B minimum
Hardness test	D3363	2H
Bend test	D522	180° bend ½-inch (12.5 mm) diameter mandrel with no breaks flaking or cracks
UV exposure	G154	1,000 hours no film failure
Thickness	G12	3 mil (0.075 mm) minimum
Abrasion taber abraser	D4060	1,000 gram 1,000 cycles 100 mg maximum weight loss

Submit two 4 x 4-inch (100 x 100 mm) by 24 gauge (0.51 mm) coupons along with the test results of the coating material used to the Project Manager. The coating must be representative of expected quality and color of coatings from a production line.

710.04 ANTI-GRAFFITI COATING-PERMANENT

Furnish a permanent, non-sacrificial siloxane-based anti-graffiti coating capable of withstanding multiple cleanings which is listed on the QPL. Coating must allow graffiti to be removed through the use of a water pressure washer and without detergents or chemicals. Product must be approved by the manufacturer for use on the intended material or surface and have a finished dry film thickness of not less than 6 mils (0.150 mm). Remove any graffiti prior to application of an anti-graffiti coating. Prepare the substrate surface, apply, cure, and maintain coating in accordance with the manufacturer's recommendations.

SECTION 711
REINFORCING STEEL, STRUCTURAL STEEL HARDWARE, AND MISCELLANEOUS STRUCTURE ITEMS

711.01 REINFORCING STEEL

711.01.1 Bar Reinforcing

Furnish the specified reinforcing steel in accordance with AASHTO M 31.

The Project Manager may accept small lots of reinforcing steel subject to it passing the bending test specified in AASHTO M 31.

711.01.2 Epoxy-coated Reinforcing Bars

Furnish epoxy-coated reinforcing bars in accordance with ASTM A615 and the contract requirements. Epoxy-coating on reinforcing bars must be in accordance with ASTM A775 or ASTM A934.

Ensure the bars are coated by an applicator plant listed on the QPL and certified under the CRSI epoxy coating plant certification program for fusion-bonded epoxy applicator plants.

711.01.3 Wire and Wire Mesh

Furnish concrete reinforcing wire in accordance with AASHTO M 32.

Furnish wire mesh reinforcing for concrete in accordance with AASHTO M 55 and the contract.

Furnish bar mats AASHTO M 54.

711.02 STRUCTURAL STEEL

Furnish structural steel for:

A. Bridge superstructure applications in accordance with AASHTO M 270.

Use material in accordance with Charpy V-notch impact test requirements for zone 3 to fabricate webs, flanges in tension or stress reversal zones, splice plates, w-shaped rolled beams.

This requirement applies to diaphragms and diaphragm connection plates for horizontally curved girders.

B. Other applications in accordance with AASHTO M 270.

711.03 STRUCTURAL STEEL TUBING

Furnish structural steel tubing in accordance with ASTM A500, Grade B, for cold-formed welded seamless carbon steel structural tubing in rounds and shapes.

711.04 PINS AND ROLLERS

Furnish pins and rollers of annealed carbon steel forgings in accordance with AASHTO M 102, Class C requirements, or cold-finished carbon steel shaft in accordance with AASHTO M 169, Grades 1018 to 1030 inclusive. Fabricate pins and recessed pin nuts as detailed in the AISC *Manual of Steel Construction*.

711.05 WELDING ELECTRODES

Use welding electrodes in accordance with AWS, AASHTO, and the contract.

711.06 HIGH TENSILE STRENGTH BOLTS

Furnish high strength bolts for structural steel joints in accordance with ASTM A325 Type 1 or 3, ASTM A490 Type 1 or 3 as specified in the contract.

A. Tension Control Bolts. Meet the requirements of ASTM F1852 when substituting tension control bolt assemblies for ASTM A325 bolts. Meet the requirements of ASTM F2280 when substituting tension control bolt assemblies for ASTM A490 bolts.

B. Nuts. Furnish heavy hex nuts for high strength bolts in accordance with Table 711-1.

TABLE 711-1
HEAVY HEX NUTS

Bolt Type		Heavy Hex Nut ASTM A563
ASTM A325	Type 1-plain	Grade C, C3, D, DH, DH3
	Type 1-galvanized	DH
	Type 2	Grade C3, DH3
ASTM A490	Type 1	Grade DH, DH3
	Type 2	Grade DH3

Notes:
1. Plain heavy hex nuts Grades C, C3 and D must have a minimum hardness of 89 HRB.
2. A194 Grade 2H may be substituted for A563 Grade DH
3. When galvanized fasteners are specified, furnish assemblies manufactured and lubricated with a visible dye, so a visual check verifies the lubricant's presence at installation.

C. Hardened Washers. Furnish washers for ASTM A325 or A490 bolts in accordance with ASTM F436. Washers are to be circular, beveled or extra thick as required in the contract. Washers must have the same surface condition and weathering characteristics as the bolts specified in the contract.

D. Direct Tension Indicators. Furnish direct tension indicators in accordance with ASTM F959. Galvanize DTI's by mechanical deposition in accordance with ASTM B695 Class 55. Hot dip galvanizing is not allowed.

E. Galvanized High Strength Bolts. Hot dip galvanize ASTM A325 bolts and hardware in accordance with ASTM F2329. Hot dip galvanizing ASTM A490 bolts is not allowed.

Testing for failure and additional rotation will be done in accordance with MT 601.

711.07 BOLTS AND NUTS

Furnish bolts, threaded rod, and nuts in accordance with ASTM A307 Grade A requirements.

711.08 GALVANIZED METAL

Furnish galvanized ferrous metal products in accordance with AASHTO M 111, or when applicable, meeting ASTM B695 (Class 50) requirements.

711.09 WELDED STUD SHEAR CONNECTORS

Furnish shear connector studs in accordance with AWS D1.5 Section 7 specification for *Stud Welding* and the contract.

711.10 STEEL PILING

711.10.1 Structural Steel Piles

Furnish new steel "H" piles, melted and manufactured in the USA, in accordance with AASHTO M 270 Grade 345 MPa (50 ksi) and contract.

711.10.2 Steel Pipe Piles

Furnish new steel pipe piles, melted and manufactured in the USA, in accordance with ASTM A252, Grade 2 with a minimum yield strength of 45 ksi (310 MPa). Steel pipe diameter and wall thickness is specified in the contract.

711.11 PRESTRESSING STEEL

Furnish prestressing steel in accordance with ASTM A416.

711.12 CASTINGS

711.12.1 Steel Castings for Highway Bridges

Furnish castings in accordance with ASTM A148.

711.12.2 Chromium Alloy Steel Castings

Furnish castings made from Grade CA-15 in accordance with AASHTO M 163.

711.12.3 Drainage Structure Castings

Furnish structural drainage castings in accordance with the Detailed Drawings and AASHTO M 306 - HS-25.

711.13 BEARING ASSEMBLY ANCHOR BOLTS FOR BRIDGES

Furnish anchor bolts sized in accordance with AASHTO M 314.

711.14 ELASTOMERIC BEARING DEVICES

Furnish elastomeric bearings in accordance with AASHTO M 251 and the contract. For reinforced elastomeric devices, furnish steel laminates in accordance with AASHTO M 270 Grade 36 or ASTM A1011.

711.15 COMPRESSION JOINT SEALS

Furnish preformed elastic joint seals in accordance with the open cell compression seal requirements of ASTM D3542 and the contract.

Furnish joint seals that accommodate the design movement specified in the contract and follow the manufacturers recommended installation width.

Use the seal manufacturer's recommended adhesive lubricant for seal installation. Use Lubricant in accordance with ASTM D4070.

Furnish a minimum 3-foot (915 mm) long seal sample taken from each size and type furnished on the project. Order the seals 3 feet (915 mm) longer than required for the installation. Submit a copy of the manufacturer's certificate of compliance in accordance with Subsection 106.03, attesting that the material meets specifications.

Obtain the Project Manager's approval of all joint seals before installation.

Install the seals following the manufacturer's recommendations. Do not field splice seals.

Furnish and install the seals, including these costs in the bid price for structural steel.

711.16 FIBER REINFORCED PADS

Furnish vulcanized rubber-fiber pads made from new un-vulcanized rubber and synthetic fibers. Each component must make up 50% of the pads weight.

The pad surface must have:

1. A standard rubber hardness of 80 ± 5 Shore A durometer;
2. An ultimate compressive breakdown strength of at least 7,000 psi (48.3 MPa); and
3. A minimum and maximum pad thickness of $\frac{1}{16}$-inch (2 mm) and $\frac{1}{8}$-inch (3 mm), respectively.

Submit the manufacturer's certification that the pads meet these specifications. A copy of the certification must accompany the shipment to the project. Pads not meeting these requirements will be rejected.

Fiber reinforced pads are incidental to and included in payment for other structural steel work.

711.17 METAL BIN-TYPE RETAINING WALLS

Furnish metal bin-type retaining walls in accordance with the contract.

Furnish the necessary bolts and appurtenances for complete assembly of the members into a continuous closed-face wall of connected bins.

Ensure the base metal and spelter coating are in accordance with AASHTO M 218. Use galvanized bolts, nuts, washers, and other hardware in accordance with ASTM A153 or B695 (Class 50, Type I).

Ensure all members are fabricated so units of the same nominal size are fully interchangeable. Do not drill, punch, or drift holes to correct defects in manufacture. Replace members having improperly punched holes at Contractor expense.

Remove and replace damaged members or members with damaged or broken spelter at Contractor expense.

Meet the applicable treatment and handling requirements for bituminous-coated steel structural plate pipe and pipe arches under Section 709 when handling bituminous-treated walls. Repair broken or damaged bituminous coating at Contractor expense.

711.18 MECHANICAL REBAR CONNECTORS

Furnish any type mechanical connector meeting a yield strength minimum of 125% of the reinforcement and be of a type commonly used and readily available. Splice epoxy coated reinforcement with epoxy coated mechanical connectors.

Submit 4 copies of the product data sheet for the proposed type of connector with the specified performance criteria to the Project Manager prior to installation.

711.19 METRIC PLATE SUBSTITUTION

Define the requirements for substituting standard inch-sized steel plate for metric steel plate. This applies to AASHTO M 270 Grade 250 steel plate used in the following applications:

- Bridge rail
- Pre-stressed concrete beams
- Bridge guard angles
- Bridge pier protection anchors and plates
- Fixed shoe bearing devices

This does not apply to AASHTO M 270 Grades 345 through 690.

Show the metric plate thickness and add a table to the shop drawings similar to Table 711-2.

TABLE 711-2
STEEL PLATE SUBSTITUTIONS

Plate Thickness (inch)	Allowable Substitute Plate Thickness (mm)
1/8*	3
3/16	5
1/4	5 or 6
5/16	8
3/8	10
1/2	12 or 13
5/8	16
3/4	19 or 20
7/8	22
1	25
1 1/4	30
1 1/2	38 or 40

*10 gauge ASTM A1011 sheet may also be substituted for 1/8-inch (3 mm) shim plates

711.20 POLYTETRAFLUOROETHYLENE (PTFE)

Furnish PTFE resin in accordance with ASTM D4894 and ASTM D4895 requirements. Use PTFE sheets consisting of pure PTFE resin, molded by pressure and heat and skived into sheets of 1/16-inch (1.5 mm) thick. Finished sheets must conform to the properties listed in Table 711-3.

TABLE 711-3
PTFE SHEET PROPERTIES

ASTM Test	Physical Property	Requirement
D 4894	Tensile Strength	2800 psi (19.3 MPa)
D 4895	Tensile Elongation	200%

Furnish stainless steel sheets, if applicable, in accordance with ASTM A167 or ASTM A240 Type 304.

SECTION 712
FENCING MATERIALS

712.01 CHAIN LINK FENCE

712.01.1 General

Meet AASHTO M 181 requirements, as modified herein. Use one of the following fence fabrics, as specified in the contract:

- Type 1 Class C zinc-coated steel
- Type 2 aluminum-coated steel
- Type 3 aluminum alloy

Zinc-5% aluminum-mischmetal alloy in accordance with ASTM B750 may be substituted for zinc coating (hot-dipped) at a Class 2, or 1.0 oz/ft^2 (305 g/m^2), coating thickness as specified by ASTM F1345.

Use zinc-coated steel for all Type 1 and Type 2 fabric fence parts; including posts, rails, gate frames, expansion sleeves, wire ties, fabric ties, hog rings, tension wire, miscellaneous fittings, and hardware. Use aluminum alloy for these same Type 3 fabric fence parts. Use either zinc-coated steel or aluminum alloy for these Type 4 fabric fence parts.

712.01.2 Fence Fabric

Furnish fence fabric having 2-inch (50 mm) openings and in accordance with AASHTO M 181. Use 11-gauge wire for fabric 48 inches (1,220 mm) high and under. Use 9-gauge wire for fabric 60 inches (1,525 mm) high and over. The fabric height is specified in the contract.

712.01.3 Posts, Rails, and Braces

Meet ASTM F1043 and the contract length requirements. Furnish all posts with a watertight cap that fits securely over the outside post top and supports the top rail.

712.01.4 Truss Rods

Furnish ⅜-inch (9.5 mm) truss rods as follows:

- Steel - galvanized with dropforged turnbuckles or other approved type of adjustment.
- Aluminum - with cast aluminum turnbuckles or other approved type of adjustment.

712.01.5 Fabric Bands and Stretcher Bars

Furnish bands as follows:

- Steel - a minimum ⅛-inch (3 mm) thick x 1-inch (25 mm) wide.
- Aluminum - a minimum ⅛-inch (3 mm) thick x ⅞-inch (22 mm) wide.

Furnish aluminum or steel stretcher bars as follows:

- A minimum ¼-inch (3 mm) thick x ¾-inch (19 mm) wide.
- At least 2 inches (50 mm) shorter than the fabric width used.

712.01.6 Tie Wire

Furnish 9-gauge galvanized steel tie wire in accordance with AASHTO M 279. Furnish 11-gauge; Class 1 galvanized steel hog ring fasteners in accordance with AASHTO M 279.

Furnish 9-gauge aluminum tie wire in accordance with ASTM B211 Alloy 1100, Temper H14. Furnish minimum 11-gauge aluminum hog ring fasteners in accordance with ASTM B211, Alloy 6061.

712.01.7 Tension Wire

Furnish 7-gauge galvanized coiled spring steel tension wire. Meet AASHTO M 279, Class 1 galvanizing requirements.

Furnish 6-gauge aluminum tension wire in accordance with ASTM B211, Alloy 6061, Temper T 94.

712.01.8 Gates

Furnish gates complete with all necessary hinges, latch, and drop-bar locking device for the type of gate and gateposts specified. Weld in accordance with Section 624.

A. Steel Gates. Construct gate frames from steel sections in accordance with ASTM F900. The gate frame corners may be welded or fastened and reinforced with galvanized malleable-iron fittings designed for this use.

Use chain link fabric for gate frames in accordance with Subsection 712.01.2 and match the fabric used in the fence.

B. Aluminum Gates. Construct gate frames from aluminum sections in accordance with ASTM F900. Assemble the gates frames by welding.

Use aluminum alloy cast hinges in accordance with ASTM B108 or B26 or made of malleable iron or steel and hot-dip galvanized or mechanically galvanized in accordance with ASTM B695 (Class 50). Make all latches, stops, and keepers of the aluminum alloy specified for hinges or use galvanized malleable iron or pressed steel.

Use chain link fabric for the gate frame in accordance with Subsection 712.01.2 and matching the fabric used in the fence.

712.02 WIRE FENCE

712.02.1 Woven Wire

Furnish woven wire in accordance with AASHTO M 279 and either of Table 712-1 designations.

TABLE 712-1
WOVEN WIRE REQUIREMENTS

Specification	Grade	Design Number	Metallic Coating
AASHTO M 279	No. 12½ Grade 60	832-6-12 ½*	Type Z, Class 1 or Type ZA, Class 20
AASHTO M 279	No. 14 Grade 125	832-6-14*	Type Z, Class 3 or Type ZA, Class 40

*For use with Type C fence.

Provide a 6-inch (150 mm) stay spacing. Match the fence height and mesh dimensions of the fence being replaced if not specified.

712.02.2 Barbed Wire

Use 2-point 12½ or 13½-gauge barbed wire in accordance with AASHTO M 280. Space barbs at a 4-inch nominal (100 mm) or a 5-inch nominal (130 mm) spacing. Provide the Project Manager certification that the wire is in accordance with AASHTO M 280.

712.02.3 Brace Wire

Use 9 or 12½-gauge soft, smooth wire.

712.02.4 Staples and Nails

Use minimum 9-gauge U-shaped, 1¾-inch (45 mm) long staples unless otherwise specified in the contract.

712.02.5 Tie Wires

Use minimum 12½-gauge galvanized tie wire. Commercial galvanized fasteners supplied with the wire may be used if approved by the Project Manager.

712.02.6 Metal Fence Stays

Use commercially made and fabricated metal fence stays from 9½-gauge wire twisted to form a two-wire unit.

712.02.7 Metal Posts and Assemblies

Provide metal fence posts and assemblies in accordance with AASHTO M 281, modified as follows:

- Section 7 and Tables 3 and 4 of AASHTO M 281 apply to finished posts and assemblies after fabrication, punching, drilling, and finish coating.

Galvanize or paint posts, braces, and anchor plates. Meet AASHTO M 111 galvanizing requirements. Furnish nuts, bolts, fittings, and other hardware in accordance with ASTM A153 or B695 (Class 50) galvanizing. Paint following the paint manufacturer's recommendations.

Furnish fence posts and braces of the lengths shown in Table 712-2.

TABLE 712-2
POST LENGTHS

Post Type	Braces, Brace Rails And Panel Posts	Line Posts
Metal	--	6 feet - 6 inch (2.0 m)
Wood	8 feet (2.4 m)	7 feet (2.1 m)

Use Tee, Channel, U, or Y bar section line posts with corrugations, knobs, notches, holes, or studs placed to engage the fence line wires.

Attach a steel anchor plate to each line post so that the anchor top is 2 to 3 inches (50 to 75 mm) below ground line when the post is set to the specified depth.

712.02.8 Wood Fence Posts and Brace Rails

A. General. Make fence posts and brace rails from well-seasoned, sound, and straight-grained western larch, lodgepole pine, ponderosa pine, southern yellow pine, or douglas fir. Remove all bark from the posts.

Taper round posts, to be driven, from 6 to 12 inches (150 to 305 mm) up from the bottom to a 1 ± ½-inch (25 ± 12 mm) point. Bevel the edges of post tops to produce a flat surface with a diameter 1 ± ½-inch (25 ± 12 mm) less than post diameter. These taper lengths are included in the specified post lengths. Perform all machining before treatment.

Furnish posts and rails 10 feet (3 m) in length or less free of crooks and sweeps greater than ¾-inch (19 mm) from the post centerline. The maximum offset from centerline for posts and rails longer than 10 feet (3 m) is ¾ plus $^{1}/_{16}$-inch (19 plus 2 mm) per additional foot (305 mm) of length. The centerline is defined as a straight line from the center of the tip to the center of the butt.

Treat round posts and rails meeting AWPA Standards for Commodity Specification B and Use Category 4A. Supply round posts and rails meeting the AWPA minimum penetration requirements specified for natural posts, with a penetration of at least ⅜-inch (9 mm). Posts and rails must have sufficient sapwood to provide the ⅜-inch (9 mm) minimum penetration. Treat the S4S post in accordance with Subsection 706.04.

Treat injuries, cuts, and holes in timber pile after treatment in accordance with Subsection 706.04.

B. Line Posts. Furnish line posts and brace rails from a minimum 4-inch (100 mm) diameter round, or a minimum 4 x 4-inch (100 x 100 mm) square sawn. Furnish corner, end, gate,

and pull posts from a minimum 5-inch (130 mm) diameter round post or a 5 x 5-inch (130 x 130 mm) square sawn post.

712.02.9 Metal Gates

Furnish each gate complete with hinges, latch, and all other hardware used with the type of gate and gate post specified.

712.02.10 Gates for Interstate Fence

Use plain-top single-drive metal gates of tubular steel frame with wire fabric filler. Fit the gate to the opening between the gate posts of the approximate widths shown in the Detailed Drawings. Provide a centered steel upright brace for gates for openings of less than 14 feet (4.3 m), two upright steel braces at third points for gates for openings of 14 feet (4.3 m) or greater.

Fill the metal gates with galvanized wire fabric securely fastened to the top, bottom, ends of the gate frame.

Use fabric in accordance with Subsection 712.02.1, Class 1 or better.

The approximate weight of the gate frames (less fabric) must meet Table 712-3 requirements.

TABLE 712-3
APPROXIMATE GATE FRAME WEIGHTS

Width of Opening	Approximate Wt[1]
8 feet (2.4 m)	48 pounds (22 kg)
10 feet (3.0 m)	55 pounds (25 kg)
12 feet (3.7 m)	62 pounds (28 kg)
14 feet (4.3 m)	72 pounds (33 kg)
16 feet (4.9 m)	80 pounds (36 kg)

Notes:

1. Heavier gates will be permitted if they meet all other requirements.

712.02.11 Gates for Farm Fence

Furnish farm fence gates in accordance with the Detailed Drawings and contract.

712.02.12 Deadman or Anchor

Furnish deadman and anchor(s) in accordance with the Detailed Drawing.

712.02.13 Miscellaneous

Bolts, nuts, fittings, hinges, and all other metal parts for constructing fences and gates must be galvanized in accordance with ASTM specifications.

SECTION 713
MISCELLANEOUS MATERIALS

713.01 WATER

Furnish water for mixing and curing concrete in accordance with AASHTO M 157, 4.1.4. Water will be tested in accordance with AASHTO T 26. Known potable water may be used without testing.

Use irrigation quality water for irrigating trees, plants, and seeded areas, free of elements harmful to plant growth.

713.02 HYDRATED LIME

Furnish hydrated lime in accordance with AASHTO M 303.

713.03 CHLORIDES

A. **Magnesium Chloride.** Furnish liquid magnesium chloride in accordance with Table 713-1. Products will be tested as received in accordance with MT 532.

TABLE 713-1
LIQUID MAGNESIUM CHLORIDE REQUIREMENTS

	Requirement
Alkali chlorides	≤5.0% by mass NaCl
Arsenic	≤5.0 mg/Kg
Assay	≥28.5% MgCl2 by mass
Barium	≤100.0 mg/Kg
Cadmium	≤0.2 mg/Kg
Chromium	≤1.0mg/Kg
Copper	≤1.0 mg/Kg
Cyanide	≤0.20 mg/Kg
Lead	≤1.0 mg/Kg
Magnesium hydroxide	≤0.2% by mass Mg(OH)2
Mercury	≤0.05 mg/Kg
Phosphorous	≤2500.0 mg/Kg
Selenium	≤5.0 mg/Kg
Settleable solids	≤1.0%
Sulfate	≤3.0% by mass SO4
Zinc	≤10.00 mg/Kg

B. Calcium Chloride.

1. Furnish liquid calcium chloride in accordance with Table 713-2. Products will be tested as received in accordance with MT 531.
2. Furnish dry calcium chloride in accordance with Table 713-2 and ASTM D98 Type S.

TABLE 713-2
LIQUID CALCIUM CHLORIDE REQUIREMENTS

	Requirement
Alkali chlorides	≤6.0% by mass NaCl
Arsenic	≤5.0 mg/Kg
Assay	≥30.0% CaCl2 by Mass
Barium	≤100.0 mg/Kg
Cadmium	≤0.2 mg/Kg
Calcium hydroxide	≤0.2% by mass Mg(OH)2
Chromium	≤1.0mg/Kg
Copper	≤1.0 mg/Kg
Cyanide	≤0.20 mg/Kg
Lead	≤1.0 mg/Kg
Magnesium	≤0.5% by mass MgCl2
Mercury	≤0.05 mg/Kg
Phosphorous	≤2500.0 mg/Kg
Selenium	≤5.0 mg/Kg
Settleable solids	≤1.0%
Zinc	≤10.00 mg/Kg

713.04 CEMENT GROUT

Produce grout consisting of 1 part cement to 3 parts of sand thoroughly mixed with water to produce a uniform thick mortar. Use mortar within 30 minutes of adding water. Mortar cannot be re-tempered.

Use sand for mortar in accordance with Subsection 701.01.1 and Table 713-3 gradation.

TABLE 713-3
MORTAR SAND GRADATION REQUIREMENTS

Percentage By Weight Passing Square Mesh Sieves	
Sieve Size	**% Passing**
No. 4 (4.75 mm)	100
No. 8 (2.36 mm)	90-100
No. 16 (1.18 mm)	60-90
No. 50 (0.300 mm)	15-40
No. 100 (0.150 mm)	0-10

713.05 TOPSOIL

Furnish topsoil meeting Table 713-4 gradation requirements.

TABLE 713-4
TOPSOIL GRADATION REQUIREMENTS

Fraction	Particle Size (mm)	Max. % Of Soil (-10 Mesh) (2mm) Fraction
Sand	0.05-2.0	85
Silt	0.005-0.05	80
Clay	less than 0.005	50
Gravel	larger than 2.0	max. % of total sample[1]

Notes:
1. A maximum of 20% is allowable. Any quantity exceeding 10% is not included in the basis for payment. Gradation is tested in accordance with AASHTO T 88.

Meet the following:

1. Soil pH between 5.5 and 8.0 or up to 8.5 if the exchangeable sodium is less than 10%;
2. Soil conductivity factor less than 4; and
3. Organic content between 1% and 20%.

Topsoil is sampled and tested in accordance with MT 412.

713.06 RESERVED

713.07 RESERVED

713.08 RECLAMATION SEED

Furnish all seed that meets and is labeled under Montana Seed Law and meeting the contract requirements.

Furnish seed originating from the North American Continent above 41 degrees latitude. Make written request for waivers of the above requirements to the Project Manager who will work with the Department Agronomist. Do not furnish seed, grown or originating, from production fields outside of North America.

Furnish seed free of prohibited noxious weed seed with restricted weed seed not exceeding Montana Seed Law.

Wet, moldy, or otherwise damaged seed will be rejected.

Calculations of “pure live seed” may be made based on either a germination test or a tetrazolium test, in addition to the purity analysis.

Submit a purity analysis and germination test of the seed proposed for use. A germination test must have been performed within 12 months of the seeding date.

Apply seed on a “pure live seed” basis. The quantity of “pure live seed” per 100 pounds (45.4 kg) of seed is determined as follows:

% Pure Live Seed = Germination % x Purity x 100

Bulk Seed Needed = Total Lbs. Pure Live Seed Required / % Pure Live Seed x 100

Submit a written notification of the seed source and the approximate date the seeding is planned to begin. Do not begin seeding until the germination and purity test results are known and a Department seed blend report is furnished to the Project Manager.

Store all seed under weather-proof cover until time of seeding. Seed bags exposed to rain or snow will be rejected.

713.09 FERTILIZER

Furnish fertilizer in accordance with all applicable laws, rules, and regulations. Furnish the

product data sheet to the Project Manager upon delivery. Contaminated or damaged fertilizer will be rejected.

713.10 MULCH

Furnish mulch listed on the QPL, and in accordance with the contract.

713.10.1 Vegetative Mulch

Vegetative mulch is dried cereal grain or oilseed crop straw, cornfield residue, or grass hay with the majority of stems and leaves at least 4 inches (100 mm) in length.

Mulch will be rejected for any of the following reasons:

1. Chopped or ground mulch;
2. Mulch that is musty, moldy, rotted, or contains noxious weed or grass seed-bearing stalks;
3. Mulch containing stones, dirt, roots, stumps, and other foreign material; or
4. Harvested or stored for over 2 years.

713.10.2 Hydraulic Mulch

A. **Wood Fiber.** Wood fiber hydraulic mulch is specially prepared wood fibers free of growth or germination inhibiting materials that forms a homogeneous slurry when combined with water, tackifiers, fertilizer, and other specified additives and remains uniformly suspended under agitation. The mulch may be colored with a water-soluble, nontoxic dye to aide visual metering during application. Apply the mulch to produce a uniform mat-like cover on the seeded ground.

   At least 30% of the mulch fibers must average 0.15 inches (4 mm) or longer with 50% or more retained on a Clark Fiber Classifier 24-mesh screen.

B. **Straw Fiber.** Straw fiber hydraulic mulch is specially manufactured and prepared straw stems that are packaged and commercially sold specifically as hydraulic mulch. Straw hydraulic mulch can be formulated as 100% straw or combined with other types of mulch and tackifer products during the manufacturing process. The contract will specify the rate, type and formulation of straw fiber hydraulic mulch to be used.

C. **Multi-Fiber.** Multi-fiber hydraulic mulches are composed of various types and percentages of natural fibers and tackifiers. The contract will specify the type of multi-fiber mulches allowed.

713.11 SOD

Furnish commercially manufactured sod that is a living, vigorous growth of grass of the type and thickness specified.

Sod that shows signs of stress from mishandling or lack of water will be rejected.

Provide sod adapted to the general locality of the project, having a dense root system, is free of noxious weeds, and other foreign substances harmful to the development and maintenance of the sod.

Furnish a product data sheet to the Project Manager prior to delivery specifying the origin of the sod.

Cut the sod when the grass length is approximately 2 inches (50 mm) high but not exceeding 3 inches (75 mm). Ensure the sod is free of debris before cutting.

Wet the sod to permit cutting, rolling, and hauling without crumbling or breaking.

Water the sod using water and equipment free of contaminants, from a municipal, domestic, or other source suitable for irrigation. Trucks previously used for application of salt solutions are prohibited for use as watering vessels, unless approved by the Project Manager.

713.12 ROLLED EROSION CONTROL PRODUCTS

Furnish erosion blankets listed on the QPL, and in accordance with the contract. Furnish natural fiber netting consisting of woven 100% biodegradable natural fibers such as coir, jute or sisal. Furnish blankets designed to stabilize and hold previously applied mulch or compost on slopes as well as newly constructed stream banks and slopes.

Natural fiber netting is available in various fiber types, strengths, weights and mesh-opening sizes.

A. Short Term Blankets. An erosion control blanket composed of processed natural fibers mechanically bound together with 100% biodegradable threading and natural fiber nettings to form a continuous matrix. The fiber matrix can be composed of straw, coir, cotton, wool, curled wood or other approved product. Thread and netting material must be non-synthetic, generally of plied coir, jute or cotton. Meet the requirements for Type II blankets in accordance with Table 713-5.

B. Long Term Blankets. An erosion control blanket composed of one of the following materials:

1. Processed slow degrading natural or polymer fibers mechanically-bound together between two slow degrading synthetic or natural fiber nettings to form a continuous matrix.

2. An open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix.

Meet the requirements for Type III-B blanket in accordance with Table 713-5.

TABLE 713-5
TEMPORARY ROLLED EROSION CONTROL

Property	Type II				Type III		Type IV	Test Method
	A[1]	B	C	D	A[1]	B		
Typical functional longevity[2] (months)	12				24		36	N/A
Minimum tensile strength[3] lbs/ft^2 (kg/m^2)	5 (24.4)	50 (244.1)		75 (366.2)	25 (122.1)	100 (488.2)	125 (610.3)	ASTM D4595
Maximum "C" factor[4]	0.10 at 1V:5H	0.10 at 1V:4H	0.10 at 1V:3H	0.10 at 1V:2H	0.10 at 1V:5H	0.25 at 1V:1.5H	0.25 at 1V:1H	ASTM D6459
Minimum permissible shear stress[5,6] psf (Pa)	.25 (12)	.50 (23.9)	1.50 (71.8)	1.75 (83.8)	.25 (12)	2.00 (95.8)	2.25 (107.7)	ASTM D6460

Notes:

1. Obtain max "C" factor and allowable shear stress for mulch control nettings with the netting used in conjunction with pre-applied mulch material.

2. Functional longevities are for guidance only. Actual functional longevities may vary based on site and climatic conditions.

3. Minimum average roll values, machine direction.

4. "C" factor calculated as ratio of soil loss from rolled erosion control product protected slope (tested at specified or greater gradient, v:h) to ratio of soil loss from unprotected (control) plot in large-scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions and failure criteria using Erosion Control Technology Council (ECTC) Test Method #2.

5. Minimum shear stress the rolled erosion control product (un-vegetated) can sustain without physical damage or excess erosion (>½-inch (13 mm) soil loss) during a 30-minute flow event in large-scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions and failure criteria using ECTC test method #3.

6. The permissible shear stress levels established for each performance category are based on historical experience with products characterized by Manning's roughness coefficients in the range of 0.01 to 0.05.

C. Permanent Turf Reinforcement Mat (TRM).

1. **Synthetic Fiber Matrix.** Furnish a web of mechanically bonded synthetic fibers that are entangled to form a strong and dimensionally stable mat. Place fibers between 2 or 3 high-strength, biaxially oriented nets mechanically bound together by stitching with polyolefin thread. The netting material must be resistant to biological, chemical, and ultra-violet degradation.

TABLE 713-6
SYNTHETIC FIBER TRM

Property	Value	Test Method
Matrix material -100% synthetic fibers	minimum 10 oz/yd^2 (339 g/m^2)	N/A
Top, bottom and center netting	polypropylene, polyethylene or nylon minimum 5 lbs/1,000 ft^2 (2.44 kg/100 m^2)	N/A
Minimum tensile strength – TD	400 lbs/ft (5.84 KN/m)	ASTM D6818
Minimum tensile strength – MD	300 lbs/ft (4.38 kN/m)	ASTM D6818
UV stability (minimum % tensile retention)	80%	ASTM D4355 (1,000-hour exposure)
Minimum thickness (inches)	¼-inch (6 mm)	ASTM D6525
Minimum shear stress	minimum 10 lbs/ft (.15 kN/m)	ASTM D6525

2. **Natural Fiber Matrix.** Furnish a natural fiber matrix constructed of two or three nets of heavy-duty polypropylene, polyethylene or nylon. The internal matrix fiber is composed of a natural fiber such as curled wood, straw or coconut.

TABLE 713-7
NATURAL FIBER TRM

Property	Value	Test Method
Matrix material – 100% biodegradable	70% straw/30% coconut, or 100% coconut fiber, or 100% Curled wood fiber. minimum 0.5 lbs/yd^2 (.27 kg/m^2)	N/A
Top and bottom netting	Synthetic fiber – minimum 5.0 lbs/1,000 ft^2 (2.44 kg/100m^2)	N/A
Center net	Synthetic fiber – minimum 24.0 lbs/1,000 ft^2 (11.72 kg/100 m^2)	N/A
Minimum tensile strength – TD	737 lbs/linear ft (10.76 kN/m)	ASTM D6818
Minimum tensile strength – MD	620 lbs/linear ft (9.05 kN/m)	ASTM D6818
UV stability (minimum % tensile retention)	100%	ASTM D4355 (1000-hour exposure)
Minimum thickness	0.7 inches (17.5 mm)	ASTM D6525

713.13 COMPOST

Compost is the soil amendment product resulting from the controlled decomposition of organic materials also known as feedstock material. Acceptable compost feedstock material consist of agricultural vegetative residuals, leaf/yard trimmings, manure, domestic livestock

carcasses, wood residue, municipal biosolids (sewage sludge), or food waste. If biosolids are used as a feedstock, compliance with USEPA 40 CFR Part 503 is required.

Furnish compost in accordance with Table 713-8.

TABLE 713-8
COMPOST PHYSICAL AND CHEMICAL PROPERTIES

Property	Requirement	Method[1]
Particle size	90% (by volume) passing 1-inch (25 mm) screen	TMECC 05.08-B
% Moisture	30% to 55%	TMECC 03.09-A
% Organic matter	30% minimum	TMECC 05.07-A
pH	5.0 to 8.5	TMECC 04.11-A
C/N ratio	10:1 to 30:1	TMECC 05.02-A
Inert material	<1%	TMECC 03-02-A
Maturity	Stable, ≥5 using Solvita test	Solvita test kit
Soluble salt concentration (electrical conductivity)	11.0 mmhos/cem maximum	TMECC 04.10-A

Notes:
1. TMECC – test methods for evaluating compost and composting

Provide a manufacturer's certification in accordance with Subsection 106.03, attesting that the material meets these specifications.

SECTION 714
PAVEMENT MARKING MATERIALS

714.01 TEMPORARY STRIPING TAPE

Furnish temporary striping tape that is 4-inch (100 mm) wide, retro-reflective, pressure-sensitive tape specifically manufactured for use as pavement striping. The tape must be available in white and yellow.

714.02 TEMPORARY STRIPING TABS

Furnish temporary striping tabs in accordance with the following:

1. Types I and II: “L” shaped, extruded polyurethane, at least 4 inches (100 mm) wide by 2 inches (50 mm) high with a reflectorized strip meeting requirement No. 2 below; attached horizontally across the top of the vertical portion of the tab; an adhesive strip meeting requirement No. 3 below:
   - **a.** Type I tabs: white reflectorized tape on both sides with white bodies;
   - **b.** Type II tabs: yellow reflectorized tape on both sides with yellow bodies;
2. Reflective flexible sheeting meeting ASTM D4956 Type V or better;
3. An adhesive strip at least ¾-inch (19 mm) wide x ⅛-inch (3 mm) thick on the tabs underside; and
4. A cover protecting the reflective strip that does not come off under traffic but is manually removable.

714.03 TEMPORARY WATERBORNE TRAFFIC PAINT

Furnish temporary waterborne traffic paint in accordance with Table 714-1.

TABLE 714-1
TEMPORARY WATERBORNE TRAFFIC PAINT COMPOSITION

Test	Specification	Test Method
Color (x, y, Y)	ASTM D6628	ASTM D6628 and ASTM D7585
Antimony	≤20.0 mg/Kg	MT 544
Arsenic	≤20.0 mg/Kg	
Cadmium	≤4.0 mg/Kg	
Chromium	≤5.0 mg/Kg	
Cobalt	≤20.0 mg/Kg	
Lead	≤20.0 mg/Kg	
Mercury	≤1.00 mg/Kg	
Tin	≤20.0 mg/Kg	

714.04 WATERBORNE TRAFFIC PAINT

Furnish waterborne traffic paint in accordance with Table 714-2. Where the NTPEP method is specified, recorded NTPEP results must be within the specifications shown.

TABLE 714-2
WATERBORNE TRAFFIC PAINT COMPOSITION

Test	Specification	Method
Color (x, y, Y)	ASTM D6628	ASTM D6628 and ASTM D7585
Durability (Wheel)	minimum of 6 at 12 months	NTPEP
Luminance	white: ≥30 at 12 months yellow: ≥20 at 12 months	NTPEP
Viscosity (Krebs Stormer), K.U. at 77 °F (25 °C)	80-95	ASTM D562
Density deviation	maximum of ±0.30 lbs/gallon (±35.9 g/L) from density target	ASTM D1475
Contrast ratio	0.92	MT 545
Dry no track	90 seconds	NTPEP
Freeze-thaw stability	Δ10KU	ASTM D2243
Static heat stability	Δ10KU	MT 548
Bleeding ratio	0.95 minimum	ASTM D868
Skinning and lumps	Pass	MT 549
Settling	Pass	MT 549
Skinning	Pass	MT 549
NTPEP lab test verification	must match NTPEP	NTPEP and MT 543
Antimony	≤20.0 mg/Kg	MT 544
Arsenic	≤20.0 mg/Kg	
Cadmium	≤4.0 mg/Kg	
Chromium	≤5.0 mg/Kg	
Cobalt	≤20.0 mg/Kg	
Lead	≤20.0 mg/Kg	
Mercury	≤1.00 mg/Kg	
Tin	≤20.0 mg/Kg	

714.05 HIGH DURABILITY WATERBORNE TRAFFIC PAINT

Furnish high durability waterborne traffic paint in accordance with Table 714-3. Where the NTPEP method is specified, recorded NTPEP results must be within the specifications shown.

TABLE 714-3
HIGH DURABILITY WATERBORNE TRAFFIC PAINT COMPOSITION

Test	Specification	Method
Color (x, y, Y)	ASTM D6628	ASTM D6628 and ASTM D7585
Durability (wheel)	minimum of 8 at 24 months	NTPEP
Luminance	white: ≥30 at 12 months yellow: ≥20 at 12 months	NTPEP
Viscosity (Krebs Stormer), K.U. at 77 °F (25 °C)	80-95	ASTM D562
Density deviation	maximum of ±0.30 lbs/gallon (±35.9 g/L) from density target	ASTM D1475
Contrast ratio	0.92	MT 545
Dry no track	10 minutes maximum	NTPEP
Freeze-thaw stability	Δ10KU	ASTM D2243
Static heat stability	Δ10KU	MT 548
Bleeding ratio	0.95 minimum	ASTM D868
Skinning and lumps	Pass	MT 549
Settling	Pass	MT 549
Skinning	Pass	MT 549
NTPEP lab test verification	must match NTPEP	NTPEP and MT 543
Antimony	≤20.0 mg/Kg	MT 544
Arsenic	≤20.0 mg/Kg	
Cadmium	≤4.0 mg/Kg	
Chromium	≤5.0 mg/Kg	
Cobalt	≤20.0 mg/Kg	
Lead	≤20.0 mg/Kg	
Mercury	≤1.00 mg/Kg	
Tin	≤20.0 mg/Kg	

714.06 EPOXY OR OTHER POLYMERIC TRAFFIC PAINT

Furnish epoxy or other polymeric traffic paint in accordance with Table 714-4. Where the NTPEP method is specified, recorded NTPEP results must be within the specifications shown.

TABLE 714-4
EPOXY OR OTHER POLYMERIC TRAFFIC PAINT COMPOSITION

Test	Specification	Method
Color (x, y, Y)	ASTM D6628	ASTM D6628 and ASTM D7585
Durability (wheel)	minimum of 7 at 36 months	NTPEP
Luminance	White: ≥30 at 36 months Yellow: ≥15 at 36 months	NTPEP
Dry no track	45 minutes maximum	NTPEP
NTPEP lab test verification	must match NTPEP	NTPEP and MT 543
Antimony	≤20.0 mg/Kg	MT 544
Arsenic	≤20.0 mg/Kg	
Cadmium	≤4.0 mg/Kg	
Chromium	≤5.0 mg/Kg	
Cobalt	≤20.0 mg/Kg	
Lead	≤20.0 mg/Kg	
Mercury	≤1.00 mg/Kg	
Tin	≤20.0 mg/Kg	

714.07 PREFORMED PLASTIC PAVEMENT MARKING MATERIAL

714.07.1 Composition Requirements

Furnish preformed plastic pavement marking material consisting of plastics and plasticizers, pigments, and reflective glass beads combined and proportioned to meet the following:

1. Available in both yellow and white color;
2. The total pigment in white marking material a minimum 20% by weight titanium dioxide;
3. The total pigment in yellow marking material a minimum 18% by weight medium chrome yellow;
4. Marking material colors that match the Federal Standard Highway color # 595 A, 33538 for yellow, 37925 for white;
5. Non-yellowing white material;
6. Non-fading yellow material during the expected life of the materials; and
7. Having reflective glass beads in accordance with Subsection 714.08 uniformly distributed throughout the entire material.

714.07.2 Adhesive Requirements

Furnish material having a pre-coated pressure-sensitive adhesive on the base to adhere to plant mix and PCCP. The adhesive must:

1. Be sufficiently free of tack so the material can be handled or repositioned on the pavement before being permanently fixed in position;
2. Mold to the pavement contours, breaks, faults under traffic at normal pavement temperatures;
3. Reseal itself so that, under normal use, it fuses with itself and previously applied markings of similar composition;
4. Capable of being inlaid in pavement at temperatures up to 275 °F (135 °C); and
5. Not lose its adhesive and reflective properties when exposed to water used in rolling operations.

714.07.3 Dimensional Requirements

Furnish the pavement marking material in standard manufactured widths of 4-inch, 6-inch, 8-inch, 12-inch, and 24-inch (105, 155, 205, 305, and 610 mm).

Furnish the material for words and symbols in pre-cut configurations matching the shapes and dimensions in accordance with the Detailed Drawings.

Furnish the pavement marking material in the thickness specified in the contract.

714.07.4 Physical Requirements

A. **Tensile Strength.** Furnish plastic material having a minimum tensile strength of 40 psi (276 kPa) when tested in accordance with ASTM D638. The break resistance is based on an average of at least 3 samples tested at a temperature of 70 to 80 °F (21 to 27 °C) using a jaw speed of 0.25-inch (6 mm) per minute.

B. **Plastic Pull Test.** A 1 x 6-inch (25 x 150 mm) sample of the plastic material must support a dead weight of 0.66 pounds per 0.01 inch (1.2 kg/mm) of material thickness for at least 5 minutes at a temperature of 70 to 80 °F (21 to 27 °C).

C. **Bend Test.** At 80 °F (27 °C) bend a 3 x 6-inch (75 x 150 mm) sample over a 1-inch (25 mm) diameter mandrel until the end faces are parallel and 1-inch (25 mm) apart. The sample must not show any fracture lines in the uppermost surface under unassisted visual inspection.

D. **Skid Resistance.** The plastics surface friction properties must be at least 35 BPN when tested under ASTM E303.

E. **Reseal Test.** The plastic must re-seal itself without adhesives when tested as follows: Overlap two 1 x 3-inch (25 x 75 mm) pieces face-to-face forming a single 1 x 5-inch (25 x 130 mm) piece with a 1 square inch (645 mm^2) overlap in the center. Place the 1 x 5-inch (25 x 130 mm) piece on a hard surface with a 1,000-gram weight resting uniformly on the entire overlap area and maintain at 140 to 190 °F (60 to 88 °C) for 2 hours. Maintain the temperature within the specified range. Cool to room temperature. The pieces must not separate without tearing.

F. **Reflectivity.** Meet the reflective values listed in Table 714-5. Reflective values are measured on a 2 x 2½-foot (610 x 762 mm) panel in accordance with the instrumental photometric measurements of retro-reflective materials and retroflective devices, Federal test method Standard 370.

TABLE 714-5
MINIMUM SIA[1] (CANDELAS PER FOOTCANDLE PER SQUARE FOOT (m^2))
PLASTIC PAVEMENT MARKING MATERIAL

Observation Angle	Entrance Angle	White	Yellow
0.2°	86°	0.20 (2.1)	0.15 (1.6)
0.5°	86°	0.15 (1.6)	0.10 (1.0)

Notes:
1. SIA - specific intensity per unit area

714.07.5 Samples

Submit a 4-inch x 1-foot (100 x 305 mm) sample from each lot of material proposed for use on the project to the Materials Bureau for approval. Obtain approval before using in the work.

714.07.6 Certification

Submit the manufacturer's certification in accordance with Subsection 106.03. Include evidence from the manufacturer that the material proposed for use in the work has performed

successfully under similar climatic conditions and traffic usage. This evidence of successful use is required for the product to be approved for use.

714.08 REFLECTIVE GLASS BEADS

A. General. Provide glass beads for reflectorizing traffic pavement markings that are spherical, transparent, have a smooth, lustrous surface, and in accordance with AASHTO M 247 except as modified below and the pavement marking manufacturer's recommendations. Ensure the delivered beads are free from extraneous material and bead clumps easily break up while handling and distributing onto the stripe.

B. Imperfections. Ensure the glass beads do not contain more than 25% irregularly shaped particles when tested in accordance with ASTM D1155.

C. Color. Ensure the glass beads do not impart a noticeable daytime hue to white pavement markings.

D. Chemical Stability. Ensure the beads can withstand refluxing in distilled water in a Soxhlet extractor for 90 hours without noticeable dulling of the surface luster and not more than 2.5% loss in weight.

E. Gradation. Meet Table 714-6 gradations, tested in accordance with ASTM D1214.

TABLE 714-6
REFLECTIVE GLASS BEAD GRADATION

Percentage By Weight Passing Square Mesh Sieves		
Sieve Size	**Montana Type 1**	**Montana Type 2**
No. 20 (0.850 mm)	100	90 – 97
No. 30 (0.600 mm)	75 - 95	50 - 75
No. 40 (0.425 mm)	--	15 - 45
No. 50 (0.300 mm)	15 - 35	0 - 15
No. 80 (0.180 mm)	--	0 - 5
No. 100 (0.150 mm)	0 - 5	--

F. Packaging and Marking. Package glass beads in moisture-proof containers marked to identify the contents, manufacturer, lot number, batch number and net weight.

G. Samples. Furnish a sample of the beads upon request. The Department will furnish the containers.

H. Heavy Metals. Ensure the glass beads contain no more than 200 ppm of lead or arsenic when tested under EPA method 6010C. The beads will be prepared by EPA method 3052.

SECTION 715
TRAFFIC CONTROL DEVICES

715.01 SIGNS AND CHANNELIZING DEVICES

Meet the Detailed Drawings and MUTCD requirements. Use rigid materials for sign backing. Flexible signs are not permitted. Adjust signs within specified distances to prevent obstruction from or to existing signs.

Mount signs so they are vertical and stable. Posts must not extend more than 2 feet (610 mm) above the top of signs.

Construction signs may be horizontally hinged at the midpoint of the sign face provided the hinge gap does not exceed ½-inch (13 mm) and the sign legend is legible.

715.02 CONSTRUCTION SIGN SUPPORT ASSEMBLIES

Construct sign support assemblies from lightweight yielding material. Meet the following requirements:

A. Use wood members with a maximum 16 square inch (10,325 mm^2) cross section for base construction and 8 square inch (5,160 mm^2) cross section for uprights and braces. Provide wood members that are free of bark.

B. Use tubular metal members with a maximum 9 square inch (5,805 mm^2) cross section.

C. Use solid metal members with a maximum 1 square inch (645 mm^2) cross section.

Signs may be portable trailer mounted if:

1. The weight of the trailer assembly does not exceed 250 pounds (113.5 kg);
2. The axle, frame, support assembly, and other structural members cannot exceed the dimensions of the portable sign support assembly; and
3. The trailer tire outside diameter does not exceed 28 inches (715 mm). Automotive and equipment axle assemblies cannot be used for trailer-mounted sign supports.

715.03 ADVANCE WARNING ARROW PANELS

Furnish advance warning arrow panels (arrow boards) in accordance with Part 6 of the MUTCD, equipped with at least 25 lamps.

Use 36 x 72-inch (915 x 1,830 mm) Type “B” arrow boards on striping units and shadow vehicles. Use Type “C”, 48 x 96-inch (1,220 x 2,440 mm) for all other applications.

Equip the arrow board with a dimming device to automatically reduce the intensity of the flasher at night.

715.04 WARNING LIGHTS

Equip all vehicles, hauling units, and mobile construction equipment operating within the project limits and operating on roadways used by the traveling public with an amber flashing or strobe light visible from all directions for at least 0.4 mile (0.6 km) during daylight and clear weather conditions.

715.05 ADVANCE WARNING SIGNS

Illuminate the W20-7a (advance flagger ahead sign) and the W3-3 (advance traffic signal ahead sign) to meet the following:

- Signs may be illuminated either internally or externally.
- Use 8 high-power amber LEDs.
- Mount LEDs to illuminate each corner of the sign with an additional LED spaced equally between the corners.
- All LEDs activate simultaneously with a flash rate of 50 to 60 times per minute.
- LEDs must be visible a minimum of 1,000 feet upstream from the W20-7a, W3-3 during both daylight and nighttime use.

- Power the LEDs using a generator, solar panel, or battery power, or a combination of the three.

Meet Subsection 715.02 requirements for mounting portable sign support assemblies and the illumination power source.

SECTION 716
GEOTEXTILES

716.01 GENERAL PHYSICAL REQUIREMENTS

Use geotextiles and thread used in joining geotextiles manufactured from fibers consisting of long-chain polymers, composed of at least 95% by weight of polyolefin or polyesters. Use geotextiles with fibers formed into a stable network such that the fibers or yarns retain their dimensional stability relative to each other, including selvages (edges) during shipping, handling, placement, and in service. Use geotextile free from defects or tears.

A. Minimum Average Roll Values. All property values, with the exception of Apparent Opening Size (AOS), represent MARV in the weakest principal direction. Provide geotextiles whose average test results from any roll sampled in a lot for conformance or quality assurance testing meets or exceeds minimum values provided in this Section.

B. Apparent Opening Size. Values for AOS represent maximum average roll values. Acceptance will be based on ASTM D4759.

Furnish geotextiles in accordance with the strength property requirements of Table 716-1 and the AOS, permittivity, and ultraviolet stability requirements of Table 716-2 for separation geotextile, Table 716-3 for stabilization geotextile, Table 716-4 for subsurface drainage geotextile filter, and Table 716-5 for erosion control geotextile. Furnish temporary silt fence geotextile in accordance with Table 716-6. The geotextile properties required for each class of survivability are dependent upon geotextile type (i.e. woven or nonwoven). When sewn seams are used, the strength of the sewn seams must be equal to or greater than 90% of the specified grab tensile strength.

TABLE 716-1 E
GEOTEXTILE STRENGTH PROPERTY REQUIREMENTS

			Geotextile Survivability[1]			
			Moderate Survivability		High Survivability	
Property	**Test Methods**	**Units**	**Woven**	**Nonwoven**	**Woven**	**Nonwoven**
Grab elongation	ASTM D4632	%	< 50	≥ 50	< 50	≥ 50
Grab strength	ASTM D4632	lbs.	250	160	315	200
Sewn seam strength[2]	ASTM D4632	lbs.	225	145	285	180
Tear strength	ASTM D4533	lbs.	90	55	110	80
Puncture strength	ASTM D6241	lbs.	495	310	619	433
Apparent opening size	ASTM D4751	sieve size	Required property values for AOS, permittivity, and UV stability are based on the geotextile applications. Refer to Table 716-2 for separation geotextile, Table 716-3 for stabilization geotextile, Table 716-4 for subsurface drainage geotextile filter, and Table 716-5 for erosion control geotextile.			
Permittivity	ASTM D4491	$sec.^{-1}$				
Ultraviolet stability (retained strength)	ASTM D4355	%				

Notes:
1. All numeric values represent MARV in the weaker principal direction.
2. When sewn seams are required. Refer to Subsection 622.03 for overlap requirements.

TABLE 716-1 M
GEOTEXTILE STRENGTH PROPERTY REQUIREMENTS

			Geotextile Survivability[1]			
			Moderate Survivability		High Survivability	
Property	**Test Methods**	**Units**	**Woven**	**Nonwoven**	**Woven**	**Nonwoven**
Grab elongation	ASTM D4632	%	< 50	≥ 50	< 50	≥ 50
Grab strength	ASTM D4632	N	1100	700	1400	900
Sewn seam strength[2]	ASTM D4632	N	990	630	1260	810
Tear strength	ASTM D4533	N	400	250	500	350
Puncture strength	ASTM D6241	N	2200	1375	2750	1925
Apparent opening size	ASTM D4751	mm	Required property values for AOS, permittivity, and UV stability are based on the geotextile applications. Refer to Table 716-2 for separation geotextile, Table 716-3 for stabilization geotextile, Table 716-4 for subsurface drainage geotextile filter, and Table 716-5 for erosion control geotextile.			
Permittivity	ASTM D4491	$sec.^{-1}$				
Ultraviolet stability (retained strength)	ASTM D4355	%				

Notes:
1. All numeric values represent MARV in the weaker principal direction.
2. When sewn seams are required. Refer to Subsection 622.03 for overlap requirements.

716.02 SEPARATION GEOTEXTILE

Provide geotextile in accordance with the strength requirements from Table 716-1 for the level of survivability specified in the contract or special provisions. Provide geotextile in accordance with the permittivity, apparent opening size, and ultraviolet stability requirements of Table 716-2.

TABLE 716-2
SEPARATION GEOTEXTILE PROPERTY REQUIREMENTS

	Test Methods	Units	Requirements
Geotextile survivability	As specified from Table 716-1		
Permittivity[1]	ASTM D4491	$sec.^{-1}$	≥ 0.02
Apparent opening size	ASTM D4751	sieve size (mm)	No. 30 (≤ 0.60)
Ultraviolet stability (retained strength)	ASTM D4355	%	≥ 50 after 500 hrs. of exposure

Notes:
1. Minimum value. Permittivity of the geotextile must be greater than that required for the soil. Use greater value as specified in the contract or special provisions.

716.03 STABILIZATION GEOTEXTILE

Do not use woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character). Provide geotextile in accordance with the strength requirements for high survivability from Table 716-1. Provide geotextile in accordance with the permittivity, apparent opening size, and ultraviolet stability requirements of Table 716-3.

TABLE 716-3
STABILIZATION GEOTEXTILE PROPERTY REQUIREMENTS[1]

	Test Methods	Units	Requirements
Geotextile survivability	High survivability from Table 716-1		
Permittivity[2]	ASTM D4491	sec.$^{-1}$	≥ 0.10
Apparent opening size	ASTM D4751	sieve size (mm)	No. 40 (≤ 0.43)
Ultraviolet stability (retained strength)	ASTM D4355	%	≥ 50 after 500 hrs. of exposure

Notes:
1. Do not use woven slit film geotextiles.
2. Minimum value. Permittivity of the geotextile must be greater than that required for the soil. Use greater value as specified in the contract or special provisions.

716.04 SUBSURFACE DRAINAGE GEOTEXTILE FILTER

Do not use woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character). Provide geotextile in accordance with the strength requirements from Table 716-1 for the level of survivability specified in the contract or special provisions. Provide geotextile in accordance with the permittivity, apparent opening size, and ultraviolet stability requirements of Table 716-4.

TABLE 716-4
SUBSURFACE DRAINAGE GEOTEXTILE FILTER PROPERTY REQUIREMENTS1

			Requirements[2]		
	Test Methods	Units	Class A	Class B	Class C
Geotextile survivability			As specified from Table 716-1		
Permittivity[3]	ASTM D4491	sec.$^{-1}$	≥ 0.5	≥ 0.4	≥ 0.3
Apparent opening size	ASTM D4751	sieve size (mm)	No. 40 (≤ 0.43)	No. 60 (≤ 0.25)	No. 80 (≤ 0.18)
Ultraviolet stability (retained strength)	ASTM D4355	%	≥ 50 after 500 hrs. of exposure		

Notes:
1. Do not use woven slit film geotextiles.
2. Use Class “A” subsurface drainage geotextile when the in situ soil has less than 15% fines (gravel or sand). Use Class “B” subsurface drainage geotextile when the in situ soil has 15 to 50% fines (silty or clayey sand or gravel). Use Class “C” subsurface drainage geotextile when the in situ soil has more than 50% fines (silt or clay).
3. Minimum values. Permittivity of the geotextile must be greater than that required for the soil. Use greater values as specified in the contract or special provisions.

716.05 PERMANENT EROSION CONTROL GEOTEXTILE

Do not use woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character). Provide geotextile in accordance with the strength requirements from Table 716-1 for the level of survivability specified in the contract or special provisions. Provide geotextile in accordance with the permittivity, apparent opening size, and ultraviolet stability requirements of Table 716-5.

TABLE 716-5
PERMANENT EROSION CONTROL GEOTEXTILE PROPERTY REQUIREMENTS[1]

			Requirements[2]		
	Test Methods	**Units**	**Class A**	**Class B**	**Class C**
Geotextile survivability			As specified from Table 716-1		
Permittivity[3]	ASTM D4491	sec.$^{-1}$	≥ 0.7	≥ 0.4	≥ 0.2
Apparent opening size	ASTM D4751	sieve size (mm)	No. 40 (≤ 0.43)	No. 60 (≤ 0.25)	No. 70 (≤ 0.22)
Ultraviolet stability (retained strength)	ASTM D4355	%	≥ 70 after 500 hrs. of exposure		

Notes:
1. Do not use woven slit film geotextiles.
2. Use Class "A" permanent erosion control geotextile when the in situ soil has less than 15% fines (gravel or sand). Use Class "B" permanent erosion control geotextile when the in situ soil has 15 to 50% fines (silty or clayey sand or gravel). Use Class "C" permanent erosion control geotextile when the in situ soil has more than 50% fines (silt or clay).
3. Minimum values. Permittivity of the geotextile must be greater than that required for the soil. Use greater values as specified in the contract or special provisions.

716.06 TEMPORARY SILT FENCE GEOTEXTILE

Provide geotextile in accordance with Table 716-6.

TABLE 716-6
TEMPORARY SILT FENCE PROPERTY REQUIREMENTS

	Test Methods	**Units**	**Stabilized Silt Fence[1]**	**Unstabilized Silt Fence[2]**
Grab strength, machine direction	ASTM D4632	lb. (N)	≥ 90 (≥ 400)	≥ 125 (≥ 550)
Grab strength, X-machine direction	ASTM D4632	lb. (N)	≥ 90 (≥ 400)	≥ 100 (≥ 450)
Permittivity[3]	ASTM D4491	sec.$^{-1}$	≥ 0.05	≥ 0.05
Apparent opening size	ASTM D4751	sieve size (mm)	No. 30 (≤ 0.60)	No. 30 (≤ 0.60)
Ultraviolet stability (retained strength)	ASTM D4355	%	≥ 70 after 500 hrs. of exposure	

Notes:
1. Unstabilized silt fence is supported with either wood or metal fence posts.
2. Stabilized silt fence is supported with metal fence posts and with woven wire backing.
3. Minimum values. Use greater values as specified in the contract or special provisions.

SECTION 717
CONCRETE SEALANTS

717.01 CONCRETE CURING MATERIALS

717.01.1 Curing and Protective Coverings

Furnish protective cover materials for curing concrete in accordance with ASTM C 171, Sheet Materials for Curing Concrete, excluding curing paper.

717.01.2 Burlap Cloth

Furnish burlap cloth in accordance with AASHTO M 182, Class 3. In lieu of the minimum weight (mass) specified, ensure that a sample dried in an oven at a temperature of 215 to 225 °F (102 to 107 °C) has a weight not less than 8.0 ounces per square yard (270 g/m^2).

717.01.3 Liquid Membrane-Forming Concrete Curing Compounds

Furnish liquid membrane-forming compounds for curing concrete in accordance with ASTM C 309 Type 1-D, clear or translucent and containing a fugitive dye, or Type 2, white pigmented.

717.02 BRIDGE DECK SEALANTS

717.02.1 Silane Sealer

Furnish a Silane Sealant listed on the QPL.

717.02.2 Bridge Deck Crack Sealant

A. High Molecular Weight Methacrylate (HMWM) Bridge Deck Crack Sealant.

Furnish a low viscosity, non-fuming, HMWM resin conforming to Table 717-1 and listed on the QPL.

TABLE 717-1
PROPERTIES OF HMWM

Physical Property Requirements for HMWM Resin	
Viscosity:	1.4 x 10^{-3} lb/in-s (25 centipoises) maximum (Brookfield Model RVT Viscometer, No. 1 Spindle at 60 RPM)
Specific Gravity:	0.90 minimum at 77 °F (25 °C)
Tensile Elongation:	30% minimum (ASTM D638)
Odor:	Low
Vapor Pressure:	0.02 psi at 77 °F (140 Pa at 25 °C) maximum
Flash Point:	175 °F (80 °C) minimum (ASTM D3278)
Solids Content:	100%
Performance Properties of HMWM Resin	
Cure Speed	-
Bulk Cure	less than 3 hours at 73 °F (25 °C)
Surface Cure	less than 8 hours at 73 °F (25 °C) less than 24 hours at application temperature
Gel Time	25-75 min. at application temperature, 1.7 fl. oz. (50 ml) sample

B. Epoxy Bridge Deck Crack Sealant.

Furnish epoxy bridge deck crack sealant listed on the QPL.

C. Deck Sealant Sand.

Furnish silica or garnet sand containing less than 0.5% moisture and in accordance with Table 717-2.

TABLE 717-2
DECK SEALANT SAND GRADATIONS

Percentage By Weight Passing Square Mesh Sieves	
Sieve Size	**Percent Passing**
No. 8 (2.36 mm)	100
No. 16 (1.18 mm)	80-100
No. 50 (0.30 mm)	0-7

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