# John Owen
# FAS Improvements
## Specifications

Prepared by:
*Missoula Engineering*
*P.O. Box 2833*
*Missoula, MT 59806*
*March 2024*

# TABLE OF CONTENTS

## Special Provisions



## Specifications

Division 1 – General Requirements

Division 2 – Site Construction

Section 02100 – Site Preparation
- 02210 Geotextiles

Section 02200 – Earthwork
- 02230 Street Excavation, Backfill and Compaction
- 02235 Crushed Base Course

Section 02500 – Paving and Surfaces
- 02510 Asphalt Concrete Pavement
- 02581 Pavement Markings and Markers
- 02582 Reflective Thermoplastic Pavement Markings

## 1. PROJECT DESCRIPTION

The Project involves construction work associated with:

John Owen Fishing Access Site (FAS)
21 Stevensville Cutoff Road E.
Stevensville, MT 59870

The project generally includes but is not specifically limited to: resurfacing the existing access road, installation of a gravel road and parking area, installation of a gravel and paved pedestrian trail trail and the installation of a sealed vault pit privy.

Project contacts are designated as follows:

| | |
|---|---|
| Owner: | Montana Fish, Wildlife, and Parks<br>PO Box 200701<br>Helena, MT 59620-0701 |
| FWP Project Representative: | Jamie Mongoven, PE<br>Project Manager<br>1522 9th Avenue<br>Helena, MT 59601<br>406-841-4011 (wk)<br>406-841-4004 (fax) |

## 2. SITE INSPECTION

All Bidders should satisfy themselves as to the construction conditions by personal examination of the site described in this document. Bidders are encouraged to make any investigations necessary to assess the nature of the construction and the difficulties to be encountered, see General Conditions, Article 3.

## 3. SOILS INFORMATION

Geotechnical investigation work has not been done for this Project. It is the responsibility of the Bidders to conduct all investigations and determine the soil type and digging conditions that may be encountered with this Project prior to bid preparation, see General Conditions, Article 3.

## 4. PROJECT REPRESENTATIVE, INSPECTIONS, AND TESTING

The Project Representative will periodically monitor the construction of work to determine if the work is being performed in accordance with the contract requirements. The Project Representative does not have the authority or means to

control the Contractor's methods of construction. It is, therefore, the Contractor's responsibility to utilize all methods, equipment, personnel, and other means necessary to assure that the work is installed in compliance with the Drawings and Specifications, and laws and regulations applicable to the work. Any discrepancies noted shall be brought to the Contractor's attention, who shall immediately correct the discrepancy. Failure of the Project Representative to detect a discrepancy will not relieve the Contractor of his ultimate responsibility to perform the work as required, see General Conditions, Article 3.

The Contractor shall inspect the work as it is being performed. Any deviation from the Contract requirements shall be immediately corrected. Prior to any scheduled observation by the Project Representative, the Contractor shall again inspect the work and certify to the Project Representative that he has inspected the work and it meets the requirements of the Contract Documents. The Project Representative may require uncovering of work to verify the work was installed according to the contract documents, see General Conditions, Article 12.

The work will be subject to review by the Project Representative. The results of all such observations, and all contract administration, shall be directed to the Contractor only through the Project Representative.

4.1 Services Required by the Contractor. The Contractor shall provide the following services:

a. Any field surveys to establish locations, elevations, and alignments as stipulated on the Contract Documents. FWP reserves the right to set preliminary construction staking for the project. The Contractor is responsible to notify FWP for any construction staking discrepancies.
b. Preparation and certification of all required shop drawings and submittals as described in the General Conditions, Article 3.
c. All testing requiring the services of a laboratory to determine compliance with the Contract Documents shall be performed by an independent commercial testing laboratory acceptable to the Project Representative. The laboratory shall be staffed with experienced technicians properly equipped, and fully qualified to perform the tests in accordance with the specified standards.
d. Preparation and submittal of a construction schedule, including submittals, see General Conditions, Article 3. The schedule shall be updated as required, as defined in the Contract Documents.
e. All Quality Control testing as required by the Contractor’s internal policies.

f. All Quality Assurance testing and/or re-testing as stated in the Contract Documents, see General Conditions, Article 13.

4.2 Services Provided by the Owner. The Owner shall provide the following services at no cost to the Contractor except as required for retests as defined in the Contract Documents.

a. The Project Representative may check compaction of backfill and surfacing courses using laboratory testing submittal information supplied by the Contractor. These tests are to determine if compaction requirements are being fulfilled in accordance with the Contract Documents. It is ultimately the responsibility of the Contractor to ensure that this level of compaction is constant and met in all locations.

b. Any additional Quality Assurance testing deemed appropriate by the Owner, at the Owner's expense.

**5. ENGINEERING INTERPRETATIONS**

Timely Engineering decisions on construction activities or results have an important bearing on the Contractor's schedule. When engineering interpretation affects a plan design or specifications change, it should be realized that more than 24 hours may be required to gain the necessary Owner participation in the decision process including time for formal work directive or change order preparation as required.

**6. REJECTED WORK**

Any defective work or nonconforming materials or equipment that may be discovered at any time prior to the expiration of the warranty period, shall be removed and replaced with work or materials conforming to the provisions of the Contract Documents, see General Conditions, Article 12. Failure on the part of the Project Representative to condemn or reject bad or inferior work, or to note nonconforming materials or equipment on the Contractors submittals, shall not be construed to imply acceptance of such work. The Owner shall reserve and retain all its rights and remedies at law against the Contractor and its Surety for correction of any and all latent defects discovered after the guarantee period (MCA 27-2-208). Only the Project Representative will have the authority to reject work which does not conform to the Contract Documents.

**7. UTILITIES**

The exact locations of existing utilities that may conflict with the work are not precisely known. It shall be the Contractor's responsibility to contact the owners of the respective utilities and arrange for field location services. **One Call Locators, 1-800-424-5555**

The Contract Documents may show utility locations based on limited field observation and information provided to the Project Representative by others. The Project Representative cannot guarantee their accuracy. The Contractor shall immediately notify the Project Representative of any discrepancies with utility locations as shown on the Contract Drawings and/or their bury depths that may in any way affect the intent of construction as scoped in these specifications. There will be no separate payment for exploratory excavation required to locate underground utilities.

7.1 Notification. The Contractor shall contact, in writing, all public and private utility companies that may have utilities encountered during excavation. The notification includes the following information:

a. The nature of the work that the Contractor will be performing.
b. The time, date and location that the Contractor will be performing work that may conflict with the utility.
c. The nature of work that the utility will be required to perform such as moving a power pole, supporting a pole or underground cable, etc.
d. Requests for field location and identification of utilities. A copy of the letter of notification shall be provided to the Project Representative. During the course of construction, the Contractor shall keep the utility companies notified of any change in schedule, or nature of work that differs from the original notification.

7.2 Identification. All utilities that may conflict with the work shall be the Contractor's responsibility to locate before any excavation is performed. Field markings provided by the utility companies shall be preserved by the Contractor until actual excavation commences. All utility locations on the Drawings should be considered approximate and should be verified in the field by the Contractor. The Contractor shall also be responsible for locating all utilities that are not located on the Drawings.

7.3 Removal or Relocation of Utilities. All electric power, street lighting, gas, telephone, and television utilities that require relocation will be the responsibility of the utility owner. A request for extending the specified contract time will be considered if utility owners cause delays.

7.4 Public Utilities. Water, sewer, storm drainage, and other utilities owned and operated by the public entities shall, unless otherwise specifically requested by the utility owner, be removed, relocated, supported or adjusted as required by the Contractor at the Contractor's expense. All such work shall be in accordance with these Contract Documents, or the Owner's

Standard Specifications or written instructions when the work involved is not covered by these Specifications.

7.5 Other Utilities. Utilities owned and operated by private individuals, railroads, school districts, associations, or other entities not covered in these Special Provisions shall, unless otherwise specifically requested by the utility owner, be removed, relocated, supported or adjusted as required by the Contractor at the Contractor's expense. All work shall be in accordance with the utility owner's directions, or by methods recognized as being the standard of the industry when directions are not given by the owner of the utility.

7.6 Damage to Utilities and Private Property. The Contractor shall protect all utilities and private property and shall be solely responsible for any damage resulting from his construction activities. The Contractor shall hold the Owner and Project Representative harmless from all actions resulting from his failure to properly protect utilities and private property. All damage to utilities shall be repaired at the Contractor's expense to the full satisfaction of the owner of the damaged utility or property. The Contractor shall provide the Owner with a letter from the owner of the damaged utility or property stating that it has been repaired to the utility owner's full satisfaction.

7.7 Structures. The Contractor shall exercise every precaution to prevent damage to existing buildings or structures in the vicinity of his work. In the event of such damages, he shall repair them to the satisfaction of the owner of the damaged structure at no cost to the Owner.

7.8 Overhead Utilities. The Contractor shall use extreme caution to avoid a conflict, contact, or damage to overhead utilities, such as power lines, streetlights, telephone lines, television lines, poles, or other appurtenances during the course of construction of this project.

7.9 Buried Gas Lines. The Contractor shall provide some means of overhead support for buried gas lines exposed during trenching to prevent rupture in case of trench caving.

7.10 Pavement Removal. Where trench excavation or structure excavation requires the removal of curb and gutter, concrete sidewalks, or asphalt or concrete pavement, the pavement or concrete shall be cut in a straight line parallel to the edge of the excavation by use of a spade-bitted air hammer, concrete saw, colter wheel, or similar approved equipment to obtain a

straight, square, clean break. Pavement cuts shall be 2 feet wider than the actual trench opening.

7.11 Survey Markers and Monuments. The Contractor shall use every care and precaution to protect and not disturb any survey marker or monuments, such as those that might be located at lot or block corners, property pins, intersection of street monuments or addition line demarcation. Such protection includes markings with flagged high lath and close supervision. No monuments shall be disturbed without prior approval of the Project Representative. Any survey marker or monument disturbed by the Contractor during the construction of the project shall be replaced at no cost to the Owner by a licensed land surveyor.

7.12 Temporary Utilities. The Contractor shall provide all temporary electrical, lighting, telephone, heating, cooling, ventilating, water, sanitary, fire protection, and other utilities and services necessary for the performance of the work. All fees, charges, and other costs associated therewith shall be paid for by the Contractor.

## 8. CONSTRUCTION SAFETY

The Contractor shall be solely and completely responsible for conditions of the jobsite, including safety of all persons (including employees and subcontractors) and property during performance of the work. This requirement shall apply continuously and not be limited to normal working hours. Safety provisions shall conform to U.S. Department of Labor (OSHA), and all other applicable federal, state, county, and local laws, ordinances, codes, and regulations. Where any of these are in conflict, the more stringent requirement shall be followed. The Contractor's failure to thoroughly familiarize himself with the aforementioned safety provisions shall not relieve them from compliance with the obligations and penalties set forth therein, see General Conditions, Article 10.

## 9. CONSTRUCTION LIMITS AND AREAS OF DISTURBANCE

9.1 Construction Limits. Where construction easements or property lines, are not specifically called out on the Contract Documents, limit the construction disturbance to ten (10) feet, when measured from the edge of the slope stake grading, or to the adjacent property line, whichever is less. Disturbance and equipment access beyond this limit is not allowed without the written approval of both the Project Representative and the Owner of the affected property. If so approved, disturbance beyond construction limits shall meet all requirements imposed by the landowner; this includes existing roads used and/or improved as well as the construction of new access roads.

Special construction, reclamation, or post-construction reclamation or other closure provisions required by the landowner on access roads beyond the construction limits shall be performed by the Contractor at no additional cost to the Owner.

9.2 Areas of Disturbances. Approved areas of disturbance are those areas disturbed by construction activities within the construction limits and along designated or approved access routes. Such areas may require reclamation and revegetation operations, including grading to the original contours, top soiling with salvaged or imported topsoil, seeding, fertilizing, and mulching as specified herein. Other areas that are disturbed by the Contractor's activities outside of the limits noted above will be considered as site damage or unapproved areas of disturbance, see General Conditions, Articles 3 and 10. This includes areas selected by the Contractor outside the defined construction limits for mobilization, offices, equipment, or material storage.

10. **DECONTAMINATE CONSTRUCTION EQUIPMENT** Power wash all construction equipment entering the project site to prevent the spread of noxious weeds and aquatic invasive species. This applies to all FWP projects, whether or not individual construction permits specifically address cleaning of equipment.

11. **TREE PROTECTION AND PRESERVATION** The Contractor and the Owner shall individually inspect all trees within the project construction limits prior to construction. The Owner shall determine which trees are to be removed and which trees are to be preserved. Construction of the grading, utilities and various roadway facilities must not significantly damage the trees root system or hinder it’s 100 chances for survival. Reasonable variations from the Contract Documents, as directed by the Project Representative, may be employed to ensure the survival of trees.

12. **CONSTRUCTION SURVEYS** The Contractor will be responsible for all layout and construction staking utilizing the Project Representative’s existing control and coordinate data for the project, after the Engineer’s set of staking described in Section 01050. Dimensions and elevations indicated in layout of work shall be verified by the Contractor. Discrepancies between Drawings, Specifications, and existing conditions shall be referred to the Project Representative for adjustment before work is performed. The Project Representative may set location and grade stakes prior to construction; however, it is ultimately the responsibility of the Contractor to check and verify all construction staking for the project. Existing survey control (horizontal and vertical) has been set for use in the design and ultimately the construction of these improvements. A listing of the coordinates and

vertical elevation for each of these control points is included in the project drawings. The Contractor will be responsible for preserving and protecting the survey control until proper referencing by the Contractor has been completed. Any survey control obliterated, removed, or otherwise lost during construction will be replaced at the Contractor's expense. Contractor shall be aware of property pins and survey monuments. Damage to these pins will require replacement of such by a registered land surveyor at no cost to the owner. Original field notes, computations and other records take by the Contractor for the purpose of quantity and progress surveys shall be furnished promptly to the Project Representative and shall be used to the extent necessary in determining the proper amount of payment due to the Contractor.

13. **MATERIAL SOURCES AND CONSTRUCTION WATER** The Contractor shall be responsible for locating all necessary material sources, including aggregates, earthen borrow and water necessary to complete the work. The Contractor shall be responsible for meeting all transportation and environmental regulations as well as paying any royalties. The Contractor shall provide the Project Representative with written approvals of landowners from whom materials are to be obtained, prior to approval. The Contractor may use materials from any source, providing the materials have been tested through representative samples and will meet the Specifications. Water for compaction efforts shall be supplied by the Contractor.

14. **MATERIALS SALVAGE AND DISPOSAL**
    Notify the Owner for any material salvaged from the project site not identified in the Contract Documents. The Owner reserves the right to maintain salvaged material at the project site, compensate the Contractor for relocation of salvaged material, or agreed compensation to Owner for material salvaged by the Contractor. 101 Haul and waste all waste material to a legal site and obey all state, county, and local disposal restrictions and regulations.

15. **STORED MATERIALS**
    Contractor shall use an approved storage area for materials. Materials and/or equipment purchased by the Contractor may be compensated on a monthly basis. For compensation, provide the Project Representative invoices for said materials, shop drawings and/or submittals for approval, and applicable insurance coverage, see General Conditions, Article 9.

16. **STAGING AND STOCKPILING AREA**
    Contractor shall use staging and stockpiling sites to facilitate the project as approved by the Owner. Contract Documents may show approved staging and

stockpiling locations. Notify Owner within 24 hours for approval of staging and stockpiling sites not shown on the Contract Drawings.

**17. SECURITY**

The Contractor shall provide all security measures necessary to assure the protection of equipment, materials in storage, completed work, and the project in general.

**18. CLEANUP**

Cleanup for each item of work shall be fully completed and accepted before the item is considered final. If the Contractor fails to perform cleanup within a timely manner the Owner reserves the right to withhold final payment. Review these Contract Documents for additional Final Cleanup specifications for specific measures, associated with Contractor responsibilities and final payment.

**19. ACCESS DURING CONSTRUCTION**

Provide access to all public and private roadways and approaches within the project throughout the construction period.

**20. CONSTRUCTION TRAFFIC CONTROL**

The Contractor is responsible for providing safe construction and work zones within the project limits by implementing the rules, regulations, and practices of the Manual on Uniform Traffic Control Devices, current edition.

**21. SANITARY FACILITIES**

Provide on-site toilet facilities for employees of Contractor and Sub-Contractors and maintain in a sanitary condition.

**22. CONTRACT CLOSEOUT**

The Contractor's Superintendent shall maintain at the project site, a "Record Set of Drawings" showing field changes, as-built elevations, unusual conditions encountered during construction, and such other data as required to provide the Owner with an accurate "as constructed" set of record drawings. The Contractor shall furnish the "Record Set" to the Project Representative 102 following the Final Inspection of the Project. The Contractor's final payment will not be processed until the "Record Set" of drawings are received and approved by the Project Representative.

**23. MEASUREMENT AND PAYMENT**

Review these Contract Documents for additional Measurement and Payment specifications for definitions. Quantities are listed on the Bid Proposal for Payment

# Division 1

## General Requirements

MONTANA CONTRACTORS ASSOC.
THE CONSTRUCTION ASSOCIATION

**SECTION 01010**

**SUMMARY OF WORK**

## PART 1 - GENERAL

### 1.1 DESCRIPTIONS

A. The Invitation to Bid contains a general description of the project work to be performed under this Contract. The Supplemental Conditions and Special Provisions and other documents contain additional information necessary to perform the work.

### 1.2 CONTRACT DOCUMENTS

A. Portions of the Contract Documents are written in the imperative mode. Except where specifically intended otherwise, the subject of all imperative statements is the Contractor. For example, “Furnish...” means “Contractor shall furnish...”, “Provide” means Contractor shall provide...”. For imperatives specifically addressing the Engineer/Owner, see paragraph 1.02, General Conditions.

B. Contract Documents are defined in Article 1, paragraph 1.01.A.13, General Conditions, as modified by Montana Public Works Standard Specifications, any supplemental conditions, and Article 7 of the Agreement Form.

C. The Contract Documents are intended to provide the basis for proper completion of the work suitable for the intended use of the Owner. Comply with Article 3, General Conditions. Specifications and Drawings included in these contract documents establish the performance, quality requirements, location and general arrangement of materials and equipment, and establish the minimum standards for quality of workmanship and appearance. Anything not expressly set forth but which is reasonably implied or necessary for proper performance of the project shall be included.

D. The various portions of the Contract Documents, of which these specifications are a part, are essential parts of the Agreement, and a requirement occurring in any portion or part is binding as though occurring in all. All portions are intended to be complementary and to describe and provide for a complete work as referenced in Article 3, General Conditions. Unless specifically noted otherwise, in the case of discrepancy the following hierarchy shall be observed:

1. Addenda, which will govern over;
2. Special Provisions, which will govern over;
3. Standard Modifications, which will govern over;
4. Supplementary Specifications, which will govern over;
5. Project Drawings, which will govern over;
6. These Specifications and Standard Drawings, which will govern over;

7. Montana Department of Transportation Standard Specifications for Road and Bridge Construction

E. The copy of the Montana Public Works Standard Specifications, as distributed by the Montana Contractors Association, Inc., will govern as the legal set of these specifications.

F. A requirement mentioned in one part/section of the Contract Documents shall be considered as having been mentioned in all parts/sections.

1.3 WORK SEQUENCE

A. Comply with paragraph 2.05 and 4.04 of the General Conditions and Milestones specified in the Contract Documents.

B. Submit detail schedules as specified in the Contract Documents.

C. Field verify dimensions indicated on drawings before fabricating or ordering materials. Do not scale drawings.

D. Notify Engineer/Owner of existing conditions differing from those indicated on the drawings. Comply with paragraph 5.04, of the General Conditions and any Supplementary Conditions. Verify the existence and location of underground utilities along the route of the proposed work. Omission of an existing or previous abandoned utility location on the Drawings is not to be considered as its nonexistence. Inclusion of existing utility locations on the Drawings is not to be considered as its definite location. Do not remove or alter existing utilities without prior written approval.

1.4 CONTRACTOR USE OF PREMISES:

A. Comply with paragraph 5.02, General Conditions, and as specified in the Contract Documents.

B. Do not park vehicles or equipment or store materials on private property without written permission from the property owner. Provide Engineer/Owner with copy of authorization.

1.5 OWNER-FURNISHED ITEMS

A. Owner-furnished items are listed in the Contract Documents.

**PART 2 - NOT USED PART**

**PART 3 - NOT USED**

## PART 4 - MEASUREMENT AND PAYMENT

4.1 PAYMENT

A. Unless specifically noted otherwise, the work of Division 1 shall be incidental to the work, and no separate payment shall be made.

**END OF SECTION**

**SECTION 01041**

**PROJECT COORDINATION**

## PART 1 - GENERAL

1.1 DESCRIPTIONS

A. This section specifies the requirements for coordinating and sequencing the work under the Contract documents, and requirements regarding existing site conditions.

1.2 COORDINATION WITH PUBLIC AND PRIVATE AGENCIES

A. Comply with Article 8, General Conditions. Permit utility companies to repair or replace their lines in the project limits.

B. Contact the Montana one-call system for utility locations before starting work.

C. Comply with paragraph 7.18, General Conditions.

## PART 2 - PRODUCT — NOT USED

## PART 3 - EXECUTION — NOT USED

## PART 4 - MEASUREMENT AND PAYMENT — NOT USED

**END OF SECTION**

## SECTION 01050

## FIELD ENGINEERING

### PART 1 - GENERAL

1.1 ENGINEERING SURVEYS

A. Notify Engineer of required survey work at least 48 hours before starting work.

B. Preserve all benchmarks, control points and stakes.

C. Replace benchmarks, control points and stakes destroyed or disturbed by Contractor or subcontractor.

D. Comply with paragraph 5.05, General Conditions.

1.2 STREET MONUMENTS AND PROPERTY CORNERS

A. Mark and protect existing property pins and/or street monuments.

B. Use a licensed land surveyor to replace all property corners or other monuments marked or shown on the plans that are destroyed by the work.

### PART 2 - PRODUCT — NOT USED

### PART 3 - EXECUTION — NOT USED

### PART 4 - MEASUREMENT AND PAYMENT — NOT USED

**END OF SECTION**

**SECTION 01090**

**REFERENCES**

## PART 1 - GENERAL

### 1.1 COORDINATION OF CONTRACT DOCUMENTS

### 1.2 DEFINITIONS

A. These specifications use "Article 1 - Definitions" of the Standard General Conditions of the Construction Contract, Form No. C-700 prepared and issued by the Engineer's Joint Contract Documents Committee (EJCDC), for the definition of terms herein. Changes to definitions are by either substitution for the article or in Supplementary Conditions.

### 1.3 REFERENCES

A. This section lists some of the construction industry organizations, professional and technical associations, societies and institutes, and government agencies issuing, promoting, or enforcing standards in the Contract Documents along with the abbreviations commonly used for those references. Also included are general requirements for using industry standards specified, and for applying quality control standards.

### 1.4 USE OF REFERENCE STANDARDS

A. Work specified by reference to a published standard or specification of a government agency, technical association, trade association, professional society or institute, testing agency, or other organization must meet or exceed the minimum quality standards for the material and workmanship in the designated standard or specification.

B. Where specified, assure products or workmanship meet the prescriptive or performance requirements in the Contract Documents when it is a more stringent standard than the referenced standard. Contract should reference only one specification to prevent argument as to which specification is most stringent.

C. Where the specific issue date of the standard is not identified in the standard, the edition and all published amendments available on the date of the Invitation to Bid applies.

D. If two or more standards are specified, provide the product and workmanship meeting or exceeding the requirements of the most stringent standard.

E. If a conflict exists between standards, meet the more stringent standard.

F. Where both a standard and a brand name are specified, assure the proprietary product names meet or exceed the specified reference standard. The listing of a trade name in a Contract Document does not warrant that the product meets the referenced standard.

G. Copies of Standards
   1. Copies of applicable referenced standards are not bound in this Contract Document.
   2. Where the contractor needs copies of standards for work superintendence and quality control, obtain a copy or copies directly from the publication sources and maintain copies at the job site, making them available to Contractor personnel, subcontractors, Owner, and Engineer.

## 1.5 ABBREVIATIONS

A. Abbreviations for Trade Organizations and Government Agencies: Following is a list of construction industry organizations and government agencies commonly referenced in the Contract Documents, with abbreviations used.

| | |
|---|---|
| AA | Aluminum Association |
| AAMA | Architectural Aluminum Manufacturers' Association |
| AASHTO | American Association of State Highway and Transportation Officials |
| ACI | American Concrete Institute |
| AFBMA | Anti-Friction Bearing Manufacturers' Association |
| AGA | American Gas Association |
| AGC | Associated General Contractors of America |
| AGMA | American Gear Manufacturers' Association |
| AISC | American Institute of Steel Construction |
| AISI | American Iron and Steel Institute |
| AITC | American Institute of Timber Construction |
| ALS | American Lumber Standards |
| AMCA | Air Moving and Conditioning Association |
| ANSI | American National Standards Institute |
| APA | American Plywood Association |
| API | American Petroleum Institute |
| AREA | American Railway Engineering Association |
| ARI | Air Conditioning and Refrigeration Institute |
| ASAE | American Society of Agricultural Engineers |
| ASCE | American Society of Civil Engineers |
| ASHRAE | American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. |
| ASME | American Society of Mechanical Engineers |
| ASSE | American Society of Sanitary Engineers |
| ASTM | American Society for Testing and Materials |
| AWI | Architectural Woodwork Institute |
| AWPA | American Wood Preservers' Association |
| AWPB | American Wood Preservers' Bureau |
| AWPI | American Wood Preservers' Institute |

| | |
|---|---|
| AWS | American Welding Society |
| AWWA | American Water Works Association |
| BHMA | Builders Hardware Manufacturers' Association |
| CBMA | Certified Ballast Manufacturers' Association |
| CDA | Copper Development Association |
| CGA | Compressed Gas Association |
| CISPI | Cast Iron Soil Pipe Institute |
| CMAA | Crane Manufacturers' Association of America |
| CRSI | Concrete Reinforcing Steel Institute |
| FGMA | Flat Glass Marketing Association |
| FM | Factory Mutual |
| Fed Spec. | Federal Specifications |
| FS | Federal Specification |
| GA | Gypsum Association |
| HI | Hydraulic Institute |
| HMI | Hoist Manufacturers' Institute |
| ICBO | International Conference of Building Officials |
| ICEA | Insulated Cable Engineers' Association |
| IEEE | Institute of Electrical and Electronics Engineers, Inc. |
| IES | Illuminating Engineering Society of North America |
| ISA | Instrument Society of America |
| JIC | Joint Industry Conferences of Hydraulic Manufacturers |
| MIA | Marble Institute of America |
| Mil. Sp. | Military Specifications |
| MMA | Monorail Manufacturers' Association |
| NAAMM | National Association of Architectural Metal Manufacturers |
| NBHA | National Builders' Hardware Association |
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturers' Association |
| NESC | National Electrical Safety Code |
| NFPA | National Fire Protection Association |
| NHLA | National Hardwood Lumber Association |
| NLMA | National Lumber Manufacturers' Association |
| NTMA | National Terrazzo and Mosaic Association |
| NWMA | National Woodwork Manufacturers' Association |
| OECI | Overhead Electrical Crane Institute |
| OSHA | Occupational Safety and Health Act (both Federal and State) |
| PEI | Porcelain Enamel Institute |
| PS | Product Standards Section - U.S. Department of Commerce |
| RLM | RLM Standards Institute, Inc. |
| RMA | Rubber Manufacturers' Association |
| SAE | Society of Automotive Engineers |
| SDI | Steel Deck Institute |
| SDI | Steel Door Institute |
| SIGMA | Sealed Insulating Glass Manufacturing Association |
| SJI | Steel Joist Institute |
| SMACNA | Sheet Metal and Air Conditioning Contractors National Association |
| SSPC | Steel Structures Painting Council |

| | |
|---|---|
| SWI | Steel Window Institute |
| TEMA | Tubular Exchanger Manufacturers' Association |
| TCA | Tile Council of America |
| UBC | Uniform Building Code |
| UFC | Uniform Fire Code |
| UL | Underwriters' Laboratories, Inc. |
| WCLIB | West Coast Lumber Inspection Bureau |
| WWPA | Western Wood Products Association |

**PART 2 - PRODUCT — NOT USED**

**PART 3 - EXECUTION — NOT USED**

**PART 4 - MEASUREMENT AND PAYMENT — NOT USED**

**END OF SECTION**

**SECTION 01300**

**SUBMITTALS**

## PART 1 - GENERAL

1.1 CONSTRUCTION SCHEDULES

A. Submit to the Engineer a progress schedule under Sections 2.03, 2.05 and 4.04 of the General Conditions.

B. Submit to the Engineer adjusted progress schedules under Section 4.04 of the General Conditions.

C. Submit to the Engineer, value schedules under Sections 2.03 and 2.05 of the General Conditions.

1.2 SHOP DRAWINGS, PRODUCT DATE, AND SAMPLES:

A. Submit shop drawings to the Engineer under Sections 2.03, 2.05 and 7.16 of the General Conditions. Submit all shop drawings for the Contractor, subcontractor(s), and supplier(s)

B. Review all shop drawings prior to submittal in accordance with Section 7.16 of the General Conditions.

C. Submit in writing any substitutions to previously approved items for review by the Engineer.

D. Within 15 days after Notice to Proceed, submit a complete list of products proposed for use, providing manufacturer's name, trade name, and model or catalog numbers, and manufacturer data. Submit the number of copies needed by the Contractor, plus three copies for Engineer use.

E. Where specified, submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Where specified, submit samples of finishes including colors, textures, and patterns.

## PART 2 - PRODUCT — NOT USED

## PART 3 - EXECUTION — NOT USED

## PART 4 - MEASUREMENT AND PAYMENT — NOT USED

**END OF SECTION**

## SECTION 01400

## CONTRACTOR QUALITY CONTROL AND OWNER QUALITY ASSURANCE

### PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section describes the Contractor quality control testing requirements and Owner's quality assurance program.

### 1.2 REFERENCES

A. The following ASTM publication is a part of this specification.
   1. ASTM E329 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

### PART 2 - PRODUCT — NOT USED

### PART 3 - EXECUTION

### 3.1 GENERAL

A. Be responsible for quality control tests and inspections to control contractor production and construction processes. Include in the Contractor quality control system an internal organization, plans, and procedures to produce the specified end product. Assure the system covers all construction operations, both on-site and off-site, and is keyed to the construction sequence. Quality control testing frequency is at Contractor discretion, except where tests are specifically required in the technical specifications for individual products.

B. Sampling and testing to assure specification conformance are performed by the Owner or the Owner's testing agency as quality assurance testing.

C. The Owner may select a testing agency to perform quality assurance testing. (ASTM E329 is referenced as a guide to the selection of a qualified testing agency.) The Owner will pay for (or provide) the quality assurance testing. Quality assurance testing frequency is at Owner discretion for individual products.

D. Quality assurance testing is performed following the standards in the technical specifications for individual products.

### 3.2 CONTRACTOR COOPERATION WITH QUALITY ASSURANCE AGENCY

A. Assure the Owner's personnel and quality assurance agency have access to all work areas at all times work is in progress. Provide any special facilities or equipment to access work areas at Contractor expense.

B. Notify the Engineer of the work ready for quality assurance testing. Establish and update as the construction schedule to provide the Engineer estimated sampling/testing dates and times.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.1 PAYMENT FOR TESTING

A. Pay for all quality control testing as outlined in Subsection 3.1 above. Mix designs for Portland Cement Concrete and Flowable Fill, mix designs for Asphalt Concrete, and all initial aggregate quality tests are quality control tests and are at Contractor expense. Testing costs are incidental to the work and to be included in the unit price bid for the respective item.

B. Owner will pay all quality assurance testing costs.

### 4.2 RETESTING

A. Quality assurance re-testing due to failing initial tests will be performed by the Owner or the Owner's quality assurance testing agency, and the re-test costs deducted from the contract amount for the affected bid item.

**END OF SECTION**

## SECTION 01500

## CONSTRUCTION AND TEMPORARY FACILITIES

### PART 1 - GENERAL

### 1.1 CONSTRUCTION FACILITIES

A. Furnish temporary services and utilities, including use fees and operation costs for: potable and non-potable water; lighting and power; and, materials storage.

B. Furnish personnel support facilities including: sanitary facilities; drinking water; first aid supplies and facilities; and, trash removal.

C. Do not park vehicles or equipment or store materials on private property without written permission from the property owner under Section 01010.1.4.B.

### 1.2 SECURITY

A. Provide fencing, barricades, warning signs, and lights to secure all work areas, equipment, and materials.

### 1.3 DUST CONTROL

A. Be responsible for dust and vehicle off tracking control, providing all equipment and personnel for the work. Furnish Engineer name(s) and telephone number(s) of the person(s) responsible for dust control during evenings and weekends. If this person cannot be contacted, Owner may at Contractor expense, perform the work or contract the work out.

### 1.4 HAUL ROUTES

A. Obtain Owner approval of haul routes

### 1.5 IRRIGATION SYSTEMS

A. Contractor shall remove and reinstall; or modify irrigation systems as necessary to accommodate the construction work. Irrigation systems shall be operational within 5 calendar days after initial shutdown for construction between April 15th and October 15th. The Contractor shall coordinate construction activities with the appropriate property owner to assure proper shutdown, removal, relocation, and replacement of existing sprinkler or irrigation systems. It is recommended that the Contractor contact the property owners where sprinkler or irrigation systems are located to determine whether

the system is functioning properly prior to starting any work. Contractor shall take care to cut and remove the system with as little damage as possible. Replacement of damaged components will be with parts of equal or greater quality and preferably the same brand as the existing system. Although the Contractor will not be required to restore a non-functional system to be functional, it will be the Contractor's responsibility to restore any portion of the system that is damaged during construction. Contractor shall notify Engineer immediately of the locations of non-functioning sprinkler or irrigation systems

**PART 2 - PRODUCTS — NOT USED**

**PART 3 - EXECUTION — NOT USED**

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 PAYMENT**

A. All items in Part 1 are incidental to the work and no separate payment is made for these items.

**END OF SECTION**

## SECTION 01570

## CONSTRUCTION TRAFFIC CONTROL

### PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This work is the furnishing of labor, materials and equipment for installing, maintaining and operating traffic control devices to ensure the safety of the general public and project personnel.

### 1.2 REQUIREMENTS

A. Perform work under this section meeting Manual of Uniform Traffic Control Services (MUTCD) and contract requirements.

### 1.3 NOTIFICATIONS

A. Coordinate all construction activities to reduce traffic conflicts at the work site, off-site events or other construction projects.

B. Furnish the Engineer, for Owner review, the construction traffic control plan at least one week before construction begins or before changes in segments or phases of the work on the project. The Owner will review and approve the Traffic Control Plan considering known off-site activities and may require modification to the plan or construction timing to coordinate events. Work shall not commence until said plan is approved.

C. For project sites involving a through street, provide the Engineer with a news release. Include in the news release, as a minimum, the work activity and duration. Once approved, furnish the news release to the local media at least three days before starting work. Notify all landowners or residents adjacent to the work of the type and duration of the construction.

### PART 2 - PRODUCT

### 2.1 TRAFFIC CONTROL DEVICES

A. Assure all signs and barricades are reflectorized. Assure all night time traffic control devices meet MUTCD lighting requirements.

B. Use traffic control devices meeting the “Manual of Uniform Traffic Control Devices” and the “Traffic Control Devices Handbook” requirements, available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20492.

C. Assure all traffic control devices are clean, legible, reflective for night-time use, and operable.

## PART 3 - EXECUTION

### 3.1 WORK METHODS:

A. Place all traffic control devices as planned before permitting workers or equipment on the traveled way. Install signs, cones and barricades in that order.

B. Inspect the work area at least twice each day during construction and maintain records of traffic control devices used and their location.

C. Assure traffic control is appropriate to the work. Assure traffic control devices are appropriate and clean before suspending work for the day.

D. Remove traffic control devices in reverse order of installation at the end of each shift.

E. Remove and store all unnecessary traffic control devices away from traffic’s view.

### 3.2 NONCOMPLIANCE

A. Remove, repair or replace any traffic control device not providing its intended function.

B. Do not begin work until all required traffic control devices are placed.

C. The Engineer will periodically inspect the traffic control and inform the Contractor of any deficiencies.

D. Contractor failure to correct any deficiency in the traffic control within 4 hours of notification is cause to deduct monies from the contract payment on the next progress payment.

E. The Engineer may direct correcting traffic control deficiencies immediately. Failure to immediately correct the deficiency is cause for the Engineer to correct the deficiency at Contractor expense.

### 3.3 FLAGGING

A. Furnish competent and properly equipped flag persons as described in the booklet “Instructions for Flag persons” furnished by the Montana Department of Transportation.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.1 PAYMENT

A. Separate measurement for each traffic control device is not made unless the on-site field traffic plan requirements differ materially from the original traffic control plan in the contract. Measurement and payment for the Contractor's off- site traffic control plan and the designed on-site traffic control plan is on a lump sum basis. The lump sum payment is full reimbursement for all costs of furnishing, installing, maintaining, replacing and operating the construction traffic control systems throughout the work period. The construction traffic control system includes but is not limited to, signs, barricades, pavement markings, watering, flag persons and pilot cars.

B. Progress payments are in proportion to total construction completed.

C. If changes in the approved Traffic Control Plan are directed by the Engineer, additional payment or reduction in payment is made for the additional or deleted items as agreed to between the Contractor and the Engineer.

**END OF SECTION**

## SECTION 01580

## TEMPORARY WATER SUPPLY

### PART 1 - GENERAL

### 1.1 DESCRIPTION

A. Provide temporary water service to all residential and commercial service connections interrupted by water system replacement projects. The Contractor shall verify with the Engineer and Owner at least 72 hours (excluding weekends and holidays) prior to the suspension of service the areas where consumers will require a temporary water supply. Temporary water service shall not include temporary service for commercial fire protection unless specifically indicated on the drawings.

B. The Contractor shall not disrupt a residential water service for more than 8 hours without providing temporary water. The Contractor shall provide homes that are subject to more than two water shut downs with temporary water. The Contractor also shall not disrupt service to commercial customers unless:

1. The Contractor obtains an authorization letter from the property owner and business owner (if different) at least 7 days prior to the interruption of service. The owners shall agree in the letter to the time and dates of the interruption of the water service and;
2. The Contractor submits a comprehensive work plan to the Engineer for approval that details the planned methodology to be used to ensure the commercial facility is not out water for more than the time detailed in the above letter.

### 1.2 STANDARD DRAWINGS

A. The Owner may have atlas maps showing the water system in the work zones. It shall be the Contractor's responsibility to determine the extent of water system to be taken out of service to perform the work and the subsequent configuration of the temporary water system to provide service to all affected water customers.

### 1.3 SUBMITTALS

A. Contractor shall submit a shop drawing including all materials proposed to be used for temporary water. Additionally, a temporary water plan shall be submitted for each zone prior to starting the layout of the temporary water system. This submittal shall include as a minimum, connection points, hydrants and/or valves to be operated by the Owner, layout for connection to each service, and the location of all street crossings. Depending on the circumstances of the zone, additional information may be required by the Engineer. These submittals shall be submitted in accordance with Section 01300 of these specifications.

B. Contractor shall notify the Fire Department at least 48 hours in advance whenever the fire supply to any commercial buildings is interrupted.

## 1.4 APPLICABLE LAWAS AND REGULATIONS

A. Contractor shall comply with all applicable laws and regulations.

# PART 2 - PRODUCTS

## 2.1 TEMPORARY WATER PIPING

A. The water piping of temporary hoses, piping, etc. shall be a 160 psi rating, NSF approved hose, flexible polyethylene pipe, or PVC pipe. All pipe used for the temporary water system must have a visible NSF approval stamp by the manufacturer. A short section of high-pressure flexible rubber hose may be used for the connection to each residence. The temporary system must be leak proof.

## 2.2 SHUT OFF VALVE

A. The distribution pipe shall have a manual shut-off valve at each service tee. Shut- off valves shall be NSF approved valves.

## 2.3 BACKFLOW PREVENTER

A. The backflow prevention assembly shall be approved by the Engineer and the Owner during the submittal process. Backflow prevention devices shall be designed in accordance with the current AWWA Standard for Double Check Valve Backflow-Prevention Assembly.

B. Each backflow preventer shall be properly supported to protect the assembly and the attached piping from breakage.

C. The first time a backflow prevention assembly is set up on a project it shall be tested to verify its integrity. If the project is suspended over the winter, all backflow preventers shall be re-tested in the spring. All costs associated with this testing shall be the responsibility of the Contractor.

D. Each backflow prevention assembly shall be tested upon relocation. The cost for all subsequent tests shall be the responsibility of the Contractor.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Following the Engineer's and Owner's review and approval of any proposed shutdown request, the Contractor shall be required to give a minimum 48-hour advance notice (excluding weekends and holidays) to all residential consumers whose service will be temporarily affected, by means of individual notices delivered to each consumer including the date, time, and length of the proposed shutdown. If the notices are not issued or the temporary service is not ready to be put in use, the Owner shall be free to exercise their authority in not closing down the existing valves and water main systems

B. The Contractor must have available all the necessary materials to complete the restoration of water to each of residential service within 8 hours after the suspension begins or before 5:00 p.m., whichever comes first. House-to-houseor building-to-building connections will not be allowed unless approved by the Owner.

C. Special arrangements shall be made by the Contractor to provide temporary water service for all commercial services regardless of the length of time the water main is out of service. The Contractor shall supply all hoses, fittings, etc., for providing temporary water service at Contractor's expense. Copper piping or other "non-taste" inducing pipe shall be necessary if the commercial consumer serves food or water products as part of the business.

D. Fire protection is not included unless specifically shown by the Engineer. The Fire Department may require the Contractor to provide personnel for continuous "fire watch" at assisted living facilities where residents may require assistance in the event of a fire.

E. At all times, the Contractor shall be responsible for ensuring no component of the temporary water system comes in contact with or is at risk of being in contact with sources of contamination. The Contractor shall also be responsible for ensuring there are not potential cross-connections to the temporary water system.

### 3.2 LOCATING CURB STOPS

A. The Contractor shall be solely responsible for all activities related to locating, exposing and operating curb stop valves to the individual properties. Existing conditions shall be identified and noted by the Contractor. Any existing condition that is suspected to indicate a defect of the curb stop valve, box, or service shall be reported immediately to the Engineer.

B. The Contractor shall be responsible for correcting any defects or damage that occurs to the curb stop valve, box, or service if not reported to the Engineer before the Contractor operates the curb stop valve.

## 3.3 LAWN WATERING CONNECTIONS

A. Each house connection shall be equipped with a tee connection for lawn watering. The tee shall be NSF approved and shall be equipped with an NSF approved vacuum breaker and shut off valve. The connection to each customer shall require a short section of high-pressure flexible rubber hose at the connection point.

## 3.4 TEMPORARY WATER SYSTEM SIZING

A. All pipe sizes shall be adequate to meet ordinary water supply demands of the consumers. The Contractor shall upsize the service at no additional cost if the home or business can show reasonable cause as to service deficiency.

B. The temporary water system shall be designed to maintain a minimum working pressure of 35 pounds per square inch at all points in the distribution system, including the service lines.

C. Where the accumulation of air could diminish the flow capacity of the system, the Contractor shall provide air relief.

## 3.5 TEMPORARY WATER SYSTEM DISINFECTION

A. All temporary water systems shall be assembled, flushed, and disinfected in place and approved by the Engineer and Owner before being placed into service. The disinfection procedures shall be equal to the procedures required for the new water main.

B. Temporary hoses, piping, fittings, etc. are to be flushed and disinfected in accordance with the State of Montana Department of Environmental Quality standards, and the standards of this specification prior to being put into service.

## 3.6 CONNECTION TO BUILDINGS

A. Once the temporary water system has been assembled, pressure tested and disinfected, the Contractor will make the final connection to the building. The Contractor should expect to find the existing plumbing on some services to have been in service for several years. The Contractor shall use an ordinary degree of care while working on these services. Also, there may not be any convenient point of temporary connection on some services. In this case, temporary fittings must be provided to achieve the connection. This work will be incidental to the temporary water work. Any damage to the existing residential plumbing shall be repaired at Contractor's expense.

## 3.7 CROSSING ROADS, ALLEYS AND DRIVEWAYS

A. The Contractor will be required to protect the pipe at road crossings, alleyways, or residential driveways. The method of pipe protection shall be approved by the Engineer prior to placement.

B. The Contractor will be required to install the temporary water supply at street crossings in a shallow trench or other methods acceptable to the Engineer. The Engineer may not allow new asphalt to be cut for temporary water trenches in which case the temporary water main is to be relocated or other crossing methods are to be used. Aerial crossings of the temporary water lines at street crossings will not be allowed. Temporary water supply pipes shall not be installed in storm drain pipes. Mounding millings or cold mix over a temporary water pipe that has been trenched into existing asphalt pavement will be allowed under the following conditions:

1. The maximum height shall be 2.5 inches.
2. Provisions are made to avoid impact loads on the temporary water pipe.
3. Signs are erected indicating a bump ahead at 500 feet and 100 feet from the bump and at the bump in both directions.

C. The asphalt crossings shall be cut straight and vertical shall have uniform width and shall be cut perpendicular to the centerline of the street. Restoration shall match the appropriate surface restoration detail and shall be a minimum of 2 feet wide and shall be compacted with a small mechanical compactor. There will be no payment for any street cuts or asphalt restoration under this item, this being incidental to the work. Exceptions to this requirement shall be made only on a case-by-case basis following the Contractor's proposal and subsequent review and approval by the Owner and Engineer.

## 3.8 RECONNECTION TO NEW WATER SYSTEM

A. After services are connected or reconnected and prior to flushing, testing and chlorinating the new main, the water service piping shall be thoroughly backflushed from the residence to the new main. Should any service include a backflow prevention device, Contractor shall temporarily remove such device or provide other means to backflush the service. The corporation stop for the reconnected services shall not be left open to the new main until the Bac-T testfor the new main has been completed and is acceptable.

# PART 4 - MEASUREMENT AND PAYMENT

## 4.1 GENERAL

A. Measurement for the complete temporary water system shall be on a Lump Sum Basis and will include all incidentals to complete the temporary system.

**END OF SECTION**

**SECTION 01700**

**CONTRACT CLOSEOUT**

## PART 1 - GENERAL

### 1.1 CLEANUP

A. Before Final inspection (as outlined in Section 15.05 of the General Conditions) execute the following.
   1. Where applicable, clean interior and exterior glass and surfaces exposed to view. Remove temporary labels.
   2. Where applicable, clean equipment and fixtures to a sanitary condition.
   3. Where applicable, clean debris from roof, gutters, and downspouts.
   4. Remove debris, waste, surplus materials, and rubbish from right-of-way, easements (construction or permanent) and private property.
   5. Where applicable, remove debris, dirt, and silt from storm drain basins, sanitary sewer and storm drain manholes, and water valve boxes.
   6. Rake landscaped surfaces clean of debris.
   7. Where applicable, remove temporary coverings from traffic control devices.
   8. Clean traffic control devices and signs.
   9. Where applicable, remove temporary traffic striping.
   10. Sweep dirt and debris from all paved areas affected by the work.

### 1.2 RECORD DOCUMENTS

A. Submit record documents as outlined in the General Conditions. Final payment will not be processed until the documents are submitted to and approved by the Engineer.

### 1.3 OPERATION AND MAINTENANCE DATA

A. Where applicable, submit two sets, before final inspection, bound in three ring binders. Prepare a table of contents for each volume with each product or system identified.

B. Where applicable, prepare the following:

C. Directory, listing names, addresses and telephone numbers of Engineer, Contractor, Subcontractor, and Equipment Suppliers.

D. Operations and maintenance instructions, arranged by system. For each category, identify the applicable Contractor(s) or Subcontractor(s) and suppliers. Identify the following:
   1. Significant design criteria
   2. List of equipment
   3. Parts list for each component

4. Operating instructions
5. Maintenance instructions

1.4 WARRANTIES AND BONDS

A. Submit, with final payment request, all warranty certificates, lien releases, and consent of security forms.

**PART 2 - PRODUCTS — NOT USED**

**PART 3 - EXECUTION — NOT USED**

**PART 4 - MEASUREMENT AND PAYMENT — NOT USED**

**END OF SECTION**

# Division 2

## Site Work

MONTANA CONTRACTORS ASSOC.
THE CONSTRUCTION ASSOCIATION

# Section 02100

## Site Preparation


MONTANA CONTRACTORS ASSOC.
THE CONSTRUCTION ASSOCIATION

**SECTION 02110**

**GEOTEXTILES**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This work consists of furnishing, and placing a geotextile as a subsurface drainage fabric permeable separator between dissimilar materials (such as between subgrade and sub base/base), stabilization fabric, temporary and/or permanent erosion control measures or as waterproofing/stress releasing membrane within pavement structures.

### 1.2 REFERENCES

A. The current publications listed below form part of this specification.

B. ASTM Standards

| | |
|---|---|
| D123 | Standard Terminology Relating to Textiles |
| D276 | Standard Test Methods for Identification of Fibers in Textiles |
| D4354 | Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products for Testing |
| D4632 | Standard Test Method for Grab Breaking Load and Elongation of Geotextiles (Grab Method) |
| D4533 | Standard Test Method for Trapezoid Tearing Strength of Geotextiles |
| D3786 | Standard Test Method for Bursting of Textile Fabrics - Diaphragm Bursting Strength Tester Method |
| D4833 | Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products |
| D4491 | Standard Test Method for Water Permeability of Geotextiles by Permeability |
| D4751 | Standard Test Method for Determining the Number of Constrictions “m” of Non-Woven Geotextiles as a Complementary Filtration Property |
| D4354 | Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products for Testing |

| | |
|---|---|
| D4759 | Standard Practice for Determining the Specification Conformance of Geosynthetics |
| D276 | Standard Test Methods for Identification of Fibers in Textiles |
| D4355 | Standard Test Method for Deterioration of Geotextiles by Exposure to Light,-Moisture and Heat in a Xenon Arc-Type Apparatus |
| D4873 | Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples |
| D5141 | Standard Test Method for Determining Filtering Efficiency and Flow Rate of the Filtration for-Component of a Sediment Retention Device |
| D5261 | Standard Test Method for Measuring Mass per Unit Area of Geotextiles |
| D1140 | Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing |
| D4318 | Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils |
| D698 | Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3) |

C. AASHTO Specifications – Standard Specifications for Transportation Materials and Methods of Sampling and Testing
   1. Augmenting and prevailing over this specification section.

**PART 2 - PRODUCTS**

**2.1 PHYSICAL AND CHEMICAL REQUIREMENTS**

A. Assure that fibers used in the manufacture of geotextiles, and the threads used in joining geotextiles by sewing, consist of long-chain synthetic polymers, composed of at least 95 percent by weight polyolefins or polyesters. They must be formed into a network so the filaments on yarns retain dimensional stability relative to each other, including selvedges. Furnish materials meeting the physical requirements listed in Section 2.4 or as shown on the plans.

B. Provide moderate or high survivability non-woven polypropylene fabric that is inert to commonly encountered chemicals and soils and that remains stable over a temperature range of -50 degrees Fahrenheit (-46° C) to 150 degrees Fahrenheit (66° C) and at a pH range of 2 to 13.

## 2.2 CERTIFICATION

A. Assure the manufacturer furnishes the purchaser a certificate stating: the name of the manufacturer, the chemical composition of the filaments or yarns, and other information fully describing the geotextile. The manufacturer must include in the certificate, a guarantee stating that the geotextile furnished meets specifications. The certificate must be attested to by a person having a legal authority to bind the company. Mismarking, or misrepresentation by the manufacturer is reason to reject the geotextile under these specifications. Notice sent to the manufacturer by the purchaser regarding rejection of, will be considered to be notice to all wholesalers, jobbers, distributors, agents and other intermediaries handling the manufacturer's product.

B. Label the fabric and its container with the manufacturer's name and fabric type or trade name, lot number and quantity.

## 2.3 SHIPMENT AND STORAGE

A. During shipment and storage, protect the fabric from direct sunlight, ultra-violet rays, temperatures exceeding 160 degrees Fahrenheit (71$^{o}$C), mud, dust and debris. Keep the fabrics in the manufacturer's wrapping until just before use. Include with each shipping, a document, a certification showing that the geotextile meets the manufacturer's certificate and a guarantee that has been previously filed with the purchaser.

B. At the time of installation, the fabric will be rejected if it has defects, seams or weakness, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation or storage.

## 2.4 MATERIALS

A. Drainage Fabric
   1. Furnish Class 2 fabric as specified in AASHTO M 288 – Geotextile Specifications for Highway Applications.

B. Separation Fabric
   1. Furnish Class 1 fabric as specified in AASHTO M 288 – Geotextile Specifications for Highway Applications.

C. Stabilization Fabric
   1. Furnish Class 1 fabric as specified in AASHTO M 288 – Geotextile Specifications for Highway Applications

D. Permanent Erosion Control
   1. Furnish Class 1 fabric, as specified in AASHTO M 288 – Geotextile Specifications for Highway Applications, with an Apparent Opening size of #40, #60, #70, or #100 (US Sieve No.), as shown on the plans.

E. Silt Fence Fabric

1. Support silt fence with either wood or metal fence posts.
2. Assure silt fence geotextile meets the minimum requirements in the following table:

| ***Required Properties for Silt Fence*** | | |
|---|---|---|
| *Property* | *Test Method* | *Value* |
| *Minimum Grab Tensile Strength (lbs)* | *ASTM D4632* | *≥125* |
| *Minimum Grab Tensile Strength, X Direction (lbs)* | *ASTM D4632* | *≥100* |
| *Minimum Permittivity ($sec^{-1}$)* | *ASTM D4491* | *≥0.05* |
| *Maximum Apparent Opening (US Sieve No.)* | *ASTM D4751* | *#30* |
| *Ultraviolet Stability (% Retained After 500 hrs of Exposure)* | *ASTM D4355* | *≥70* |

F. Landfill Cell Filter Fabric

1. Assure landfill cell filter fabric minimum requirements in the following table:

| ***Required Properties for Landfill Cell Filter Fabric*** | | |
|---|---|---|
| *Property* | *Test Method* | *Value* |
| *Minimum Grab Tensile Strength (lbs)* | *ASTM D4632* | *390* |
| *Grab Tensile Elongation (%)* | *ASTM D4632* | *50* |
| *Puncture (lb)* | *ASTM D4833* | *240* |
| *Maximum Apparent Opening Size (US sieve number)* | *ASTM D4751* | *100* |

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Where placing geotextiles on native ground, cut the trees and shrubs flush with the ground surface. Do not remove the topsoil and vegetation mat. Remove all sharp objects and large rocks. Fill depressions or holes with a suitable material to provide a firm foundation.

B. Replace or repair all geotextile that is torn, punctured, or muddy. Remove the damaged area and place a patch of the same type of geotextile overlapping 3 feet, in all directions, (0.9m) beyond the damaged area.

## 3.2 DRAINAGE, SEPARATION AND STABILIZATION APPLICATIONS

A. Shape the subgrade to a smooth surface and to the cross section required. Shape slopes to gradually transition into slope adjustments without noticeable breaks. At the ends of cuts, the intersection of cuts, and embankments, adjust slopes in the horizontal and vertical planes to blend into each other or into the natural ground.

B. Remove all material larger than 6 inches (15 cm) within the top 6 inches (15 cm) of the roadbed. Remove unsuitable material from the roadbed and replace with suitable material. Finish the roadbed and ditches to the required elevation and cross-section.

C. Place the geotextile smooth and free of tension, stress, or wrinkles. Fold and cut the geotextile to conform to curves. Overlap in the direction of construction. Overlap the geotextile a minimum of 2 feet (0.6m) at the ends and sides of adjoining sheets or sew the geotextile joints according to the manufacturer's recommendations. Do not place longitudinal overlaps below anticipated wheel loads. Hold the geotextile in place with pins, staples, or piles of cover material.

D. End dump the cover material onto the geotextile from the edge of the geotextile or from previously placed cover material. Do not operate equipment directly on the geotextile. Spread the end-dumped pile of cover material maintaining a minimum lift thickness of 10 inches (250mm). Compact the cover material with rubber-tired or nonvibratory smooth drum rollers. Avoid sudden stops, starts, or turns of the construction equipment. Fill all ruts from construction equipment with additional cover material. Do not regrade ruts with placement equipment.

E. Place subsequent lifts of cover material in the same manner as the initial lift. Vibratory compactors may be used for compacting subsequent lifts. If foundation failures occur, repair the damaged areas and revert to the use of nonvibratory compaction equipment.

## 3.3 TEMORARY AND PERMANENT EROSION CONTROL APPLICATIONS

A. Place and anchor the geotextile on the approved smooth-graded surface. For slope protection, place the long dimension of the geotextile down the slope. For stream bank protection, place the long dimension of the geotextile parallel to the centerline of the channel.

B. Overlap geotextile a minimum of 24 inches (60 cm) at the ends and sides of adjoining sheets or sew the geotextile joints according to the manufacturer’s recommendations. Overlap the uphill or upstream sheet over the downhill or downstream sheet. Offset end joints of adjacent sheets a minimum of 5 feet (1.5 m). Pins may be used to hold the geotextile sheets in place other than on interior slopes of lagoons or ponds. Space pins along the overlaps at approximately 3-foot (1 m) centers.

C. Place aggregate, slope protection, or riprap on the geotextile starting at the toe of the slope and proceed upward. Place materials by overhead construction methods or in such a manner that no vehicles or equipment operate directly on the fabric. Place riprap onto the geotextile from a height of less than 12 inches (30 cm). Place slope protection rock or aggregate backfill onto the geotextile from a height less than 3 feet (1 m). In underwater applications, place the geotextile and cover material in the same day.

## 3.4 PAVEMENT APPLICATIONS

A. Use SS-1 crack filler meeting the applicable section for crack filler for surface preparation of cracks between 1/8-and 1/4-inch wide. Fill cracks exceeding 1/4- inch (6 mm) width with an asphalt emulsion slurry consisting of 20% by volume of SS-1, 2 percent by volume Portland Cement and the remaining portion fine sand.

B. Use distributors for spraying a Performance Graded (PG) Asphaltic Binder meeting the specifications for the asphalt cement being used in the asphalt concrete overlay.

C. Place fabric using manufacturer recommended equipment.

D. Handle and place all fabric following the manufacturer's recommendations.

E. Clean pavement to receive fabric of dirt, water and vegetation. Clean all cracks between 1/8-inch (3 mm) and 1/4-inch (6 mm) wide and fill flush to the surface with SS-1 bituminous material. Top with sand. Repair larger cracks or holes using the asphalt emulsion slurry. Pour the mixture into the cracks until full. Re-fill with slurry, the following day, any cracks which are not completely filled initially. When a leveling course is required, place it before installing the fabric. Areas to be covered with a leveling course do not require surface preparations for cracks unless the leveling courses will be less than 0.3 foot (10cm).

F. Uniformly apply the asphaltic binder at the rate determined by the Engineer. The quantity will vary with pavement porosity. Take care to place sufficient binder to satisfy the fabric and make the membrane impervious to water without causing a slippage plane. The applications rates are typically 0.25 to 0.30 gallon per square yard. Apply binder using a distributor.

G. Heat the asphalt binder high enough to permit a uniform spray pattern. Ensure air temperature is at least 50 degrees Fahrenheit (10° C) and rising before applying binder and fabric.

H. Place the paving geotextile onto the asphalt sealant with minimal wrinkling. Slit, lay flat and tack all wrinkles or folds higher than 1inch (25 mm). Broom and/or roll the paving geotextile to maximize fabric contact with the pavement surface.

I. At geotextile joints, overlap the geotextile 1 to 3 inches (25 to 75 mm) to ensure full closure. Overlap transverse joints in the direction of paving to prevent edge pickup by the paver. Apply additional asphalt sealant to paving geotextile overlaps to ensure proper bonding of the double fabric layer.

J. If asphalt sealant bleeds through the fabric, treat the affected areas with blotter. Minimize traffic on the geotextile. If circumstances require traffic on the fabric, apply blotter and place "slippery when wet" signs.

K. Broom the excess blotter from the geotextile surfaces before placing the overlay. Repair all damaged fabric before placing overlay. Apply a light tack coat before placing the overlay. To avoid damaging the geotextile, do not turn equipment on the geotextile.

L. Place a hot asphalt concrete overlay within 48 hours after placing the paving geotextile. Limit the lay-down temperature of the mix to a maximum of $325^0$F ($163^0$C) except when the paving geotextile is composed of polypropylene fibers, limit the lay-down temperature of the mix to a maximum of $300^0$F ($149^0$C).

## PART 4 - MEASUREMENT AND PAYMENT

### 4.1 GENERAL

A. All geotextiles will be measured by the square yard (square meter) on a plane parallel to the ground surface, excluding overlaps. The accepted quantities, measured as provided above, will be paid at the contract price per unit of measurement for the pay item that is shown in the bid schedule.

B. Payment indicated to include complete compensation for all labor, equipment, materials and incidentals required for the completion of the work.

### 4.2 PAVING FABRICS

A. Fabric is measured and paid per square yard of roadway surface covered, complete and in place. No allowance is made for additional fabric required for overlap joints. No allowance is made for blotter sand (if occasionally required).

B. Crack filling is measured per job and payment is at contract lump sum price, complete in place.

C. Asphalt cement binder is measured and paid by the ton, corrected to standard temperature, complete in place.

**END OF SECTION**

# Section 02200

## Earthwork


MONTANA CONTRACTORS ASSOC.
THE CONSTRUCTION ASSOCIATION

**SECTION 02230**

**STREET EXCAVATION, BACKFILL AND COMPACTION**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This work is the clearing and grubbing, excavation, filling or backfilling, and subgrade preparation to the specified lines, grades and cross sections as preparation for overlying base course or other courses as shown in the contract documents. Also included are the removal and disposal of debris and excess soil, the furnishing and placement of fill materials, and compaction.

### 1.2 REFERENCES

A. The current publications listed below are a part of this specification.

| | |
|---|---|
| AASHTO T99 | Moisture-Density Relations of Soils Using 5-lb (2.5kg) Rammer and 12-inch (305mm) Drop |
| ASTM D698 | Laboratory Compaction Characteristics of Soils Using Standard Effort (12,400 ft-lbf/ft$^3$)(600 kN-m/m$^3$) |
| AASHTO T191 (ASTM D1556) | Density of Soil In-Place by the Sand-Cone Method |
| AASHTO T310 | In-Place density and water content of the soil and soil aggregate |
| (ASTM D6938) | by Nuclear Method (Shallow Depth) |
| AASHTO T11 (ASTM C117) | Materials Finer Than No. 200 (0.075mm) Sieve in Mineral Aggregates by Washing |
| AASHTO T27 (ASTM C136) | Sieve Analysis of Fine and Coarse Aggregate |
| AASHTO T89 | Determining the Liquid Limit of Soils |
| AASHTO T90 | Determining the Plastic Limit and Plasticity Index of Soils |
| ASTM D4318 | Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils |

## 1.3 DENSITY CONTROL TESTING

A. Field Density Testing
   1. Meet the quality control and quality assurance testing requirements in Section 01400, Contractor Quality Control and Owner Quality Assurance.
   2. In-place field density tests for quality assurance are at Owner expense meeting ASTM D1556A (ASHTO T191), Sand Cone Method; or ASTM D2922 and ASTM D3017 (AASHTO T238 and T239) Nuclear Densometer Methods. Quality assurance field density testing frequency is at the discretion of the Engineer.
   3. Retesting of failing areas is at the expense of the Contractor.

B. Laboratory Maximum Density and Optimum Moisture
   1. Quality assurance tests will be made by the Engineer for each on-site natural soil or each source of off-site material, including borrow material, to determine the laboratory maximum density values and optimum compaction moisture content under AASHTO T99 or ASTM D698.

C. Material Submittals
   1. Submit to the Engineer results of gradation tests for Sub-excavation/Replacement Below Subgrade pitrun gravel/sand.
   2. Submit to the Engineer samples of soils and/or aggregates for laboratory moisture-density relationship testing by the Engineer.

# PART 2 - PRODUCTS

## 2.1 ON-SITE EMBANKMENT

A. Fill and backfill materials are to consist of natural soils free from organic matter, frozen material, refuse, construction debris or other man-made items. Obtain approval of the Engineer for all fill before placing and use only the fill from designated borrow areas.

## 2.2 IMPORTED BORROW MATERIALS (FOR EMBANKMENTS IN-PLACE)

A. If required, obtain borrow soil for embankments from areas off the project site. Furnish imported borrow at Contractor expense. Obtain Engineer approval of borrow areas. Imported borrow is to meet the requirements of Section 2.1, On-Site Embankment.

## 2.3 SUBEXCAVATION/REPLACEMENT BELOW SUBGRADE

A. Sub-excavation consists of removing and disposing of unstable material from below planned subgrade elevation in cut sections or from below the natural ground line in embankment sections.

B. Replacement material for sub-excavations consists of either:

1. Suitable materials from within the project limits if suitable material is present within the project limits, or

2. Imported materials if suitable material is not present within the project limits. Where imported pitrun gravel is used, furnish replacement material meeting the following gradation requirement:

| Sieve Opening | % Passing |
|---|---|
| 3 Inch | 100 |
| No. 4 | 25 - 60 |
| No. 200 | 12 Max. |

## PART 3 - EXECUTION

### 3.1 CLEARING AND GRUBBING

A. Perform clearing and grubbing including the excavation, removal and disposal of roots, stumps, sod, or any organic material and buried debris from within construction limits. Construction limits are defined by all areas within the cut/fill limits and extending 1 foot (0.3 m) beyond the back of sidewalk and/or curb and gutter, or 2 feet (0.6 m) beyond the edge of pavement if no sidewalk or curb and gutter is present. Remove unsuitable material to at least 12 inches (30 cm) below subgrade elevation.

B. Stockpile for project use any topsoil removed by clearing and grubbing.

C. Dispose of all clearing and grubbing material as specified.

### 3.2 EXCAVATION STABILITY AND SAFETY

A. Meet OSHA requirements for excavations and excavated material stockpiles. This may require design of temporary slopes and/or shoring by a licensed professional engineer.

### 3.3 PROTECTION OF PROPERTY

A. Take precautions to protect all adjoining private and public property and facilities, including underground and overhead utilities, curbs, sidewalks, driveways, structures, fences, and vegetation. Any disturbed or damaged facilities will be suitably restored or replaced consistent with condition(s) which existed prior to construction.

### 3.4 EXCAVATION

A. Excavate to the specified lines and grades or as directed by the Engineer. Excavate without causing rutting, pumping or other disturbance to underlying materials.

B. Excavation made outside the specified grade limits is not measured for paymentin the Excavation or Embankment In-Place quantities.

1. Restore sub-excavated areas as directed by the Engineer. Correct subgrade disturbance by removing the disturbed soil and replacing and compacting to reach at least 95 percent of the maximum laboratory dry density determined by AASHTO T99 or ASTM D698.

2. Correct subgrade disturbance before placing overlying fill, backfill, base course or other courses. Disturbed soils may be replaced with imported material approved by the Engineer and compacted to 95% of maximum laboratory dry density determined by AASHTO T99 or ASTM D698.

C. Maintain the subgrade to drain at all times. Construct side ditches or gutters from cuts to embankments to prevent erosion damage to embankments.

D. Construct and maintain temporary drainage where existing surface drainage, sewers, or under-drainage are disturbed during the work until permanent drainage facilities are completed. Protect and preserve all existing drains, sewers, sub-surface drains, conduits, gas lines, and other underground structures which may be affected by the work. Repair all damage to these facilities or structures resulting from the work, to the satisfaction of the Engineer.

E. Excavate to minimize foundation soil and/or subgrade soil exposure to erosion, drying or infiltrating moisture. Perform excavation to provide drainage away from foundation/subgrade soils and minimize the potential for surface runoff to enter the foundation/subgrade soils.

F. Grade all intersecting streets and approaches within the project limits asspecified or as directed using suitable materials on the surfaces to produce smooth riding and satisfactory approaches to the intersections.

## 3.5 DISPOSAL OF EXCAVATED MATERIAL

A. Dispose of debris and unused excavated materials off the project site in accordance with all applicable state and local regulations. Locate and provide suitable disposal areas.

## 3.6 DUST CONTROL

A. Furnish dust control meeting Section 01500, Construction and Temporary Facilities, requirements.

## 3.7 SUBGRADE PREPARATION AND COMPACTION

A. General

1. Assure the subgrade beneath pavements, curb, or sidewalks is natural soil free of topsoil, organic material or refuse. Place pavement components, curb and sidewalk over the prepared subgrade as soon as practical. Donot place pavement components on frozen subgrade. No separate payment is made for subgrade preparation since it is considered incidental to construction of overlying pavements/structures.

2. If the surface of a previous roadbed or pavement surface matches the surface of the finished subgrade scarify the top 6 inches (15cm) of the previous surface the full width of the subgrade to permit uniform reshaping and compaction.

B. Fine Grading

1. Assure the finished surface does not deviate not more than 0.1 foot (3cm) at any point from the staked elevation; and that the sum of the deviations from true grade of any two points less than 30 feet (9m) apart does not exceed 0.1 foot (3cm).

C. Compaction

1. Compact the upper 8 inches (20cm) of the subgrade to at least 95% of the laboratory maximum, determined by AASHTO T99 or ASTM D698. Proof roll the subgrade surface for observation by the Engineer. Compact all soft, yielding or otherwise unstable areas to provide adequate support of construction equipment as determined by the Engineer. Also compact the subgrade to meet the specified density requirements. Remove and replace any unstable or otherwise unsuitable subgrade as specified under Section 3.9, Sub-excavation/Replacement Below Subgrade.

## 3.8 EMBANKMENT PLACEMENT AND COMPACTION

A. General

1. Place fill materials (embankment) to the specified lines and grades. Place fill in uniform layers not exceeding 8 inches (20cm) in loose thickness. Once placed, moisten or aerate, mix, and compact each layer as specified. Work clay soils to maximum 2-inch (5cm) nominal size before compacting. Do not begin fill placement until the subgrade construction has been approved by the Engineer. Do not place fill on wet or frozen areas. Do not operate heavy equipment for spreading or compacting fill within 4 feet (1.2m) of structures.

2. If grading operations are suspended due to weather, blade the entire area until it is smooth, free of depressions and ruts, and crowned to drain water.

B. Compaction

1. Control the fill moisture content to assist in obtaining the specified field density. Maintain the moisture content of fill soils within ± 3% of optimum moisture. Compact each fill layer and the top 8 inches (20cm) of subgrade soil to at least 95 percent of maximum laboratory density as determined by AASHTO T99 or ASTM D698. Compact areas within 4 feet (1.2m) of structures in maximum 8-inch (20cm) loose lifts using power-driven hand-held tampers.

2. Apply water, when required, at the locations and in the amounts required to compact the material to the specified requirements. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application. Apply water during the work to control dust and to maintain all embankment and base courses in a damp condition in accordance with Section 1500. Water required for compacting subgrade and/or embankments may be obtained from the municipal system if approved by the Owner, or from other sources.

3. Do not place fill or embankment when moisture content prevents effective compaction or causes rutting. Dry all embankments having excessive moisture by scarifying and blading the affected areas before compacting or placing succeeding layers.

## 3.9 SUBEXCAVATION/REPLACEMENT BELOW SUBGRADE

A. Sub-excavation consists of removing and disposing of unsuitable material from below planned subgrade elevation in cut sections or from below the natural groundline in embankment sections.

B. Soil is unsuitable if, in the opinion of the Engineer, it contains excessive organics, refuse, construction debris, or other objectionable material; or if it unstable, rutting or yielding; or if it contains excessive moisture. Generally, soils will be sub-excavated and replaced only if they are unable to adequately support equipment typically used for excavation and soil transport.

C. Assure the Engineer has measured the area where unstable materials have been removed before backfilling. Do not backfill any area where unstable foundation soils have been excavated until authorized by the Engineer. Backfill placed without approval may be ordered removed and replaced at Contractor expense.

D. Backfill with either suitable soils from within the project limits or imported pitrun gravel complying with the requirements of Section 2.3, Sub-excavation/Replacement Below Subgrade. Different measurement and payment items are used for the on-site soil and pitrun gravel replacements.

E. Compact the replacement material to 95% of the maximum laboratory density as determined by AASHTO T99 or ASTM D698.

## 3.10 PROTECTION OF THE WORK

A. Repair damaged embankments to the specified elevations and grades. Maintain ditches and drains along the subgrade to drain the subgrade. Assure the finished grade does not deviate more than 0.1 (3cm) foot at any point from the staked elevation and the sum of the deviations from true grade of any two points not more than 30 feet (9m) apart does not exceed 0.1 foot (3cm). Do not place any surface course or pavement until the subgrade has been checked and approvedby the Engineer.

# PART 4 - MEASUREMENT AND PAYMENT

## 4.1 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

A. Excavation Above Subgrade - Cubic Yard Basis.

1. When specified in the contract as a bid item, this item is paid for at the number of cubic yards (cubic meters), as specified in the contract documents and computed using the plan lines and grades.

2. The volume, based upon the plan quantity as specified above, is paid for at the contract unit price bid for Excavation Above Subgrade, and is full compensation for all labor, equipment, tools and incidentals necessary to accomplish all clearing, grubbing, old pavement removals, hauling, disposal, and excavating to prepare the subgrade shown in the contract.

3. When Excavation Above Subgrade is not specified in the contract as a bid item, the cost of excavation above subgrade is incidental to and included in the unit prices bid for the associated bid items for the work.

4. Payment is made under: Excavation - Per Cubic Yard (Cubic Meters).

B. Sub-excavation/Replacement Below Subgrade.

1. This item is field measured using the average end area method and paidfor by the cubic yard (cubic meter) in-place of material removed, measured in its original position, at the contract unit price bid for Sub-excavation/Replacement Below Subgrade, which price and payment constitutes full compensation for all labor, equipment, tools, and incidentals to complete the excavation and disposal of unsuitable material in the embankment foundation or in the subgrade. The cost of backfilling and compacting holes created by the removal of unsuitable material with the specified replacement material is also included in Sub-excavation/Replacement Below Subgrade Item.

2. Payment is made under:
   a. Sub-excavation/Replacement Below Subgrade (Replacementwith On-site Materials) - Per Cubic Yard (Cubic Meter).
   b. Sub-excavation/Replacement Below Subgrade (Replacement with Imported Materials) - Per Cubic Yard (Cubic Meter).

C. Embankment In Place.

1. When specified in the contract as a bid item, Embankment In Place is paid for at the contract unit price per cubic yard (cubic meter) for the actual field measured volume of embankment constructed and accepted in place to the specified lines and grades. Price and payment are full compensation for all labor, tools, equipment, and other incidentals necessary to secure borrow material, haul, place, level, manipulate, compact the embankment material, and perform other work for embankment construction.

2. When Embankment In Place is not specified in the contract, the cost of constructing embankments is incidental to and included in the unit prices bid for the associated bid items for the work.

3. Payment is made under: Embankment In Place - Per Cubic Yard (Cubic Meter).

**END OF SECTION**

**SECTION 02235**

**CRUSHED BASE COURSE**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This work is the placing of one or more base courses composed of crushed gravel, stone or other similar materials meeting the gradation and other quality criteria specified herein.

### 1.2 REFERENCES

| | |
|---|---|
| AASHTO T11 | Materials Finer than No. 200 (0.075 mm) Sieve in Aggregate |
| AASHTO T27 | Sieve Analysis of Fine and Coarse Aggregates |
| AASHTO T89 | Determining Liquid Limit of Soils |
| AASHTO T90 | Determining the Plastic Limit and Plasticity Index of Soils |
| AASHTO T176 | Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test |
| AASHTO T96 | Resistance to Degradation of Small-Size Coarse Aggregate By Abrasion and Impact in the Los Angeles Machine |
| AASHTO T99 (ASTM D698) | Moisture-density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb (2.5 kg) Rammer and 12-Inch (305 mm) Drop |
| ASTM D5821 | Determining the Percentage of Fractured Particles in Coarse Aggregate |
| AASHTO T191 (ASTM D1556) | Density of Soil In-Place By Sand Cone Method |
| AASHTO T310 (ASTM D6938) | In-Place density and water content of the soil and soil aggregate by Nuclear Method (Shallow Depth) |

### 1.3 DENSITY CONTROL TESTING

A. Field Density Testing

1. Meet the quality control and quality assurance testing requirements in section 01400, Contractor Quality Control and Owner Quality Assurance.
2. In-place field density tests for quality assurance are at Owner expense meeting AASHTO T191 (ASTM D1556) Sand Cone method or AASHTO T310 (ASTM D6938) Nuclear Densometer method. Quality assurance field density testing frequency is at the discretion of the Engineer.

3. Retesting of failing areas is at the expense of the Contractor.

B. Laboratory Maximum Density and Optimum Moisture

1. Moisture density curves will be provided by the Contractor for each base material provided. These will be provided at the expense of the Contractor.

1.4 MATERIALS SUBMITTALS

A. Submit to the Engineer gradations, moisture density curves and other test results for sources to be used for base materials prior to delivery to the site for approval by the Engineer. If recycled materials are proposed, CBR test data must be submitted to the Engineer to assure consistency with design requirements.

**PART 2 - PRODUCTS**

2.1 GENERAL

A. Furnish aggregate base material meeting the applicable aggregate quality requirements.

2.2 CRUSHED BASE MATERIAL

A. Consists of both fine and coarse fragments of crushed stone or crushed gravel, and/or natural gravel, and when approved, blended with sand, finely crushed stone, crusher screenings, recycled concrete and/or asphalt or other similar materials. Where recycled materials are permitted, project specifications shall state the minimum required CBR value (design minimum) of the Crushed Base Course.

B. Use crushed stone or gravel consisting of hard, durable particles of fragments of stone, free of excess of flat, elongated, soft or disintegrated pieces, dirt, or other deleterious matter, and having a percent of wear of not exceeding 50 at 500 revolutions when tested under AASHTO T96.

C. Crush material so that the percentage of fractured particles in the finished product is as constant and uniform as practical. Crush to produce material where at least 50% of the material retained on the No. 4 sieve has at least one fractured face.

D. Incorporate all material produced in the crushing operation and passing the No. 4 mesh sieve into the base material necessary to meet the gradation requirements.

2.3 GRADATION

A. As determined by AASHTO Methods T11 and T27, furnish material for the grading specified in the contract documents including binder or filler, which may have been added at the plant or at the site, meeting the requirements of that grading in the Table of Gradations below:

**TABLE OF GRADATIONS**

**PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVE**

| Passing | 1½" Minus | 1" Minus | ¾" Minus |
|---|---|---|---|
| 1½ Inch | 100 | | |
| 1 Inch | — | 100 | |
| ¾ Inch | — | — | 100 |
| ½ Inch | — | — | — |
| No. 4 Sieve | 25 - 60 | 40 - 70 | 40 - 70 |
| No. 10 Sieve | — | 25 - 55 | 25 - 55 |
| No. 200 Sieve | 0 - 8 | 2 - 10 | 2 - 10 |

B. Up to 5% "oversized" material is permitted provided that the "oversized" material passes the screen size immediately larger than the top size specified. The produced material between the maximum screen opening and the No.4 sieve shall be reasonably well graded.

C. Suitability of the aggregate is based on samples obtained during placement in the project within limits allowed in the table for the particular grading specified.

D. That portion of the fine aggregate passing the No. 200 sieve must be less than 60% of that portion passing the No. 40 sieve.

E. The liquid limit for that portion of the fine aggregate passing a No. 40 sieve cannot exceed 25, nor the plasticity index exceed 6, as determined by AASHTO T89 and T90.

2.4 WATERING:

A. Use water from an approved source.

**PART 3 - EXECUTION**

3.1 GENERAL

A. Before placing the base course, smooth and shape the surface of the underlying subgrade, sub-base or base course to the cross section shown on the plans before placing the base course.

B. Do not place base course on a wet or muddy subgrade or sub-base course. Complete at least one area of finished and accepted subgrade, sub-base or underlying base before the placing of any base course.

## 3.2 PLACEMENT AND SPREADING

A. Mix and place the material in maximum 8 inches (20 centimeters) compacted layers unless otherwise approved. Deposit and spread each load of material on the prepared subgrade, or on a completed sub-base or base course layer continuously without interruption. Discontinue operating haul units over subgrade, or over any sub-base or base course completed if the haul units damage the subgrade, sub-base or base course.

B. Deposit and spread the material in a uniform layer, without segregation, to a loose depth so that when compacted, and making allowance for any filler to be blended on the road, the layer has the specified thickness.

C. Spread material using dump boards, spreader boxes, or vehicles equipped to distribute the material in a uniform layer. The material may be deposited in windrows mixed and spread as described below.

D. Construct each layer meeting these requirements. Blade smooth and thoroughly compact each layer as specified before placing the succeeding layer.

E. If segregation or moisture problems exist, or if the material was placed on the road in windrows, thoroughly blade-mix the material of the affected layer by alternately blading to the center and back to the edges of the street.

F. Uniformly add water, when required, on site and place in amounts required to compact the material as necessary to aid in densification and to limit segregation. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application.

G. Apply water during the work to control dust and to maintain the base course in a damp condition in accordance with Section 01500 under Dust Control.

H. Uncontaminated water required for compacting base gravel may be obtained from the municipal system if approved by the owner, or from other sources.

## 3.3 FIELD DENSITY REQUIREMENTS

A. Compact placed material the full width by rolling with suitable tamping equipment or power rollers. Correct all irregularities or depressions that develop during rolling by loosening the material in these places and adding or removing material, as required.

B. Perform blading and compacting alternately as required or directed, to maintain a smooth, even, uniformly compacted surface until the final inspection. Along curbs, headers, manholes, and similar structures, and at all places not accessible to the roller, compact the base course material with suitable mechanical tampers or hand tampers to reach the compaction requirements.

C. Provide the watering and rolling required to obtain a minimum field density of 95% of maximum dry density as determined by AASHTO T99. No separate compensation is made

for rolling and watering the base course other than the base course bid item or items listed on the contract documents.

3.4 SURFACE TOLERANCES

D. The base course surface when finished and tested with a 10-foot (3.0 meter) straight edge placed on the surface with its center line parallel to the center line of the street, will not have a surface deviation from the straight edge exceeding 3/8- inch (1.0 centimeter). Additionally, the finished grade cannot deviate more than 0.05 feet (1.5 centimeters) at any point from the staked elevation, and further, the sum of the deviations from two points not more than 30 feet (9.0 meters) apart cannot exceed 0.05 feet (1.5 centimeters).

E. For base course receiving asphalt concrete surfacing, the finished grade cannot deviate more than 0.02 feet (0.6 centimeters) at any point from the staked elevations, and the sum of the deviations from two points not more than 30 feet (9.0 meters) apart cannot exceed 0.02 feet (0.6 centimeters).

F. If patching of the base course is necessary to meet the tolerances, perform patching using methods and aggregates approved by the Engineer. Payment for patching aggregate is at the unit price bid for the base course material.

**PART 4 - MEASUREMENT AND PAYMENT**

4.1 CUBIC YARD BASIS: CRUSHED BASE COURSE.

A. This item is measured and paid for by the cubic yards (cubic meters) of crushed base course of the gradations specified in the Contract documents, complete in place, at the contract unit price bid for _____" Minus Crushed Base Course". Price and payment is full compensation for furnishing, crushing, loading, hauling, spreading, shaping, watering and compacting the base course material, and for all tools, labor and incidentals necessary to complete this item.

B. Payment is made under:
1. _____" Minus Crushed Base Course - per cubic yard (cubic meters).

4.2 SQUARE YARD BASIS: CRUSHED BASE COURSE.

A. This item is measured and paid for by the square yards (square meters) of crushed base course surface area for furnishing crushed base course of the thickness and gradations specified in the Contract documents, complete in place, at the contract unit price bid for _____" Thickness of __" Minus Crushed Base Course". Price and payment is full compensation for furnishing, crushing, loading, hauling, spreading, shaping, watering and compacting the base course material, and for all tools, labor and incidentals necessary to complete this item.

B. Payment is made under:

1. _____" Thickness of __" Minus Crushed Base Course - per square yard (square meter).

4.3 LINEAR FOOT BASIS: CRUSHED BASE COURSE.

A. This item is measured and paid for by the linear feet (linear meters) of trench restored, measured along the trench centerline, with crushed base course of the gradations specified in the Contract documents, completed in place, at the contract unit price bid for _____" Minus Crushed Base Course". Price and payment is full compensation for furnishing, crushing, loading, hauling, spreading, shaping, blending, watering and compacting the base course material, and for all tools, labor and incidentals necessary to complete this item.

B. Payment is made under:
1. _____" Minus Crushed Base Course - per linear foot (linear meter).

**END OF SECTION**

# Section 02500

## Paving and Surfacing


MONTANA CONTRACTORS ASSOC.
THE CONSTRUCTION ASSOCIATION

**SECTION 02510**

**ASPHALT CONCRETE PAVEMENT**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This Work is the production and placement of plant mix asphalt concrete pavement.

B. Hot plant mix asphalt concrete is a mineral aggregate and asphalt material mixed at a hot plant meeting these specifications and placed in one or more courses on a newly prepared or existing street roadway in accordance with the contract documents.

### 1.2 REFERENCES

| | |
|---|---|
| AASHTO T11 (ASTM D1140) | Amount of Material Finer than No. 200 (0.075 mm) Sieve in Aggregate |
| ASTM D5361 | Standard Practice for Sampling Compacted Bituminous Mixtures for Laboratory Testing |
| AASHTO T27 (ASTM C136) | Sieve Analysis of Fine and Coarse Aggregate |
| AASHTO T89 (ASTM D4318) | Determining Liquid Limit of Soils |
| AASHTO T90 (ASTM D4318) | Determining the Plastic Limit and Plasticity Index of Soils |
| AASHTO T283 (ASTM D4867) | Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage |
| AASHTO T176 (ASTM D2419) | Plastic Fines in Graded Aggregates and Soils by Use of The Sand Equivalent Test |
| AASHTO T96 (ASTM C131) | Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| AASHTO T312 (ASTM D6925) | Standard Test Method for Preparation and Determination of the Relative Density of Asphalt Mix Specimens by Means of the Superpave Gyratory Compactor |
| ASTM D2041 | Theoretical Maximum Specific Gravity and Density of Bituminous Mixtures |
| ASTM C1097 | Hydrated Lime for Use in Asphalt Cement or Bituminous Paving Mixtures |
| ASTM D3666 | Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials |

| | |
|---|---|
| ASTM D5821 | Percentage of Fractured Particles in Coarse Aggregate |
| ASTM C123 | Lightweight Particles in Aggregate |
| ASTM D6307 | Asphalt Content of Asphalt Mixture by Ignition Method |
| ASTM C142 | Clay Lumps and Friable Particles in Aggregates |
| MS-2 | Asphalt Institute – Mix Design Methods |

**PART 2 - PRODUCTS**

2.1 GENERAL:

A. The Asphalt Concrete Surface Course must have at least a 3-bin separation, when continuous flow mixing types of plants are used. When a drum dryer is used with a weight batching system from dry bins, separate and stockpile the crushed aggregate into two sizes.

B. Unless otherwise specified, furnish Type B or B-Modified aggregate meeting the requirements of Table 1 in this section for all asphalt pavement applications.

C. Unless otherwise specified, furnish (PGAB) PG58-28 Asphalt Binder Material meeting the requirements of Table 2 in this section for all asphalt pavement application.

D. Prepare pavement course to conform to the lines, grades, thickness and typical cross sections shown in project documents and plans, and shall be rolled, finished, and approved by the Engineer before the placement of the next course.

2.2 PLANT MIX AGGREGATES

A. Furnish aggregates from acceptable sources approved by the Engineer.

B. Furnish test data as outlined in this section on each source to be used for acceptance by the Engineer.

C. Designation of the source of supply and the acceptability of the material there from, does not extend to the grading of the material as it may naturally come from the pit or crusher. Adjust the crusher and screens to remove certain portions of the material as may be necessary to furnish gravel that will comply with the specifications in the contract. No additional compensation will be allowed for such adjustment of the equipment or the rejection of waste. It is understood that the Engineer may order procurement of material from any portion of any area designated as a pit site and may reject portions of the deposit as unacceptable.

D. Aggregate materials shall not contain more than 1.5% by weight of clay lumps, shale, or coal, nor shall light weight particles exceed 3.5% by weight. No combination of clay, shale, coal, or lightweight particles shall exceed 3.5% by weight. Do not use Scoria (fired clay). Aggregate materials shall conform to the grading stipulated in the contract documents. Use reasonable care in the selection of material in a pit so that uniform product will be produced at all times. No compensation will be allowed for such stripping of the pit as may be required in order that satisfactory material may be secured.

E. Aggregate used shall consist of gravel, crushed to the specified size, crushed stone, composed of hard durable pebbles or stone fragments, reclaimed asphalt pavement, and finely crushed stone filler, sand or natural clean material, or other fine mineral material. The portion of the material retained on the No. 4 sieve (4.74 mm) will be called coarse aggregate and that passing the No. 4 sieve (4.74 mm) and retained on the #200 sieve (0.075 mm) will be call fine aggregate. The material Passing the #200 (0.075 mm) will be called mineral filler. The reclaimed asphalt pavement shall be removed from its original location and reduced by suitable means to such particle size as may be required for use in hot plant mix asphalt concrete.

F. For all gradings of fine aggregate, including any blended fine aggregate and mineral filler, passing a No 40 sieve (0.425 mm), shall have a liquid limit not exceeding 25 and a plasticity index of not more than 6.

G. Produce coarse aggregate retained on the No. 4 sieve (4.75 mm) having a minimum of 75% by weight of particles with at least two mechanically fractured faces. When fractures are contiguous, assure the angle between the fracture planes is at least 30 degrees to count as two fractured faces.

H. Preliminary acceptance of aggregates proposed for use may be made at the point of production. Final acceptance will be made only after tests of the aggregates are complete and in place.

I. Surface Course Asphalt Plant Mix Aggregate:

*TABLE 1*

*REQUIREMENTS FOR GRADING OF SURFACE COURSE AGGREGATE*

| Percentage by Weight Passing<br>Job Mix Target Bands | | | | | | |
|---|---|---|---|---|---|---|
| Sieve Size | A<br>1” | B<br>¾” | C<br>½” | D<br>3/8” | E<br>#4 | Job Mix<br>Tolerances |
| 1” (25.0 mm) | 90 - 100 | 100 | | | | --- |
| ¾” (19.0 mm) | 90 Max | 90 - 100 | 100 | | | +/- 5 |
| ½” (12.5 mm) | | 90 Max | 90 - 100 | 100 | 100 | +/- 5 |
| 3/8” (9.5 mm) | | | 90 Max | 90 - 100 | 95 - 100 | +/- 5 |
| No 4 (4.75 mm) | | | | 90 Max | 90 - 100 | +/- 5 |
| No 8 (2.36 mm) | 19 - 45 | 23 - 49 | 28 - 58 | 32 - 67 | | +/- 4 |
| No 30 (0.600 mm) | | | | | | +/- 3 |
| No 200 (0.075 mm) | 1 - 7 | 2 - 8 | 2 - 10 | 2 - 10 | 6 - 13 | +/- 2 |

1. The above gradation bands represent the job mix target limits, which determine the suitability of aggregate for use. The final job mix target gradation must be within the specified bands and uniformly graded from coarse to fine and not vary from the low limits on one screen to the high limits on the adjacent screen, or vice versa. The final job mix gradation limits are established by applying the job mix tolerances to the job mix targets.
2. The job mix formula establishes target values. During production of the mix, the gradations shall lie within the job mix gradation limits specified in Table 1. For example, "Type A, No. 200" band is "1-7". QA job mix target of 5 has been selected for the final mix. The job mix gradation limits is 5, plus and minus 2. Therefore, the job mix gradation limits for production is 3-7.

## 2.3 ASPHALT BINDER MATERIAL

A. Furnish asphalt binder material to be used as specified in the contract documents that meet the type and grade specified requirements in this section in Table 2.
   1. Grades:
      a. (PGAB) PG 58-28
      b. (PGAB) PG 64-22
      c. (PGAB) PG 64-28 (Polymer Modified)
      d. (PGAB) PG 70-28 (Polymer Modified)

B. The percentage of asphalt by weight, to be added to the aggregate will be, generally, between 4 and 8% of the weight of the total mix. A minimum effective asphalt binder content of 4.5% is required for ¾" for Type B and ½" mixes, 5.0% for ½" for Type C mixes. The mix design will establish the exact percentage of asphalt in the mix, based upon preliminary laboratory tests, sieve analysis and grading and character of the aggregate furnished within the specification limits. No claim is allowed for the payment for rejecting any batch or load of mixture containing an excess or deficient amount of asphalt binder varying more than 0.4 of a percent from the fixed mix design percentage.

C. Obtain Engineer approval of the asphalt material source before shipments are made to any project. The source of supply cannot change after work is started unless approved in writing by the Engineer. The Engineer is not liable for the quantity shipped.

D. Samples of asphalt binder material may be taken, as directed by the Engineer, and placed in uncontaminated one-quart containers. When sampled, these shall be taken from the tanker car or truck at the point of delivery on the project and submitted to the Engineer.

E. All transport vehicles must be equipped with a spigot or gate valve installed in either: (1) the unloading line, (2) in the tanker at the centerline on the tank, (3) in the pressure line from the unloading pump, or other locations approved by the Engineer. Assure the spigot or gate valve has a diameter of between 3/8 inch (1 cm) and 3/4 inch (2.5 cm). The spigot valve must be located to prevent contamination from plant dust or other contaminants.

F. The supplier furnishing the asphalt binder material shall inspect each tanker car or truck before it is loaded and ship only in clean, uncontaminated, fully insulated cars or trucks, sealed after loading by the supplier.

G. The material supplier shall issue, in duplicate, a certificate showing full compliance with the specifications for the designated grade of material, together with the following information. Project number, date of shipment, source of the material, car or truck initial and number, destination, gross quantity loaded, loading temperature, and net quantity in gallons at 60° F (15.5° C) or tons, whichever unit of measurement is stipulated. Assure the certificate of compliance accompanies the shipment and is furnished to the Engineer. The certificate, signed by the supplier representative, must also certify that the conveyance vessel was inspected and found to be free of contaminating material.

H. The certificate of compliance is the basis for tentative acceptance and use of the material. Samples taken according to applicable sampling methods and retained by the Engineer may be tested at the Engineer's discretion. Failure of the asphalt material to meet these specifications may result in rejection of the entire, associated work. If rejected, removed and replace rejected work.

I. Apply asphalt material at temperatures that assure uniform mixing or spreading. Application temperature ranges for each grade of material should be accompanied with the mix design. Application temperature for mixing applications will be in accordance with the mix design.

J. Upon request by the Engineer, furnish the Engineer and/or laboratory (responsible for completing the mix design) with data or a report showing the temperature-viscosity relationship of each asphalt binder used on the project. Assure this data covers the range of temperatures used for mixing and compaction. In addition, the Engineer may request a complete set of test results from Table 2 for each grade used on the project.

**TABLE 2**
**PERFORMANCE GRADED ASPHALT BINDER (PGAB)**

| Performance Grade | PG 58 | PG 64 | | PG 70 | Test Methods |
|---|---|---|---|---|---|
| | -28 | -22 | -28 | -28 | |
| Average 7-day Maximum Pavement Design Temperature, °C | <58 | <64 | | <70 | |
| Minimum Pavement Design Temperature, °C | >-28 | >-22 | >-28 | >-28 | |
| Original Binder | | | | | |
| Flash Point Temp.: Minimum °C | 230 | | | | AASHTO T48 |
| Viscosity: Maximum, 3 Pa ·s (3000 CP), Test Temp, °C | 135 | | | | ASTM D4402 |
| Dynamic Shear: G* / sin delta, Minimum, 1.00 kPa Test Temp @ 10 rad / s, °C | 58 | 64 | | 70 | AASHTO T315 |
| Rolling Thin Film Oven (AASHTO T240) or Thin Film Oven (T179) Residue | | | | | |
| Mass Loss, Maximum, % | 1.0 | | | | AASHTO T240 |
| Dynamic Shear: G* / sin delta, Minimum, 2.20 kPa Test Temp @ 10 rad / s, °C | 58 | 64 | | 70 | AASHTO T315 |
| Pressure Aging Vessel Residue (AASHTO PP1) | | | | | |
| PAV Aging Temp, °C | 100 | 100 | | 100 | AASHTO R28 |
| Dynamic Shear: G* / sin delta, Maximum, 5000 kPa Test Temp @ 10 rad / s, °C | 19 | 25 | 22 | 25 | AASHTO T315 |
| Creep Stiffness [a]: S, Minimum, 300 MPa m-value, Minimum, 0.300 Test Temp, @ 60 sec, °C | -18 | -12 | -18 | -18 | AASHTO T313 |
| Direct Tension [a]: Failure Strain, Minimum, 1.0%, Test Temp @ 1.0 mm/min. °C | -18 | -12 | -18 | -18 | AASHTO T314 |

1. If creep stiffness is below 300 MPa, the direct tension test is not required. If the creep stiffness is between 300 and 600 MPa the direct tension failure strain requirement can be used in lieu of the creep stiffness requirement. The m-value requirement must be satisfied in both cases.

2.4 HYDRATED LIME FOR ASPHALT CONCRETE.

A. Mineral filler may be incorporated in the asphalt concrete mixture. Furnish hydrated lime as filler when specified. Assure it is free of lumps and extraneous material and meets the following gradation requirements as per ASTM D242:

| Sieve | Percent Passing |
|---|---|
| No. 30 (0.60 mm) Sieve | 100 |
| No. 80 (0.180 mm) Sieve | 95-100 |
| No. 200 (0.075 mm) Sieve | 70-100 |

B. Assure the hydrated lime meets paragraph 2 (chemical composition) and paragraph 7 (a) requirements (chemical analysis) of ASTM C1097.

C. Where required, the mineral filler will be effectively mixed with the hot plant mix asphaltic concrete.

2.5 COMPOSITION OF MIXES:

A. General

1. Submit to the Engineer for approval a mix design for each mix required on the project. Assure the job-mix formula is within the gradation limits in Part 2 Products in this section.
2. Have the job-mix formula prepared by an independent testing laboratory approved by the Engineer and performed under the supervision of a Professional Engineer. The requirements of ASTM D-3666 are the guidelines for testing laboratory approval. The cost of the job-mix formula(s) is at Contractor expense.
3. Keep the job mix formula current and contain the following minimum information:
   a. Gradation of all constituent aggregates.
   b. Specific gravity of constituent aggregates and asphalt cement.
   c. Source of supply of all materials and grade of asphalt cement.
   d. Marshall design curves for stability, unit weight, flow and volumetric requirements (VMA and total voids) at asphalt contents below and above optimum (four points minimum).
   e. Measured void less (Rice's) specific gravity used in voids computations.
   f. Composite aggregate grading.
   g. Recommended asphalt cement content.
   h. Marshall or gyratory compactive effort.
   i. Date of mix design (job mix formula).
   j. Index of retained strength.
4. In addition to the job mix formula, all asphalt concrete surfacing mix submittals will have laboratory tests indicating that the Tensile Strength Ratio (TSR) as determined by AASHTO T-283 is at least 70%. Test shall be performed at 7.0 +/- 0.5% air voids and shall include the freeze cycle. Mixtures that fail to meet this minimum criteria may be resubmitted with and approved anti-strip agent meeting the same 70% criteria.

B. Asphalt Concrete Surface Course

1. The maximum permissible variation from the job-mix formula within the specification limits is as follows:
   a. Aggregate gradation within job mix tolerances
   b. Asphalt ± 0.4%*

c. Temperature of mix ± 20°F.

* This tolerance will be permitted only if the job mix parameter curves indicate that the corresponding design limits are not exceeded.

2. Produce Hot Plant Mix Asphalt Concrete Surface courses having the following characteristics as measured by AASHTO T245, ASTM D6726 & D6927 "Resistance to Plastic Flow of Bituminous Mixtures by Means of the Marshall Apparatus":

a. Number of compaction blows, each end of specimen 50.
b. Stability, minimum 1500.
c. Flow 8 – 18.
d. Air voids, percent 3-5.
e. Percent voids in mineral aggregate (minimum)

All type B-modified asphaltic concrete surfacing shall meet the following Marshall Design criteria as determined by ASTM D1559.

a. Number of Compaction Blows, Each End of Specimen 75
b. Stability, Minimum 1500 lbs.
c. Flow 8 – 16
d. Air Voids, Percent 3 - 5
e. Percent Air Voids Filled with Bitumen 65-75

3. As an alternative to Marshall mix production, SuperPave Hot Plant Mix Asphalt Concrete Surface courses can be produced having the following characteristics as measured by AASHTO R 35 and M 323.

**TABLE 3**
**SUPERPAVE GYRATORY COMPACTION EFFORT**

| 20-Year Design ESALs" (in millions) | Compaction Parameters | | | Typical Roadway Applications |
|---|---|---|---|---|
| | $N_{initial}$ | $N_{design}$ | $N_{maximum}$ | |
| < 0 .3 | 6 | 50 | 75 | Applications include roadways with very light traffic volumes, such as local roads, county roads and city streets where truck traffic is prohibited or at a very minimal level. Traffic on these roadways would be considered local in nature, not regional, intrastate or interstate. Special-purpose road ways serving recreational sites or areas may also be applicable to this level. |
| 0.3 to< 3 | 7 | 75 | 115 | Applications include collector roads or access streets. Medium- trafficked city streets and the majority of county roadways may be applicable to this level. |

a. Air voids, percent . . . . . 3-5.
b. Voids Filled with Asphalt. . . . . 65-80
c. Dust to Effective Binder ratio . . . . . .0.6-1.4

d. $N_{Max}$ . . . . . .98
e. $N_{Min}$ . . . . . .91.5
f. $N_{Design}$ . . . . . 95-97
g. Percent Voids in Mineral Aggregate . . . . . See Table 4.

| TABLE 4<br>REQUIRED VOIDS IN MINERAL AGGREGATE (VMA) | |
|---|---|
| Nominal particle size (table 2) | Voids in Mineral Aggregate, Min. |
| No 4 (4.75 mm)<br>3/8 – inch (9.5 mm)<br>½ - inch (12.5 mm)<br>¾ - inch (19.0 mm)<br>1 – inch (25.0 mm) | 16<br>15<br>14<br>13<br>12 |
| Nominal maximum particle size is one size larger than the first sieve to retain more than 10 percent. | |

**PART 3 - EXECUTION**

3.1 CRUSHING:

A. Crushing Equipment
1. Fit crushing plant-screening equipment, when required, with blowers or other devices capable of removing excess and undesirable fines.

B. Screening Plants
1. Screening plants consist of a revolving trommel screen, shaker screen, vibrating screen, or other devices capable of removing oversize material, excess and undesirable fines.

C. Scales
1. Furnish scales, when required, satisfactory to the Engineer. Test and certify scales prior to their use on the project and as often thereafter as the Engineer may consider necessary to ensure their accuracy. Have on hand not less than ten, 50-pound weights for testing scales.
2. House the recording devices of the scales in a suitable manner. Place the scales in a location suitable to facilitate accurate weighing of loads. The scales shall be accurate to one-half of one percent at any weight. Alternate methods or devices for weighing may be acceptable, provided that these methods or devices produce the same degree of accuracy as required of platform scales.

3.2 MATERIAL HANDLING:

A. All work involved in clearing and stripping pits and quarries, including handling unsuitable material encountered, are performed with no additional compensation being allowed for this work. The pits as utilized shall immediately be opened so as to expose the vertical faces of the various strata of acceptable material and, unless otherwise directed, the material shall be secured in successive vertical cuts extending through all the exposed strata.

B. Provide, unless otherwise specified, material containing as large a proportion as possible of crushed aggregate. Combine the crushed material with the screened material to obtain a uniform product.

C. No material will be accepted which is loaded into hauling units in a segregated condition or which does not meet the required grading. In case the material deposit contains sand or other material in excess of the specification gradation requirements, or of an unacceptable quality, such excess or undesirable material shall be removed and disposed of prior to crushing, or during screening operations, if crushing is not required.

D. Provide a storage bin of ample capacity to ensure uniform quality and delivery of material. Loading of trucks directly from the conveyor belt, from the crusher or screening plant will not be permitted.

3.3 STOCKPILES:

A. Grub and clean sites for aggregate stockpiles prior to storing aggregates. Assure the site is firm, smooth and well drained. Maintain a bed of aggregate suitable to avoid the inclusion of soil or foreign material.

B. Build up coarse aggregate stockpiles in tiers of not more than 4 feet (1.2 m) in thickness. Assure each tier is completely in place before the next tier is placed. Do not allow material to “cone” down over the next lower tier.

C. Dumping, casting or pushing over the sides of stockpiles will be prohibited, except in the case of fine aggregate stockpiles.

D. Space stockpiles of different gradations of aggregate far enough apart, or separated by suitable walls or partitions, to prevent the mixing of the aggregates.

E. Any method of stockpiling aggregate, which allows the stockpile to become contaminated with foreign matter or causes excessive degradation of the aggregate, will not be permitted. Excessive degradation will be determined by sieve tests of samples taken from any portion of the stockpile over which equipment has operated and failure of such samples to meet all grading requirements for the aggregate discontinuance of such stockpiling procedures.

F. Transfer the aggregate from the stockpiles in such a manner that uniform grading of the material is preserved.

3.4 CONVEYOR STOCKPILING:

A. Materials stockpiled by conveyors shall be deposited in a succession of merging-cone piles. Do not drop material over 12 feet (3.66 m) nor allow cones to exceed 12 feet (3.66 m) in height. Cones should be leveled to a thickness of approximately 4 feet (1.2 m) prior to starting another tier.

3.5 TRUCK STOCKPILING:

A. Materials stockpiled by trucks shall construct the stockpile in tiers approximately 4 feet (1.2 m) in thickness. Complete each tier before the next tier is started.

3.6 ASPHALT MIXING PLANTS:

A. Use mixing plants of either the weight batching type, the continuous flow mixing type, or drum dryer type. Use drum dryer mixers specifically designed and constructed for producing hot mix.

B. Equip all plants with approved conveyors, power units, aggregate handling equipment, aggregate screens and bins that are coordinated and operated to produce a uniform mixture within the specified job mix tolerances.

C. Use batch-type plants having a minimum batch production capacity of 2,000 pounds (900 kg). Use continuous flow or drum dryer plants having a minimum production capacity of 60 tons per hour (27 kg per hour). These capacity requirements may be modified if specified in the Contract Documents.

D. Stop production and remove from the project mixing plants that fail to continuously produce a mixture meeting requirements as specified.

3.7 INSPECTION AND CONTROL OF ASPHALT MIXING PLANT:

A. For verification of weights and measures, character of materials and determination of temperatures used in the preparation of the paving mixes, the Engineer or Engineer's authorized representative will, at all times, have access to all portions of the mixing plant, aggregate plant, storage yards and other facilities for producing and processing the materials for the work. All sampling and testing of processed and unprocessed material is performed in accordance with the provisions of the Contract Documents.

3.8 MIX DESIGN:

A. The Owner's acceptance testing agency may make gradation analyses of the completed mix to assure that the materials being produced and used are within the tolerances of the mix design and the specifications of the mix being used.

3.9 SAMPLING AND TESTING FOR ACCEPTANCE:

A. Sampling and testing of aggregates or other constituent materials may be performed by the Owner's testing agency at a frequency determined by the Owner or the Owner's representative. Field control is performed under AASHTO T245, ASTM D6926 & D6927, and ASTM D6925. Field density testing is by core testing for acceptance purposes. Densities to conform to Section 2510,3.28. Gradations to be within the job mix gradation limits. Oil content to be within 0.4% of the Mix Design.

B. Samples will be used to verify compliance with the requirements set forth in this Section. If there is a dispute, a third party testing firm may be retained by the contractor for additional retesting.

3.10 WEATHER LIMITATIONS:

A. When the moisture in the stockpiled aggregate or the dryer adversely effects the quality of mix production, normal plant operations, or when pools of water are observed on the base, mixing and placing of hot-mix asphalt is prohibited.

B. Do not place asphalt hot-mix surface course mixture when the air temperature is less than 40° F (4° C) and rising. Do not place asphalt hot-mix base course mixtures of compacted lifts 4 inches (10 cm) or more when the air temperature is less than 30° F (-1° C) and rising. Do not place asphalt upon a surface which is frozen or that has a temperature of less than 32° F (0 ° C). Do not place paving during rainfall or in standing water.

3.11 SURFACE PREPARATION:

A. Assure the area to be paved is true to line and grade and has a dry and properly prepared surface before starting paving operations. Assure the surface is free from all loose screenings and other loose or foreign material.

3.12 NEW WORK:

A. For new work, meet the surface preparation requirements in Sections 02230, 02234 or 02235 of these specifications. Prime prepared soil or aggregate bases if indicated as a bid item in the Contract Documents.

B. Before paving, proof-roll the base with equipment having at least one 18 kip single axle load or equivalent. Excavate and replace areas that yield or crack under these wheel loads as directed. This does not replace or relax the base or subgrade compaction requirements.

C. Paint the surfaces of curbs and gutters, vertical faces of existing pavements and all structures in contact with asphalt mixes with a thin coating of asphaltic material to provide a water-tight joint.

3.13 OVERLAYS OVER EXISTING PAVEMENTS AND OLD BASE:

A. Where a base is rough or uneven, place a leveling course using a paver or motor grader and compact before the placing of subsequent courses.

B. When specified, place construction fabric to control reflective cracking, as detailed, meeting Section 02110.3.4 Pavement Overlay Applications.

C. When a leveling course is not specified, patch or correct all depressions and other irregularities, subject to the Engineer's approval, before starting other paving operations. Remove all rich and unsuitable patches, excess crack or joint filler, and all surplus bitumen from the area to be paved. Do not blot excessive deposits of asphalt with sand or stone.

D. Apply a tack coat when the surface to be paved is an existing Portland Cement concrete, brick or asphalt pavement. When a tack coat is required, use the asphalt material indicated, at the rate specified in Section 02502.

E. Coat the surfaces of curbs and gutters, vertical faces of existing pavements and all structures in actual contact with asphalt mixes with a thin, complete coating of asphalt material to provide a water-tight joint.

3.14 PATCHING:

A. Weather Limitations
   1. Follow procedures set out in section 3.10.

B. Surface Preparations
   1. Assure the area to be paved is true to line and grade, is dry and properly prepared surface before starting paving operations. Clean the surface of all loose screenings and other loose or foreign material.
   2. Before paving, proof roll the base. Areas that yield excessively or crack under such wheel loads will be excavated and replaced, to correct yielding and cracking problems. This does not replace the base or subgrade compaction requirements. Cut the edge of existing pavements against which additional pavement is to be placed straight and vertical.
   3. Minimum standards for patching new or existing pavement include the following:
      a. Neatly cut all asphalt edges using an asphalt saw.
      b. Cut asphalt edges to form as regular a patch shape as practical and should, in general, approximate a rectangle.
      c. Cut asphalt edges at least 30 cm (12 inches) wider than the trench width on each side of trench excavations; and, in general, be cut parallel to the street centerline for mainline construction and perpendicular to the street centerline for service lateral construction.
      d. Skin patches will not generally be considered a satisfactory method of repair.
      e. Tack coat all existing edges prior to placing new asphalt concrete.
   4. Remove and replace asphalt surface widths of less than 3 feet (90 cm).

C. Compaction

1. Compact to a density equal to or greater than 92% of Maximum Theoretical Density (RICE) as determined by ASTM D2041.

3.15 TRANSPORTATION OF MIX:

A. Transport the mix in vehicles cleaned of all foreign material which may affect the mix. The truck beds must be painted, or sprayed with a lime-water, soap or detergent solution at least once a day or as often as required. After this operation elevate the truck bed and thoroughly drain it, with no excess solution being permitted. Dispatch the vehicles so that all material delivered is placed in daylight, unless the Engineer approves artificial light. Deliver material to the paver at a uniform rate and in an amount well within the capacity of the paving and compacting equipment.

3.16 SPREADING AND FINISHING:

A. Spread and finish meeting the following requirements

1. The minimum lift thickness shall be no less than three times the Nominal Maximum Aggregate Size for gradations above the Maximum Density Line, and no less than four times the Nominal Maximum Aggregate Size for gradations below the Maximum Density Line.
2. The maximum lift thickness is 3 inches (6.5 cm) for surface courses and 6 inches (13 cm) for base courses.

3.17 MECHANICAL PAVERS:

A. Spread and strike off the base and surface courses with a mechanical paving machine. Operate the paving machine so that material does not accumulate and remain along the sides of the receiving hopper.

B. Do not use equipment which leaves tracks or indented areas, which cannot be corrected in normal operation, produces flushing or other permanent blemishes, or fails to produce a satisfactory surface.

C. Construct longitudinal joints and edges to true line markings. Establish lines for the paver to follow in placing individual lanes parallel to the centerline of the proposed roadway. Position and operate the paver to follow closely the established lines.

D. When using pavers in echelon, assure the first paver follows the marks or lines with the second paver following the edge of the material placed by the first paver. To assure a hot joint and obtain proper compaction, assure the pavers work as close together as possible not exceeding 100 feet (30 m) apart. In backing trucks against the paver, take care not to jar the paver out of its proper alignment.

E. As soon as the first load of material has been spread, check the texture of the unrolled surface to determine its uniformity. Segregation of materials is not permitted. If

segregation occurs, suspend spreading operation until the cause is determined and corrected.

F. Offset transverse joints in succeeding courses at least 2 feet (0.6 m). Offset longitudinal joints at least 6 inches (15 cm).

G. Correct all irregularities in alignment left by the paver by trimming directly behind the machine. Immediately after trimming, thoroughly compact the edges of the course by tamping. Avoid distorting the pavement during this operation.

H. Assure edges against which additional pavement is to be placed is straight and approximately vertical. Use a lute or covered rake immediately behind the paver, when required, to obtain a true line and vertical edge. Correct all irregularities in the surface of the pavement course directly behind the paver. Remove excess material forming high spots by a shovel or lute. Fill low areas with hot mix and smooth it with the back of a shovel being pulled over the surface. Fanning of material over such areas is not permitted.

3.18 MOTOR GRADER:

A. When motor graders are used for the spreading of leveling courses, place the material on the roadbed so that the proper amount of material is available. Spread the mix to the required thickness, line and grade, with a uniform surface texture, while at a workable temperature.

3.19 HAND SPREADING:

A. In small areas where the use of mechanical finishing equipment is not practical, the mix may be spread and finished by hand, if so directed by the Engineer. Wood or steel forms, approved by the Engineer, rigidly supported to assure correct grade and cross section, may be used. In such instances, measuring blocks and intermediate strips must be used to obtain the required cross-section. Perform hand placing carefully. Uniformly distribute the material to avoid segregation of the coarse and fine aggregate. Broadcasting of material is not permitted. During the spreading operation, loosen and uniformly distribute all material using lutes or covered rakes. Reject material that has formed into lumps and does not break down readily. Following placing and before rolling, check the surface with templates and straightedges and correct all irregularities.

B. Maintain on the project heating equipment for keeping hand tools free from asphalt. Exercise caution to prevent heating that may burn the material. Assure the temperature of the tools when used is not greater than the temperature of the mix being placed. Use heat only to clean hand tools; petroleum oils or solvents are not permitted.

3.20 COMPACTION:

A. Furnish the number of rollers necessary to provide the specified pavement density. During rolling, keep the roller wheels moist to avoid picking up the material.

B. After the longitudinal joints and edges have been compacted, start rolling longitudinally at the sides and progress toward the center of the pavement. For transverse graded streets, begin rolling on the low side and progress to the high side, overlapping passes by at least one-half the width of rollers and uniformly lapping each preceding pass. Operate the rollers at a slow, uniform speed with the drive roll or wheel nearest the paver. Do not exceed 3 miles per hours (4.8 km per hour).

C. Do not quickly change the line of rolling reversing direction suddenly. If rolling displaces the material, re-work the area using lutes or shovels and restore to the original grade of the loose material before re-rolling. Do not permit heavy equipment or rollers to stand on the finished surface before it has been compacted and has thoroughly cooled.

D. When paving in single width, roll the first lane placed as follows:
   1. Transverse joints
   2. Outside edge
   3. Initial or breakdown rolling, beginning on the low side and progressing toward the high side
   4. Second rolling, same procedure as 3
   5. Finish rolling

E. When paving in echelon, or abutting a previously placed lane, perform the longitudinal joint rolling the same as transverse joint rolling.

F. When paving in echelon, leave 2 or 3 inches (5 to 7.5 cm) of the edge unrolled, which the second paver can match unrolled. Then the joint between the lanes can be rolled together. Do not leave edges exposed more than 15 minutes without being rolled.

G. In laying a surface mix adjacent to any finished area, place it high enough so that, when compacted, the finished surface is true and uniform.

H. On slight grades, check gutters with a straightedge and test with running water to assure drainage to the planned outlet.

I. The average density shall be equal to or greater than 93% of the maximum density as determined by ASTM D2041 and no individual sample shall be less than 92% of maximum density.

3.21 TRANSVERSE JOINTS:

A. Construct and compact transverse joints to provide a smooth riding surface. Joints will be straight edged and string lined to assure smoothness and true alignment.

B. Joint formed with bulkheads to provide a straight line and vertical face will be checked with a straightedge before fresh material is placed against it to complete the joint. If bulkheads are not used to form the joint and the roller is permitted to roll over the edge of the new material, locate the joint line in back of the rounded edge the distance required to provide a true surface and cross-section. If a joint has been distorted by traffic

or by other causes, trim it to line. Paint the joint face with a thin coating of asphalt before the fresh material is placed against it.

C. Place the material against the joints vertical face with the paving machine positioned so that the material overlaps the edge of the joint 1 to 2 inches (2.5 to 5 cm). Maintain a uniform depth of the overlapped material. Remove and dispose of the coarse aggregate in the overlapped material that dislodged during raking.

D. Position rollers on the previously compacted material transversely so that no more than 6 inches (15 cm) of the rolling wheel rides on the edge of the joint. Operate the roller to pinch and press the mix into place at the transverse joint. Continue rolling along this line, shifting position gradually across the joint, in 6-to 8-inch (15 to 20 cm) increments, until the joint has been rolled by entire width of the roller wheel.

E. Keep the number of transverse joints to a minimum. When paving single width and maintaining traffic, pave one lane no farther than one block. Complete all lanes to the same station at the end of each paving day. When paving in echelon, bring the lanes up even as is practical.

3.22 LONGITUDINAL JOINTS:

A. Roll longitudinal joints directly behind the paving operation. Assure the first lane placed is true to line and grade and has a vertical face. Place the material in the lane being paved up firmly against the face of the previously placed lane. Position the paver during spreading to assure the material overlaps the edge of the lane previously placed by 1 inch to 2 inches (25 to 50 mm). Uniformly maintain the width and depth of the overlapped material at all times. Keep the paver aligned with the line or markings placed along the joint for alignment purposes. Before rolling, remove and dispose of the coarse aggregate in the material overlapping the joint.

B. Shift rollers onto the previously placed lane so that not more than 6 inches (15 cm) of the roller wheel rides on the edge of the fine material left by brooming. Operate the rollers to compact the fines gradually across the joint. Continue rolling until a compacted, neat joint is obtained. When the abutting lane is not placed in the same day, paint the joint with a very thin coating of asphalt before placing the abutting lane. If the joint is distorted during the day's work by traffic or by other causes, carefully trim the edge of the lane to a neat line.

3.23 EDGES:

A. Roll the pavement edges concurrently with or immediately after rolling the longitudinal joint.

B. Exercise care in consolidating the course along the entire length of the edges. In rolling pavement edges, extend the roller wheels 2 to 4 inches (5 to 10 cm) beyond the pavement edge.

3.24 BREAKDOWN ROLLING:

A. Immediately begin breakdown rolling following the rolling of the longitudinal joint and edges. Operate rollers as close to the paver as required to obtain density without causing undue displacement. Operate the breakdown roller with the drive roll or wheel nearest the finishing machine. The Engineer may make exceptions when working on steep slopes or super-elevated curves.

3.25 SECOND ROLLING:

A. Assure the second rolling follows the breakdown rolling as close as possible while the paving mix is still at a temperature that will provide the specified density.

3.26 FINISH ROLLING:

A. Perform the finish rolling while the material is still warm enough to remove roller marks. If necessary, the Engineer may require using pneumatic-tired rollers. Complete finish rolling the same day the mixture is placed.

B. In places inaccessible to standard rollers, perform compaction using trench rollers or others to meet the specified compaction requirements. Operate the trench roller as directed until the course is compacted. Hand, manual or mechanical tamping, may be used in such areas if it is proved to the Engineer that the operation will provide the specified density.

3.27 SHOULDERS:

A. Where paved shoulders or curbs are not specified, do not place the shoulder material against the pavement edges until the surface course rolling is completed. Take care to prevent distortion of the pavement edge from specified line and grade. When shoulders are paved (except in conjunction with the traveled way paving), cold joint construction procedure is required to assure a tight bond at the joint.

B. When the rolling of the surface course has been completed and the edges have been thoroughly compacted, immediately place shoulder material against the edges and roll it.

3.28 DENSITY AND SURFACE REQUIREMENTS:

A. The average mat density shall be equal to or greater than 93% of the maximum density as determined by ASTM D2041 for single lift applications. For two lift applications, the first lift on base course shall be a minimum of 92% of the maximum density and the second lift shall be a minimum of 93% of the maximum density. In both cases individual sample shall be no less than 92% of maximum (Rice's) density, prepared as specified in

Part 2-Products in this section and made from plant mix meeting the job-mix formula. Verification of maximum density as determined by ASTM D2041 from plant produced material during production is recommended.

B. The longitudinal joints shall be compacted to a target density of 91 percent of the theoretical maximum specific gravity as determined by ASTM D2041 and no individual sample shall be less than 89 percent of maximum (Rice's) density. The theoretical maximum specific gravity used to determine the joint density will be the average of the daily theoretical maximum specific gravities for the material that was placed on either side of the joint.

C. Produce a final surface that is uniform in texture and meets the line and grade specified. Before final acceptance of the project or during the progress of the work, the Engineer will determine the thickness of all courses. Repair or replace all unsatisfactory work.

D. Assure density and thickness meets the plans and specifications. During compaction, preliminary tests to aid in controlling the thickness, may be performed by inserting a flat blade, correctly graduated, through the material to the top of the previously placed base, or by other approved methods.

E. In checking compacted depth, the cutting of the test holes, refilling with acceptable materials and proper compaction may be performed by the Owner's testing agency.

F. For testing the surface on all courses, a 10-foot (3 m) straightedge will be used with the centerline of the straightedge placed parallel to the roadway centerline.

G. Any variations that exceed 5/16-inch (0.8 cm) in 10 feet (3 m) for base course and 1/4-inch (0.64 cm) in 10 feet (3 m) for surface course must be corrected. Correct irregularities that may develop before the completion of rolling by loosening the surface mix and removing or adding materials as is required. If any irregularities or defects remain after the final compaction, remove the surface course and place and compact new material to a true and even surface. All minor surface projections, joints and minor honeycombed surfaces must be rolled smooth to grade, as directed

H. Remove and replace areas of new pavement requiring patching as directed. Patching material will be tested for meeting specifications. The cost of testing is at Contractor expense.

3.29 PAVEMENT AND MATERIAL TESTING REQUIREMENTS:

A. Contractor will produce their own core samples of the asphalt surface courses under the supervision of the Owner's testing agent and give completed cores to the Owner's testing agency to check in place density and compacted depth. The cores are 4-inch (10 cm) diameter. Materials and acceptance tests will be made by the Owner's testing agency to determine the Contractor's compliance with the specifications.

B. Materials failing to meet the tests specified may be retested if approved and as directed by the Engineer. The Contractor shall pay the costs of any required re- testing for

acceptance purposes. Re-testing will be performed by the Owner's testing agency unless otherwise approved by the owner. If there is a dispute, a third party testing firm may be retained by the contractor for additional retesting for the Engineer's review and consideration.

C. The costs of the following tests are at Contractor expense:
   1. Initial aggregate quality tests
   2. Job-mix formula
   3. Any tests the Contractor requires to control his crushing, screening or other construction operations
   4. Retesting of failing tests as provided above

D. Correct all pavement composition, field density, or thickness, deficiencies at Contractor expense.

E. The field density and thickness of the pavement is determined by measuring the cores tested. The actual thickness must be no less than 1/4-inch (6.5 mm) from the specified thickness.

F. When the measurement of any core is less than the plan thickness by more than the allowable deviation, the actual thickness of the pavement in this area may be determined by taking additional cores at intervals parallel to the centerline in each direction from the affected location. Continue in each direction until a core is found which is not deficient by more than the allowable deviation. The Engineer will evaluate areas found deficient in thickness and determine which areas warrant removal. Remove and replace the areas with asphaltic concrete of the thickness shown on the plans. Additional coring is considered as re-testing of failing areas.

**PART 4 - MEASUREMENT AND PAYMENT**

4.1 TONNAGE BASIS:

A. Asphalt Concrete Pavement
   1. These items are measured by the ton of 2,000 pounds (900 kg) of asphalt paving mixture, including the weight of the asphalt. The quantities measured for payment are the amount of asphalt paving materials actually used in the completed and accepted work in accordance with the plans and specifications.
   2. "Asphalt Concrete Pavement" is paid for at the unit price bid per ton of 2,000 pounds (900 kg).
   3. Price and payment is full compensation for cleaning base or underlying course; for producing, furnishing, transporting, stockpiling, heating, drying and screening of aggregate materials; for furnishing, handling, measuring, mixing, manipulating and placing of materials; for hauling, placing, shaping, compacting and finishing of the paving mix; for improving unsatisfactory areas; for furnishing samples; for furnishing, testing and certifying of scales; for furnishing the weigh house; for all materials (exclusive of asphalt), manipulation, labor, tools, equipment and

incidentals necessary to complete the work in full compliance with the plans and specifications.

4. Payment is made under:
   a. Asphalt Concrete Pavement Base Course - per ton (metric ton)
   b. Asphalt Concrete Pavement Surface Course Grade ____" - per ton (metric ton).

B. Asphalt Cement

1. This item is measured by the ton of 2,000 pounds (900 kg). The tonnage to be paid for is the number of tons of the asphalt cement materials used as ordered in the accepted work. Tonnage used in the paving mixture is computed from the truck weigh tickets by using the percentage of asphalt in the approved mix (and verified by extracted asphalt cement content by ASTM D6307). "Performance Graded Asphalt Cement", measured as provided above, will be paid for at the unit prices bid per ton.
2. Price and payment is full compensation for furnishing, handling, storing, heating, transporting and placing in the mixture; for all samples and for all labor, tools, equipment and incidentals necessary to complete the work in full compliance with the plans and specifications.
3. Payment is made under:
   a. PG 58-28 ASPHALT CEMENT – per ton (metric ton).
   b. PG 64-22 ASPHALT CEMENT – per ton (metric ton).
   c. PG 64-28 ASPHALT CEMENT – per ton (metric ton).
   d. PG 70-28 ASPHALT CEMENT – per ton (metric ton).

C. Hydrated Lime

1. This item is measured by the ton of 2,000 pounds (900 kg) for the amount of hydrated lime actually used in the completed and accepted work.
2. The quantities of "Mineral Filler", measured as provided above, are paid for at the unit price bid per ton. Price and payment is full compensation for furnishing, storing, handling, and other charges, all tools, equipment, labor and performance of all work necessary to mix the material with the asphalt concrete and all other incidentals necessary to complete this item.
3. Payment is made under:
   a. Mineral Filler - per ton (metric ton).

4.2 SQUARE YARD BASIS:

A. Asphalt Concrete Pavement

1. These items are measured by the square yard of asphalt pavement surface area. The quantities measured for payment are the square yards (square meters) of specified thickness of asphalt paving in the completed and accepted work as measured in the field." Thickness of Asphalt Concrete Pavement Base or Surface Course. Grade _ is paid for at the unit price bid per square yard (square meter).
2. Price and payment is full compensation for cleaning base or underlying course; for producing, furnishing, transporting, stockpiling, heating, drying and screening of aggregate materials; for furnishing, handling, measuring, mixing, manipulating

and placing of materials; for hauling, placing, shaping, compacting and finishing of the paving mix; for improving unsatisfactory areas; for furnishing samples; for all materials (exclusive of asphalt and mineral filler), manipulation, labor, tools, equipment and incidentals necessary to complete the work in full compliance with the plans and specifications.

3. Payment is made under:
   a. _____" Thickness of Asphalt Concrete Pavement - Base Course - per square yard (square meter).
   b. _____" Thickness of Asphalt Concrete Pavement - Surface Grade _____ Course - per square yard (square meter).
4. Asphalt Cement
   a. No separate measurement and payment is made for this item. The cost for this item is to be included in the cost for Asphalt Concrete Pavement Base and/or Surface Course.
5. Hydrated Lime
   a. This item is measured by the ton of 2,000 pounds (900 kg) for the amount of hydrated lime actually used in the completed and accepted work. The quantity of Hydrated Lime, measured as provided above, is paid for at the unit price bid per ton.
   b. Price and payment is full compensation for furnishing, storing, handling and other charges, all tools, equipment, labor and performance of all work necessary to mix the hydrated lime with the asphalt concrete and all other incidentals necessary to complete this item.
   c. Payment is made under:
      1) Hydrated Lime - per ton (metric ton).

4.3 LINEAR FOOT BASIS:

A. Asphalt Concrete Pavement Base and Surface Courses
1. These items are measured by the linear foot of asphalt pavement trench restoration. The quantities measured for payment are the linear feet of specified thickness of asphalt paving in the completed and accepted work as measured in the field along the trench centerline.
2. Price and payment is full compensation for cleaning base or underlying course; for producing, furnishing, transporting, stockpiling, heating, drying and screening of aggregate materials; for furnishing, handling, measuring, mixing, manipulating and placing of materials; for hauling, placing, shaping, compacting and finishing of the paving mix; for improving unsatisfactory areas; for furnishing samples; for all materials (exclusive of asphalt and mineral filler), manipulation, labor, tools, equipment and incidentals necessary to complete the work in full compliance with the plans and specifications.
3. Payment is made under:
   a. _____" Thickness of Asphalt Concrete Pavement - Base Course - per linear foot (linear meter).
   b. _____" Thickness of Asphalt Concrete Pavement - Surface. Grade _____ Course - per linear foot (linear meter)
4. Payment is made under:

a. Asphalt Concrete Pavement Base Course - per linear foot (linear meter).
b. Asphalt Concrete Pavement Surface Course Grade _____ - per linear foot (linear meter).

B. Asphalt Cement
1. No separate measurement and payment is made for this item. The cost for this item is to be included in the cost for Asphalt Concrete Pavement Base and/or Surface Courses.

C. Hydrated Lime
1. This item is measured by the ton of 2,000 pounds (900 kg) for the amount of hydrated lime actually used in the completed and accepted work.
2. The quantity of "Hydrated Lime", measured as provided above, is paid for at the unit price bid per ton. Price and payment is full compensation for furnishing, storing, handling and other charges, all tools, equipment, labor and performance of all work necessary to mix the hydrated lime with the asphalt concrete and all other incidentals necessary to complete this item.
3. Payment is made under:
a. Hydrated Lime - per ton (metric ton).

4.4 PATCHING:

A. Patching is paid for at the contract unit price bid. Price and payment is full compensation for work and incidentals necessary to complete this item.
1. Payment is made by either of the following as identified under in the Contract documents:
2. Square Foot Basis
a. These items are measured by the square foot of asphalt pavement. The quantities measured for payment are the square feet of specified thickness of asphalt paving in the completed and accepted work as measured in the field.
3. Tonnage Basis
a. These items are measured by the ton of 2,000 pounds (900 kg) of asphalt paving mixture, including the weight of the asphalt cement. The quantities measured for payment are the amount of asphalt paving materials actually used in the completed and accepted work in accordance with the plans and specifications.
b. Payment will not be made for correction of defective work as described in Section 3.29.
4. Price and payment is full compensation for cleaning base or underlying course; for producing, furnishing, transporting, stockpiling, heating, drying and screening of aggregate materials; for furnishing, handling, measuring, mixing, manipulating and placing of materials; for hauling, placing, shaping, compacting and finishing of the paving mix; for improving unsatisfactory areas; for furnishing samples; for all materials (exclusive of asphalt and mineral filler), manipulation, labor, tools, equipment and incidentals necessary to complete the work in full compliance with the plans and specifications.

## SECTION 02581

## PAVEMENT MARKINGS AND MARKERS (PRE-FORMED PLASTIC, PAINTS AND ENAMELS)

### PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This work is painting pavement lines, words and symbols, or applying plastic lines, words, symbols, channelization buttons, and other reflective markers meeting these specifications, the standard drawings, and in reasonably close conformity with the lines and dimensions shown in the contract documents or established by the Engineer.

### PART 2 - PRODUCT

### 2.1 PRE-FORMED PLASTIC PAVEMENT MARKING MATERIAL

A. Furnish plastic pavement markings and legends consisting of reflectorized, pre-fabricated, homogeneous, thermoplastic ribbon of the specified thickness. Assure the plastic contains reflective glass spheres uniformly distributed throughout its cross section and is capable of being affixed to bituminous or Portland Cement concrete pavements using a liquid contact cement or pre-coated, pressure-sensitive adhesive. Furnish white and yellow meeting standard highway colors. Assure the white plastic material is non-yellowing, and the yellow plastic material is non-fading for their expected useful life.

B. For strip line widths of 6 inches (150 mm) or less, furnish plastic pavement striping material in a single manufactured width equal to the specified width. For specified stripe line widths exceeding 6 inches (150 mm), furnish plastic pavement striping material in a single manufactured width equal to the specified width or in two or more widths totaling the specified width.

C. Cut the plastic marking material edges clean and true. Use at least 0.09-inch (2.25 mm) thick plastic material for inlaying into new asphaltic surfaces. Use at least 0.06-inch (1.50 mm) thick plastic material for application to existing surfaces or to hardened new surfaces.

D. Assure plastic pavement markings for inlay into new asphaltic surfaces are capable of being applied just before the final rolling of the new surface and can be rolled into place with conventional pavement rollers. For inlay applications, assure the plastic and adhesive are not damaged by pavement temperatures exceeding 175° F (79° C) or by water on roller drums.

E. Assure the plastic pavement marking material and its adhesive are tack free to provide easy handling without using a protective backing and can be repositioned on the surface before being permanently fixed in position. Pre-coated adhesive must be uniformly distributed over the entire contact surface of the plastic material.

F. Furnish plastic pavement marking material capable of molding itself to pavement contours, breaks, and other surface irregularities under traffic at normal pavement temperatures. Assure the plastic material will fuse with itself and with previously applied markings of the same composition under normal use conditions.

G. Assure pavement legends and symbols meet the applicable shapes and sizes specified by the "Manual on Uniform Traffic Control Devices" as adopted bythe FHWA.

H. Assure product agents or distributors furnish the manufacturer's specifications showing that the material furnished meets or exceeds these requirements and submit evidence of successful product use over a one-year period under similar climatic conditions. Plastic pavement marking material not meeting this use requirement will be rejected.

I. Submit a 4-inch (100 mm) by 1-foot (300 mm) sample from each lot of plastic material proposed for use on the project to the Engineer for approval. Use only approved plastic pavement marking material on the project.

1. Composition Requirements
    a. Furnish pre-formed plastic pavement marking material consisting of plasticizers, pigments, and graded glass spheres combined and proportioned to meet the following requirements.
        1) Pigments: Minimum 20 percent titanium dioxide of total pigment for white marking material; minimum 18 percent medium chrome yellow of total pigment for yellow marking material. Use graded glass spheres that are clean, transparent, and meet the requirements of Section 02581.2.02.A.1. Assure the glass spheres are uniformly distributed throughout the entire material.
2. Physical Requirements
    a. Tensile Strength
        1) Assure the plastic material has a minimum tensile strength of 40 psi (270 kPa) of cross section when tested under ASTM D638. The break resistance is based on an average of at least three (3) samples tested at a temperature of 70° – 80° F (22° – 27° C) using a jaw speed of 0.25 inches (6.25 mm) per minute.

    b. Plastic Pull Test
        1) A 1"-6" (25 mm – 150 mm) sample of the plastic material must support a dead weight of 0.66 lb per 0.01 inch (.28 kg per 2.5 0 mm) of material thickness for at least 5 minutes at 70° –80° F (22°-27° C).

    c. Bend Test
        1) The plastic material must be flexible so that at 80° F (27° C), a 3" by 6" (75 mm by 150 mm) sample of the material can be bent over a 1" (25 mm) diameter mandrel until the end faces are parallel and 1" (25 mm) apart without showing any fracture lines in the uppermost surface under unassisted visual inspection.

d. Skid Resistance

1) The surface friction of the plastic cannot be less than 35 BPN when tested under ASTM E303.

e. Reseal Test

1) The plastic must reseal to itself without adhesives when tested as follows: Overlap 2 1-inch by 3-inch (25 mm by 75 mm) piece face-to-face so that they form a single 1-inch (25 mm) by 5-inch (125 mm) with a 1 square inch (25 square mm) overlap in the center.

2) Place the piece on a hard surface with a 1000-gram weight resting uniformly on the entire overlap area and maintain at 140° to 190° F (60°-88° C) for 2 hours. The actual temperature to be maintained depends on the material being tested but must be within the specified range. After cooling to room temperature, the pieces must not separate without tearing.

f. Reflectivity

1) Furnish reflective pavement marking material having reflective values not less than those listed in the table below. Reflective values are measured under Federal Specifications L-S-300C. The reflective values must be measured on a 2 by 2-1/2 foot (.6 m by .75 m) panel at 85° incidence and be expressed as average candlepower per foot (meter)-candle per 5 square feet (1.5 m 2) of material.

| Divergence Angle | White | Yellow |
|---|---|---|
| 0.2 Degrees | 0.20 | 0.15 |
| 0.5 Degrees | 0.15 | 0.10 |

## 2.2 WATERBORNE PAVEMENT MARKING PAINT

A. Waterborne Pavement Marking Paint

1. Furnish acrylic latex white and lead-free yellow waterborne pavement marking paint meeting the following requirements.

a. Composition – The exact composition is at the manufacturer's discretion except that the vehicle is to be 100 percent acrylic polymer and the paint is not to contain any ingredient listed below.

1) Lead or chromate compounds; mercury; lead; chromate compounds; chlorinated solvents; hydrolysable chlorine derivatives; ethylene-based glycol ethers and their acetates.

2) Meet the following requirements:

| | White | Yellow |
|---|---|---|
| Pigment, % solids ASTM D-3723 | 68 max | 68 max |
| Total Solids, % by weight ASTM D-2369 | 75 min | 75 min |
| Titanium Dioxide, lbs./gal. ASTM D-4563 & D-1394 | 1 lb. min. | 0.15 lb. min |
| % Non-volatile vehicle of total vehicle weight ASTM D-2697 | 41 min. | 41 min. |
| VOC content, maximum EPA Method 24 | 150 g/L | 150 g/L |
| pH, min. | 9.6 | 9.6 |

ASTM E-70

| | White | Yellow |
|---|---|---|
| Viscosity (Krebs Stormer), K.U., ASTM D-562 @ 77°F, (25° C) | 80-95 | 80-95 |
| Grind, Hegman, min. ASTM D-1210 | 2 | 2 |
| Deviation in percent weight per gallon, max. (from manufacturer specified weight) | ±.30 | ±.30 |
| Daylight[1] Reflectance, min. ASTM D-2805 | 85 | 59.1[2] |
| Contrast Ratio, 15 mils wet min., ASTM D-2805 | 0.92 | 0.88 |

[1]The Y-Tristimulus value (luminance) is obtained using a standardized Tristimulus colorimeter using a C illuminant at a two- degree observation angle. The paint sample is drawn to a 15-mil wet film thickness over a white substrate. The department uses a Hunter Lab

Miniscan XE Colorimeter and Leneta Corporation Form 5C opacity charts to determine this value.

[2]Color to match the V+ color on the Hale color chart ±6%.

| ASTM TEST | WHITE AND YELLOW |
|---|---|
| D 711 mod.[1] | Dry Time, 15 mil wet film, 65% RH, minutes, max. 10 |
| D1640 mod.[2] | Dry Through @ 90% RH, 15 mil wet film, minutes, max. 130 |

| ASTM TEST | WHITE AND YELLOW |
|---|---|
| D 2243[3] | Freeze-Thaw, White and Yellow Pass |
| D 2486 | Scrub Resistance, cycles min..... 600 |
| D-969 | Bleeding Ratio, min..... 0.95 |

[1]Use a wet film thickness of 15 plus or minus 1 mil. Immediately place in a humidity chamber controlled at 65± 3% relative humidity and 72.5° F ± 2.5° F (22.5°C ± 1.4° C) with minimal airflow.

[2]Apply a 15± 1 mil thick film to a non-absorbent substrate and place in a humidity chamber controlled at 85±5% R.H. and 72.5°F ± 2.5°F (22.5°C ± 1.4°C). Determine dry through time under ASTM D 1640 exerting the minimum pressure needed to maintain contact with the thumb and film.

[3]See B(7), Freeze-Thaw Stability.

3) Titanium. Use Titanium Dioxide meeting ASTM D-476, Type I or II.

b. Characteristics

1) Flexibility and adhesion. Apply 15 mil wet film thickness to a 3" by 5" (75 mm by 130 mm) tin panel. Dry at 77°F (25°C) for 24 hours followed by two hours at 122°F (50°C). Bend sample over a ½-inch (13 mm) mandrel. Paint to adhere firmly without showing cracking or flaking.

2) Water resistance. Apply 15 mil wet film thickness to a 4" by 8" (102 mm by 203 mm) glass plate. Dry at 77°F (25°C) for 72 hours. Immerse in distilled water at 77°F (25°C) for 24 hours. Air dry for two hours on a flat surface. Paint to not show blistering or adhesion loss.

3) Skinning and lumps. Fill a pint (0.473 L) container ¾ full of paint and seal tightly. After 72 hours, strain paint through a 100 mesh screen. No lumps or skin retained on the screen is permissible.

4) Settling. Fill a centrifuge tube with paint and revolve for two hours at 1112 Newtons (250 ft/lbs). Separation from top of vehicle to top of pigment not to exceed 13 mm (1/2- inch).

5) Skinning. Fill ½ pint (0.236 L) container half full of paint and seal. Let stand for 24 hours. No skinning to be visible.

6) Bleeding. When tested under ASTM D-969, paint to not show perceptible bleeding when painted on a bituminous surface.

7) Freeze-thaw stability. When tested under ASTM D-2243, paint to not show coagulation or viscosity change exceeding 10 Krebs units.

8) Static heat stability. Pour paint into a pint (473 mL) within 0.25 inches (6.4 mm) of the top, put the lid on and seal with tape, and place the container in an oven heated to 60°C ± 1°C (140°F ± 2°F) for seven days. Equilibrate the paint at standard conditions and thoroughly mix by stirring for at least five minutes. Ensure the paint does not show signs of livering, hard settling, coagulation, lumps or course particles. Perform a consistency test meeting ASTM D-562 at 25°C (77°F). Paint viscosity to not vary 10 K.U. from the original viscosity measured at 25°C (77°F).

c. Packaging and Marking. Meet subsection 714.04.9 requirements.

d. Sampling and Acceptance. Draw three samples meeting subsection 714.04.8 requirements.

e. Retro-reflective Glass Beads. Use silene-coated moisture resistant glass beads meeting subsection 714.05 requirements.

f. Application. Follow the manufacturer's requirements for pavement cleaning and traffic paint application or as follows, whichever is more restrictive.

1) Apply to a dry surface.

2) Clean the pavement of all loose rock, dirt, and debris immediately before applying the traffic paint.

3) Do not heat the traffic paint to exceed 110°F (43.3°C) before and during application.

4) Apply the traffic paint when the ambient temperature is 50°F (10°C) and rising. Stop application when the temperature is 50°F (10°C) and dropping and when rain or other weather adverse to the traffic paint during its drying time is imminent.

5) Apply traffic paint at 15 mils (0.38 mm) wet thickness in a single application meeting subsection 620.03.3(A).

6) Remove and replace all defective pavement marking damaged by weather at Contractor expense.

7) Re-paint, at Contractor expense, all striping represented by paint samples where any specified property is outside 20 percent of the specified value.

g. Reflective Glass Beads

1) Glass beads for use in reflectorizing traffic paint markings on pavement by the drop-on method must be spherical and transparent with smooth, lustrous surfaces. The beads, as delivered, must be spherical and transparent with smooth, lustrous surfaces. The beads, as delivered, must be free from extraneous material and clumps of beads that cannot be broken up easily when applying to the stripe.

2) Imperfections – The glass beads cannot include more than 25 percent irregularly shaped particles when tested under ASTM D1155. Assure the beads are free of scratches, pits, milkiness, dark particles, and excessive air bubbles.

3) Color – The glass beads must be colorless to the extent that they do not impart a noticeable daytime hue to white pavement markings.

4) Chemical Stability – The beads must withstand refluxing in distilled water in a Soxhlet extractor for 90 hours without noticeable dulling of surface luster and not more than 2.5 percent loss in weight.

5) Index of refraction – The glass from which the beads are made must have an index of refraction of at least 1.50 by the immersion method using tungsten light.

6) Gradation – Assure the glass beads meet the following gradation requirements when tested under the Standard Method of Test for Sieve Analysis of Glass Spheres, ASTM D1214.

| Sieve No. | Total Percent Passing |
|---|---|
| 20 | 100% |
| 30 | 75-95% |
| 50 | 15-35% |
| 100 | 0-5% |

7) Packaging and Marking – Furnish glass beads in bags containing 50 lb. (26 kg) net. Assure the shipping bags are moisture proof, paper-lined burlap bags meeting specification ICC-36-C under Interstate Commerce Commission Regulation Section 78-234. Mark each bag with the name of contents, manufacturer of beads, and net weight.

8) Certification – Submit certification from a testing laboratory approved by the Engineer certifying the beads meet these expectations.

## PART 3 - EXECUTION

### 3.1 APPLICATION OF PLASTIC PAVEMENT MARKING MATERIAL.

A. Apply plastic pavement marking materials only to clean, dry surfaces free of paint, dirt, and foreign matter. On newly constructed surfaces to which a sealer has been applied, clean the surface receiving the plastic pavement marking to neutralize any acid and remove the sealer.

B. Apply following the manufacturer's recommended procedures. Apply plastic pavement marking materials only to surfaces at temperatures within the range specified by the manufacturer for optimum adhesion.

C. When activators are required for the adhesive or when various special coatings are required for different pavement surfaces, supply such information to the Engineer, indicating special application procedures.

D. Assure the width and layout of stripes or the area of application of plastic pavement markings and legends meet the dimensions shown in the contract documents or standard drawings.

E. Before applying the plastic striping material, the Engineer will establish control points on the roadway for striping alignment. The Engineer will establish control points every 100 feet (30 meters) on tangent, at least every 100 feet (30 meters) on curves of 2 degrees or less, and at 50-foot (15 meters) intervals for curves over 2 degrees. The Engineer will also designate other pavement striping locations such as stop bars, crosswalks, and the like. Maintain all lines within 2" (50 mm) of established lines.

F. Place asphaltic surfacing on the roadway just before final compaction and roll into the new surface during final completion. Assure pavement markings or legends are flush with the finished surface.

### 3.2 PAINTING TRAFFIC LINES

A. Clean the surface to be painted for dirt, rocks, gravel and any other foreign matter. Apply the paint by hand or mechanical means consistent with the scope of the job. Assure the width and layout of stripes or the area to be painted meets the plans or standard drawings.

B. Paint the top and traffic side of curbs at those locations where parking is to be restricted, as shown in the contract documents or in the pavement marking manual. Paint the top and traffic sides of all island curbs, median curb, and other specified curb. Paint by uniformly applying one (1) coat of yellow traffic line paint meeting the requirements of Section 02581.2.2.A.1 as applicable. Paint the curb after it has cured at least 30 days after being cast. Apply the paint at a rate that the curb surface is completely covered and hidden. Assure surfaces to be painted are clean and free of all foreign matter before painting.

C. Before applying paint, mark the roadway between control points established by the Engineer. The Engineer will establish such control points on tangent every 100 feet (30 meters) and on curves at least every 100 feet (30 meters) for under 2- degree curves and at 50-foot (15 meters) intervals on curves over 2-degree curvature. Maintain the line within 2" (50 mm) of the established lines. The Engineer will also designate other pavement striping locations such as stop bars, crosswalks, and the like.

D. Apply highway traffic striping during daylight hours when the air and pavement temperatures are 40° F (4° C) or higher, the pavement surface is dry and the weather is not foggy, rainy, or stormy.

E. Apply paint and glass beads with equipment manufactured specifically for that purpose and using workmen experienced in operating such equipment. Locate the bead applicator directly behind and synchronized with the paint applicator. Assure both devices are shielded to avoid spraying of paint or loss of beads outside of the designated width of line. Assure the equipment is also capable of painting a stripe or stripes of the specified width with a tolerance of plus or minus ¼ inch (6.25 mm). In "no passing zones", the machine must be able to paint three (3) stripes simultaneously. For centerline painting, assure the machine is equipped with an automatic skip control giving the specified broken-line pattern within a tolerance of 6 inches (150 mm) over each cycle.

F. Use hand-operated equipment to stripe stop bars, crosswalks, and other areas not readily accessible to the pavement striping machine.

G. Apply the pavement striping paint at the following rates per gallon (liter):

1. Four-inch stripe (100 mm) – at least 250 but not more than 275 linear feet (meters) per gallon (liter).

2. Four-inch (100 mm) dashed stripe (9 foot [2.8 meter] stripe-15 foot [4.6 meter] gap) – at least 665 but not more than 735 linear feet (meters) per gallon (liter).

3. Four-inch (100 mm) dashed stripe (10 foot [3 meter] – 30 foot [9 meter] gap) at least 1000 but not more than 1100 linear feet (meters) per gallon (liter).

H. Apply beads at the rate of 6 pounds (kg) per gallon (liter) of paint, plus or minus 0.1 pound.

I. For quality control, the Engineer will check the application at the beginning of each day's paint striping and as often as considered necessary. If equipment settings fail to produce quality striping within the limits specified, stop striping work until corrected.

J. Protect all markings until dry by placing approved guarding or warning devices as necessary. Correct all markings smeared or otherwise damaged at no expense to the owner.

K. Sufficient quantities of paint have been included in the contract to provide for an interim application and a final application of traffic line paint. The need for applying an interim application will be determined by the Engineer.

L. When plastic pavement markings are specified, use paint for the interim markings of the specified color and apply as specified in the contract documents. The final application must be plastic.

M. Apply two (2) full applications of the specified centerline and shoulder line striping on open graded friction course and seal coat pavement surfaces meeting the following table. Apply the second application a minimum of 30 days after the first application.

**PAVEMENT STRIPING – OGFC AND SEAL COATED SURFACES**

| Pavement Surface Type | | Number of Applications* | Striping Application – Direction of Travel | |
|---|---|---|---|---|
| | | | First Application | Second Application |
| OGFC and Seal Coated Surfaces | 2 lane 2-way | 2 | Not specified | Apply in opposite direction of first application |
| | 4-way | 2 | Apply in same direction as traffic flow | Apply in same directions as traffic flow |

*All transverse lines must receive two (2) applications applied in opposite directions.

## 3.3 REMOVAL OF PAVEMENT MARKINGS

A. As shown in the contract documents or directed by the Engineer, remove temporary pavement markings or markings that are no longer appropriate to the roadway.

B. Approved methods of removing markings include sand blasting with air or water; high pressure water; steam or superheated water; mechanical grinders, sanders, scrapers, brushes, burning, and the like.

C. Choose, subject to Engineer approval, the removal method best suited to the existing condition of the paint and pavement surface.

D. No other methods of removal other than those specified here will be allowed. The contractor may make written request to the Engineer for approval to use other methods, materials, or equipment. The Engineer may subsequently disapprove any prior approved method should it prove detrimental to the pavement surface or inadequate in removing the markings.

E. Remove sand or other material deposited on the pavement resulting from removing traffic markings as the work progresses. If the striping removal results in light or discolored lines on the roadway, cover the areas with a thin asphalt fog coat. Repair all damage to the pavement or surfacing caused by pavement marking removal at no cost to the owner.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.1 GENERAL

A. Plastic pavement striping is measured for payment by the number of linear feet (meters) of line of the specified width and thickness in place and accepted. Length of dashed, longitudinal pavement line is the actual length placed, e.g. 25% of the total roadway length where 10-30 lines gap ratio is used.

B. Plastic pavement marking words and symbols are measured for payment by the number of square feet (square meters) of words and symbols in place and accepted.

C. Painted traffic lines, words, and symbols are measured for payment by the number of gallons (liters) of paint used and accepted.

D. Unless otherwise provided in the contract, removal of pavement markings is measured for payment by the linear foot (meter). Words and symbols are measured by the square foot (square meter) and converted to the equivalent linear foot (meter) of 4 inches (100 mm) wide line.

E. Paint and painting of curbs, island curbs, and median curbs in accordance with Section 02581.3.2 are measured by the actual gallons (liters) of paint used and accepted.

F. Plastic pavement striping is paid for at the contract unit price per linear foot (meter) of striping of the specified width and thickness.

G. Plastic pavement marking words and symbols are paid for at the contract unit price per square foot (square meter) of plastic words and at the contract unit price per square foot (square meter) of plastic words and symbols. Payment for plastic lines, words, and symbols is full compensation for furnishing all necessary materials and equipment and doing all required work.

H. Painting of traffic lines and words and symbols is paid for at the contract unit price per gallon (liter) for “Highway Traffic Striping” complete in place, including the furnishing and application of beads. Payment is full compensation for all work necessary to complete the item.

I. Removal of pavement markings is paid for at the contract unit price per linear foot (meter).

J. The cost of paint and the painting of curbs, island curbs, and median curbs in accordance with Section 02581.3.2 are paid for at the contract unit price per gallon (liter) for curb marking.

**END OF SECTION**

## SECTION 02582

## REFLECTIVE THERMOPLASTIC PAVEMENT MARKINGS

### PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This work is furnishing and applying hot thermoplastic pavement lines, words and symbols in accordance with these specifications, the standard drawings, and meeting the lines and dimensions shown in the Project Plans.

B. Hot thermoplastic is typically applied by 3 different methods.
   1. Spraying the material onto the pavement surface.
   2. Extruding the material onto the pavement surface.
   3. Extruding the material into a groove either cut or ground into the pavement surface.

C. Method or methods of application required on the project will be specified in the contract documents.

D. Furnish thermoplastic material that is either hydrocarbon or alkyd based as specified in the contract documents. The Contractor may furnish one or the other at his option if the type is not specified. However, only one type may be used on a particular project.

### 1.2 REFERENCES

| | |
|---|---|
| AASHTO M 249 | Standard Specification for White and Yellow Reflective Thermoplastic Striping Material |

### 1.3 MATERIAL ACCEPTANCE

A. Before delivering thermoplastic material to the project, furnish the Engineer copies of the manufacturer's product specification data. Material for which the manufacturer's product specification data does not meet all specified requirements will not be approved for use.

B. The Engineer may at any time request a manufacturer's sample or may take field samples at the point of application for testing purposes. The Engineer will test samples for one or any combination of specified requirements. Remove and replace material represented by a sample for which one or more test results fail to meet specified requirements.

C. Furnish the Engineer all instructions from the thermoplastic manufacturer for preparation of the surface and application of material proposed for use before application. Instructions must include, as a minimum, types of equipment, approved work methods and procedures, material application temperatures, ambient temperature and weather limitations, precautions, and all other requirements necessary for successful installation and satisfactory performance. Do not place material for which manufacturer's installation instructions are not complete or are not available.

## PART 2 - PRODUCT

### 2.1 GENERAL

A. Furnish white and yellow thermoplastic striping material meeting the requirements of AASHTO M249 except as modified and supplemented herein.

B. Color

1. Assure the color yellow marking is reasonably close to color chip 33538 of Federal Standard No. 595A, Table 5. Quantity and type of yellow pigment is at the option of the manufacturer, providing all other requirements of this specification and AASHTO M249 are met.

2. Use yellow pigment which is heat-resistant and capable of maintaining the specified color characteristics after being heated to manufacturer's recommended application temperature.

3. Assure the color of white marking material is reasonably close to color chip 37875 of Federal Standard No. 595A, Table 9. White material cannot have any tint or coloration after weathering.

C. Glass Beads

1. Use striping material containing at least 24% by weight glass beads meeting requirements of Section 02582.2.2.A. Submit certification from the manufacturer stating this requirement is met for each batch of material used on the project.

D. Spraying Consistency

1. If the material specified on the plans is to be hot applied by spraying methods, assure the consistency of the thermoplastic material allows for excellent spraying characteristics while meeting the specified reflectivity, durability, color, chemical composition and properties, line and edge quality, tolerance, thickness, and bonding requirements as specified by the manufacturer.

### 2.2 HYDROCARBON BASED

A. Furnish hydrocarbon based thermoplastic striping material meeting the requirements of AASHTO M249 except as modified and supplemented herein.

B. Specific Gravity

1. Specific gravity cannot exceed 2.15. Actual specific gravity of material, as determined by test on samples, cannot vary from manufacturer's product specification by more than 0.5.

C. Composition

1. AASHTMO M249, Table 1, composition is replaced with the following:

| Component | White | Yellow |
|---|---|---|
| Binder, Hydrocarbon Base | 16.0% min. | 16.0% min. |
| Glass Beads | 24% min. | 24% min. |
| Titanium Dioxide | a) Anatase 5.0% min. | b) Rutile 5.0% min. |
| Calcium Carbonate & Inert Fillers | 42% max. | See note. |
| Yellow Pigments | | See note. |

a. Note: Quantity of yellow pigments and calcium carbonate and inert fillers is at the option of the manufacturer, providing all other requirements of this specification are met. Yellow pigment must be heat resistant and color stable at recommended application temperature.

b. Have the manufacturer furnish certification to the Owner that the titanium dioxide contains a minimum of 5.0% each of anatase and rutile for all batches of material used on the project.

D. Physical Characteristics

1. The following modifications are made to Section 4.3 of AASHTO M249:

a. 4.3.1 Change "2180+2C (4250+3F)" to "manufacturer's recommended application temperature".

b. 4.3.2 Change "2110+7C(412.50+12.5F)" to "manufacturer's recommended application temperature".

c. 4.3.3 Change "218C (425F)" to "manufacturer's recommended application temperature".

d. 4.3.4 Change "2180+2C(4250+3F)" to "manufacturer's recommended application temperature". Change "- 9.40+13C(1543F)" to "–20C(-40F)". Add to last sentence: "after being exposed to ambient room temperature of 20-23C (690-740F) after cooling".

e. 4.3.5. Change "2180+2C(4250+3F)" to "manufacturer's recommended application temperature".

f. 4.3.6 Softening point – After heating the thermoplastic material for four hours 0+5 min. at 2180+2C(4250+3F) and testing in accordance with ASTM D36, the materials shall have a softening point of 102.50+9.5C(2150+15F).

g. 4.3.7 Change “2180+2C(4250+3F)” to “manufacturer’s recommended application temperature”.

h. 4.3-9 Rescind this article.

i. Change “21147C(412-5412.5F)” to “manufacturer’s recommended application temperature”.

j. Change “21147C(412.50+12.5F)” to “manufacturer’s recommended application temperature” in subsection 6.1.

**PART 3 - EXECUTION**

**3.1 GENERAL**

A. Applicable requirements of Section 02581.3.2 “PAVEMENT MARKINGS AND MARKERS” apply to installation of thermoplastic striping material.

B. Perform surface preparation and material application following the manufacturer’s detailed instructions. Furnish the Engineer a copy of the manufacturer’s detailed instructions before starting work.

C. When thermoplastic markings are to be applied to existing asphalt pavement, which is open to use by traffic, place a primer or tack coat before applying thermoplastic material. Use a thin asphaltic tack completely over the surfaces of depressions or finished pavement surfaces the thermoplastic pavement markings are to be applied.

**3.2 SURFACE AND TEMPERATURE REQUIREMENTS**

A. Apply thermoplastic material only during optimal weather conditions, as recommended by the manufacturer.

B. The following requirements for air temperature and surface conditions apply unless otherwise recommended by the manufacturer.

C. Minimum allowable ambient air temperature required for application is 60°F (15°C). Assure the pavement surface is dry (exhibiting absolutely no dampness by the inspector’s sight/touch inspection) during application.

**3.3 TEMPERATURE MONITORING**

A. Assure all equipment used to melt or apply thermoplastic material has permanently attached thermometers providing a true temperature of thermoplastic contained therein. Assure monitoring devices are easily accessible and readable using a dial or other indication of the material temperature on a continuous basis.

B. When using heating equipment to pre-melt or apply thermoplastic of the oil bath heating type, provide indirect heat application to thermoplastic material that reduces risk of overheating and provides a more consistent application temperature. Assure a rotating agitator is an integral feature of pre-melt kettles to provide stirring of thermoplastic material.

## 3.4 APPLICATION

A. Use the method of application for thermoplastic striping material whether sprayed, top applied extruded, or inlaid extruded as recommended by the manufacturer. Finish lines, words, and symbols to meet the requirements specified herein for width, length, thickness, and edge quality.

1. Extruded (Inlaid)

a. Install thermoplastic striping material specified to be extruded and inlaid into pavement surface by sawing or grinding grooves into the finished pavement surface to dimensions and shapes specified. Assure the edges of thermoplastic markings are straight, uniform, and free of gaps between asphalt and thermoplastic that could allow water to enter beneath markings. To facilitate edge sealing, depressions for lines may be of a slightly reduced width. Assure finished extruded lines are wider than grooved widths by a ¼ inch (6.25 mm) minimum at each edge within ranges shown by the following table.

| ALLOWABLE MARKING/GROOVE TOLERANCE RANGE | | |
|---|---|---|
| Specified Width | Groove Width | Line Width |
| 4” (100 mm) | 3-3/4” – 4” (93.75mm-100mm) | 4” – 4-1/2”(100mm-112.5mm) |
| 8” (200 mm) | 7-1/2” – 4” (190mm-200mm) | 8” – 8-1/2” (200mm-212.5mm) |
| 24” (600mm) | 23-1/2” – 24” (590mm-600mm) | 24” – 25-1/2” (600mm-638mm) |

b. Groove widths as close to the plan specified widths as extrusion shoes or other devices used will produce within ranges indicated. Groove line lengths as specified in the plans and standards. Assure grooved configurations for words and symbols match those shown in FHWA’s “Standard Alphabets” manual within a tolerance of ¼” (6.25 mm) per 4 inches (100 mm) of width required at any point of the configuration but larger than depressions (using this same tolerance range for application of thermoplastic) to obtain the required edge sealing. Cover and seal all grooved edges with the thermoplastic. Sweep and blow out with compressed air all depressions or wash them clean and free of dirt, rocks, gravel, and all other foreign matter before placing the thermoplastic material. Fill grooves with thermoplastic within 24 hours after being cut into the pavement. Keep traffic off the grooves and re-clean grooves before applying the thermoplastic.

c. Groove the pavement surface and apply the thermoplastic in accordance with the manufacturer’s detailed instructions.

B. Spraying

1. Spray the thermoplastic material specified in accordance with the manufacturer’s detailed instructions.

C. Glass Bead Application

1. Immediately after application of thermoplastic material, apply an additional quantity of glass beads by drop-on methods at 6 lbs. (2.7ko) minimum per 100 sq. ft. (30 sq. mtrs.) of thermoplastic material applied.

2. Increase the bead application rate as directed by the Engineer.

D. Protection of Markings

1. Protect newly applied pavement markings from tracking during the setting period specified in Article 4.3.2 of AASHTO M249 using traffic control devices.

## 3.5 DIMENSIONAL TOLERANCES

A. Finish the markings to have a uniform cross section of the thickness specified. Thickness specified in the contract documents is minimum hardened thickness. Assure lines have a sharp cutoff on both sides at each end and at all edges for words and symbols. Assure lateral widths to be used for lines are within the ranges shown by the Allowable Marking/Groove Tolerance Range table in Section 02582 of these specifications. Once actual widths to be used are selected, assure they are consistent and uniform throughout the project for each width used. Lateral tolerance cannot be greater than ¼ inch (6.25 mm) of actual widths selected for use by the Contractor and approved by the Engineer. Assure specified broken line patterns have a linear tolerance of 6 inches (150 mm) over each cycle.

## 3.6 PLASTIC PAVEMENT MARKING JOINTS

A. Apply hot extruded thermoplastic to provide the minimum number of joints possible.

B. Transverse markings can have a minimum of one joint per line.

C. Apply words and symbols without joints within each symbol or letter of the word except those letters made with one or more straight lines (A,L,N,T etc.) and combination arrows (through and right or through and left, etc.). Those letters may be applied with one pass per leg. Combination arrows may be applied with one pass for each arrowhead of the marking.

D. Place longitudinal lines of 4-inch (100 mm) and 8-inch (200 mm) width (generally those approximately parallel to the road centerline) in one pass without longitudinal or cross-joints. Cross joints are acceptable only if lines exceed 100 feet (30 meters) in length, or for shorter lines which require a change of direction necessitating an adjustment for the path of application equipment.

E. Extrude all lines of 24-inch (600 mm) width with one pass of application equipment, without longitudinal joints, and with a maximum of one transverse joint unless directed otherwise by the Engineer.

F. If joints are necessary, make them have a neat professional appearance without gaps or unevenness and completely seal the joints from moisture penetration.

## 3.7 PATCHING

A. Areas of markings requiring repair or patching may have thermoplastic from that same batch used for original application applied either mechanically or by hand and beads reapplied. Assure the finished appearance matches the original extrusions and is within the shape of markings specified.

## 3.8 CLEANING AND TRIMMING OF MARKINGS

A. Irregularities of markings may be removed by methods that do not chip, crack, or otherwise damage the marking itself or cause de-lamination of the thermoplastic. Use the methods recommended by the manufacturer without damaging the asphalt or thermoplastic.

# PART 4 - MEASUREMENT AND PAYMENT

## 4.1 GENERAL

A. Thermoplastic striping material is measured for payment by the number of linear feet of line of the specified color and width in place and accepted.

B. Words and symbols are measured for payment by the number of square feet (square meters) of words and symbols in place and accepted.

C. Thermoplastic striping material is paid for at contract unit price per linear foot of striping of specified color and width.

D. Words and symbols are paid for at the contract unit price per square foot (square meter) for the configuration and size shown in the Manual on Uniform Traffic Control Devices and Supplemental Manual, Standard Alphabets for Highway Signs and Pavement Markings.

E. Consideration of payment will not be given for the tolerances allowed by Section 02581 of these specifications.

F. Consideration of payment will not be given for installed thickness exceeding that specified in the plans or special provisions. The Contractor is to evaluate pavement surface texture, operational equipment and methods, and any other factors affecting installation of thermoplastic marking thickness and compensate for them in the unit prices bid for thermoplastic pavement markings.

**END OF SECTION**

Items. Additional material quantities, volumes, and measurements may be shown on the Contract Document drawings and/or specifications. Unit Price quantities and measurements shown on the Bid Proposal are for bidding and contract purpose only. Quantities and measurements supplied, completed for the project, and verified by the Project Representative shall determine payment. Each unit price will be deemed to include an amount considered by the Contractor to be adequate to cover Contractor's overhead and profit for each bid item. The Owner or Contractor may make a Claim for an adjustment in Contract Unit Price if the quantity of any item of Unit Price Work performed by the Contractor differs materially and/or significantly (increase or decrease by 50%) from the estimated quantity indicated on the Bid Proposal. Lump sum bid item quantities will not be measured. Payment for these lump sum bid proposal items will be paid in full amount listed on the Bid Proposal when accepted by the Project Representative, unless specified otherwise.