PROJECT SPECIFICATIONS

FY 2022 PIPER LANE AND RENTAL CAR STORAGE AREA IMPROVEMENTS

Yampa Valley Regional Airport

11005 RCR 51A, Hayden, Colorado, 81639

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Issued for Bid

Mead & Hunt

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SECTION 201 CLEARING AND GRUBBING

DESCRIPTION

201.01 This work consists of clearing, grubbing, removing, and disposing of vegetation and debris within the limits of the right of way, easement areas, borrow pits, and other areas shown in the Contract or required by the work. Vegetation and objects designated to remain shall be preserved free from injury or defacement.

CONSTRUCTION REQUIREMENTS

201.02 The Engineer will designate all trees, shrubs, plants, and other objects to remain. Every object that is designated to remain and is damaged shall be repaired or replaced as directed, at the Contractor's expense.

Clearing and grubbing shall extend to the toe of fill or the top of cut slopes, unless otherwise designated.

All surface objects, trees, stumps, roots, and other protruding obstructions not designated to remain shall be cleared and grubbed. In areas to be rounded at the tops of backslopes, stumps shall be removed to at least 2 feet below the surface of the final slope line.

Except in areas to be excavated, all holes resulting from the removal of obstructions shall be backfilled with suitable material and compacted in accordance with subsection 203.06.

Burning of perishable material will not be permitted.

No material or debris shall be disposed of within the project limits without the written permission of the Engineer. Material or debris that is disposed of within the project limits shall be buried to a depth of at least 2 feet and the surface shall be reshaped to match the adjacent ground line. The Contractor shall make all arrangements to obtain written permission from property owners for disposal locations outside the limits and view of the project. Copies of this written agreement shall be furnished to the Engineer before the disposal area is used.

All cleared merchantable timber shall be removed from the project and shall become the property of the Contractor.

Branches on trees or shrubs shall be removed as directed. Branches of trees extending over the roadbed shall be trimmed to give a clear height of 20 feet above the roadbed surface. All trimming shall be done in accordance with good tree surgery practices.

The Contractor shall clear and grub the areas within the excavation or embankment grading limits and shall include the removal from the ground of brush, roots, sod, grass, residue of agricultural crops, sawdust, and other vegetable matter. See subsection 208.04(e) for disturbed area limits.

METHOD OF MEASUREMENT

201.03 Measurement will be by one of the following methods:

Lump Sum Basis. When the Contract contains a clearing and grubbing lump sum item, no measurement will be made.

BASIS OF PAYMENT

201.04 The accepted quantities of clearing and grubbing will be paid for at the contract unit prices as follows:

Lump Sum Basis. When the bid schedule contains a lump sum item, the lump sum price so bid will be paid and shall be full compensation for clearing and grubbing the entire project.

Clearing and grubbing beyond the limits designated under this item will be paid for as Extra Work in accordance with the Contract.

Payment will be made under:

Pay Item	**Pay Unit**
Clearing & Grubbing	Lump Sum

END OF SECTION

SECTION 202 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

DESCRIPTION

202.01 This work consists of the removal and disposal of trees, slope, and ditch protection, abandoned utility services, curb, gutter, pipes, sidewalk, structures, pavements, and all other obstructions that are not designated or permitted to remain. It shall also include salvaging, stockpiling, and loading salvable materials, sandblasting, plugging structures, cleaning culverts, and sawing and cutting to facilitate controlled breaking and removal of concrete and asphalt to a neat line. Except in areas to be excavated, the resulting trenches, holes, and pits shall be backfilled.

Materials removed and not designated in the Contract to be salvaged or incorporated into the work shall become the property of the Contractor.

CONSTRUCTION REQUIREMENTS

202.02 General. The Contractor shall raze, remove, and dispose of all structures and obstructions which are identified on the project, except utilities, structures, and obstructions removed under other contractual agreements, and salvable material designated to remain the property of the Sponsor.

Basements and other cavities left by structure removal shall be filled to the level of the surrounding ground with suitable material and, if within the construction limits, shall be compacted in accordance with subsection 203.06.

Blasting or other operations used to remove existing structures or obstructions will not be permitted.

Concrete and asphalt pavement shall be cut vertically along pre-marked lines. The depth of the saw cut shall be the full depth of the pavement section unless otherwise specified or approved.

Removed asphalt material may be used to construct embankments.

Where culverts or sewers are to be left in place and plugged, the ends of concrete or masonry culverts shall be filled with suitable material. Culvert and sewer ends are to be sufficiently filled or crushed to prevent future settlement of embankments. Plugging of culverts shall include removal of headwalls and other appurtenances where necessary to accommodate the work.

203.03 Salvable Material. All salvable material designated in the Contract to remain the property of the Sponsor shall be removed without damage, in sections or pieces which may be readily transported, and shall be stockpiled by the Contractor at specified locations within the project limits. The Contractor shall safeguard salvable materials and shall be responsible for the expense of repairing or replacing damaged or missing material until it is incorporated into the work or is loaded onto Sponsor equipment by the Contractor.

202.04 Signs and Traffic Signals. Removal of signs shall include removal of posts, footings, pedestals, sign panels, and brackets.

Removal and salvage of sign panel shall include removal of the panel and its attachment hardware from the existing installation. Sign panels shall be stored in a secure location until reinstallation.

Removal and salvage of tubular gas marker shall include removal of the entire marker and protection of gas line in place. The marker shall be stored in a secure location until reinstallation.

202.05 Pavement Markings. Not Used.

202.06 Detours. The Contractor shall completely remove the detour and dispose of the materials in accordance with the Contract.

202.07 Pavements, Sidewalks, Curbs. Not Used.

202.08 Portions of Structures. Not Used

202.09 Removal of Asphalt Mat (Planing).

The Contractor shall not commence planing operations until directed by the Engineer.

Prior to beginning planing operations, the Contractor shall submit a planing plan for approval by the Engineer. This plan shall include as a minimum:

(1) The number and types of planers to be used.

(2) The width and location of each planing pass.

(3) The number and types of brooms to be used, and their locations with respect to the planers. The Contractor shall have at least one back up broom on the project at all times in case one of the operating brooms breaks down.

Each planer shall conform to the following:

(1) The planer shall have sufficient power, traction, and stability to maintain an accurate depth of cut. The propulsion and guidance system of the planer shall be maintained in such condition that the planer may be operated to straight and true lines.

(2) Operation with broken or missing teeth will not be allowed. Worn teeth shall be replaced if the planer does not produce a uniform surface.

(3) The planer shall be capable of picking up the removed asphalt in a single operation. A self-loading conveyer shall be an integral part of the planer. Windrows will not be allowed.

All planed areas shall be broomed with a pick up broom, unless otherwise specified, before being opened to traffic. A sufficient number of brooms shall be used immediately after planing to remove all planed material remaining on the roadway.

If the Contractor fails to adequately clean the roadway, work shall cease until the Engineer has approved the Contractor's revised written proposal to adequately clean the roadway.

At the completion of each day's work, vertical edges caused by planing that are greater than 1 inch in height shall be: Longitudinal - tapered to not less than a 3:1 slope, Transverse - tapered to not less than a 50:1 slope.

The roadway shall be left in a safe and usable condition at the end of each work day. All required pavement markings, removed by the planing, shall be restored before the roadway is opened to traffic.

All planing shall be completed parallel to the travel lanes unless otherwise directed by the Engineer.

All planing shall be completed full width before resurfacing commences.

202.10 Clean Culvert. Culverts designated in the Contract to be cleaned shall be cleaned by removing all sedimentation and debris from within the culvert and all appurtenant structures.

METHOD OF MEASUREMENT

202.11 When the Contract provides payment for removal of obstructions on a lump sum basis, this payment will include all stipulated structures and obstructions encountered within the work area in accordance with this section. When the Contract provides payment for the removal of specific items on a unit basis, measurement will be by the unit.

Removal of asphalt mat (planing) will be measured by the area in square yards, completed to the required depth, and accepted.

Clean culvert will be measured by the number of culverts acceptably cleaned as designated on the plans, irrespective of the kind or size involved.

BASIS OF PAYMENT

202.12 The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule. Payment shall be full compensation for sawing, removing, disposal, excavation and subsequent backfill, and salvage of materials removed, their custody, preservation, storage, and disposal as provided herein.

Payment will be made under:

Pay Item	**Pay Unit**
Removal of Traffic Sign & Post	Each
Clean Culvert	Each

When the Contract does not include pay items for removal of structures and obstructions, the removal will not be paid for separately but shall be included in the work.

Unless otherwise provided for in the Bid Schedule, cutting asphalt pavement for removal will not be measured or paid for separately, but shall be included in the Work.

END OF SECTION

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SECTION 203 EXCAVATION AND EMBANKMENT

DESCRIPTION

203.01 General This work consists of excavation, hauling, disposal, placement, and compaction of all material encountered within the limits of the work, including construction of dikes and excavation for ditches and channels, necessary for the construction of the roadway in accordance with the Contract.

MATERIALS

203.02 Excavation Definitions All excavation will be defined as, "unclassified excavation", "stripping", "removal of unsuitable material", "rock excavation", "borrow", or "potholing" as described below:

(a) Unclassified Excavation. Unclassified excavation shall consist of the excavation of all materials of whatever character required for the work, obtained within the right of way, including surface boulders and excavation for ditches and channels that is not removed under some other item.

(b) Stripping. Stripping shall consist of removing overburden or other specified material from borrow pits, and the replacement of overburden or other specified material over the disturbed area of the site or pit after the underlying material has been removed.

(c) Removal of Unsuitable Material. Removal of unsuitable material shall consist of the removal of soils or mixtures of soil and organic matter identified in the Contract or as directed by the Engineer that would be detrimental to the roadway or embankment if left in place in its existing condition.

(d) Rock Excavation. Rock excavation shall consist of removal of igneous, metamorphic, and sedimentary rock which cannot be excavated without blasting or with the use of rippers, including all boulders or other detached stones having a volume of ½ cubic yard or more. Unless specified in the Contract, rock excavation is material that meets one of the following field test criteria to be conducted by the Contractor:

1. Ripping Test: Material that cannot be broken down by one pass with a single tooth ripper mounted on a crawler type tractor in low gear with a minimum net flywheel power rating of 235 horsepower; or material that cannot be broken down with a 48,000 pound tracked excavator using a bucket with rock teeth.

2. Seismic Test: Material that has a seismic velocity of 6,000 feet per second or greater. The Contractor shall submit the qualifications of the individual performing or interpreting the seismic testing to the Engineer a minimum of 14 days prior to testing. The ripping test will be used to resolve differences if seismic velocities fall below 6,000 feet per second.

3. Handling Test: Any boulder or detached stone having a volume of ½-cubic yard or more that cannot be readily broken down with the excavation equipment described above in 1.

(e) Borrow. Borrow shall consist of approved material obtained from outside the right of way required for the construction of the project.

(f) Potholing. Potholing shall consist of exposing and verifying the location of existing utilities at locations as directed.

203.03 Embankment Material. Embankment material shall consist of approved material acquired from excavations or borrow pits and hauled and placed in embankments. Approval of embankment material is contingent on the material meeting the Atterberg Limit and gradation requirements specified in the Contract. Approval of the embankment material in the upper 2 feet of embankment below the subgrade elevation is contingent on the material meeting one of the following as specified in the Contract:

(1) The specified resistance value when tested by the Hveem Stabilometer or the equivalent resilient modulus.

(2) The specified Atterberg Limit and gradation requirements.

(3) The specified resistance value when tested by the Hveem Stabilometer or equivalent resilient modulus, and the specified Atterberg Limit and gradation requirements.

Embankment material shall be classified into one of the material groups listed below, and placed and compacted in accordance with the appropriate methods specified in subsection 203.07. If any material does not meet the criteria for one of the following classifications, it shall be processed on site to meet the requirements for one of the material groups listed below, or disposed of at the Contractor's expense.

(1) Soil Embankment: Soil embankment shall have all particle sizes less than 6 inches. The material shall be classified in accordance with AASHTO M 145 and placed and compacted in accordance with subsection 203.07(a).

(2) Rock Embankment: Not Used

(3) Rock Fill: Not Used

Non-durable bedrock shall be identified and classified using Colorado Procedure CP-L 3104. Any material classified as Soil-like Non-durable (S-N) as defined in the procedure shall be pulverized, broken down and processed to 6-inch maximum particle sizes before incorporation into embankment fill. These materials shall be placed and compacted as "soil embankment" in accordance with subsection 203.07(a). Non-durable bedrock particles in excess of 6 inches shall not be placed into embankment fill.

If recycled concrete or asphalt are to be incorporated into embankment fill, the maximum dimension permitted for concrete is 24 inches and the maximum dimension permitted for asphalt is 12 inches. Embankment material imported onto the project will be tested for water soluble sulfates using CP-L 2103 Method B. The average of three consecutive tests shall show that the sulfate content is not greater than that corresponding to the sulfate exposure level specified in the Contract. No single test shall have a sulfate content more than 20 percent greater than that corresponding to the sulfate exposure level specified in the Contract.

Embankment represented by failing tests shall be removed from the project and replaced at the Contractor's expense.

Imported material used for backfilling pipes (storm sewer, cross culverts, side drains, etc.) shall be tested for compatibility with the selected pipe material. When non-reinforced concrete pipe or reinforced concrete pipe is used, the imported material shall be tested for sulfate and pH. When corrugated steel pipe, bituminous-coated corrugated steel pipe or pre-coated corrugated steel pipe is used, the imported material shall be tested for sulfates, chlorides, pH and resistivity. When aramid fiber bonded corrugated steel pipe or corrugated aluminum pipe is used, the imported material shall be tested for pH and resistivity. When plastic pipe is selected, the imported material does not need to be tested for sulfates, chlorides, pH or resistivity.

Sulfates, chlorides, pH and resistivity shall be determined by the following procedures:

(1) Water soluble sulfates using CP-L 2103 Method B

(2) Chlorides using CPL 2104

(3) Resistivity using ASTM G57

(4) pH using ASTM G51

The average of three consecutive tests shall show the imported material's sulfate, chloride, pH and resistivity is not greater than the limits corresponding to the Pipe Class in Table 203-1 or 203-2 for the pipe class specified in the Contract. No single test shall have a result more than 20 percent greater than that corresponding to the limit in Table 203-1 or Table 203-2 for sulfates, chlorides and resistivity. No single test shall have a result more than 5 percent outside the limit in Table 203-1 for pH.

Embankment represented by failing tests shall be removed from the project and replaced at the Contractor's expense.

Table 203-1

SULFATE, CHLORIDE AND PH OF IMPORTED MATERIAL SOIL

Pipe Class	Sulfate (SO4) % max	Chloride (Cl) % max	pH
0 , 7	0.05	0.05	6.0-8.5
1, 7	0.10	0.10	6.0-8.5
2, 8	0.20	0.20	6.0-8.5
3, 9	0.50	0.50	6.0-8.5
4, 9	1.00	1.00	5.0-9.0
5, 10	2.00	2.00	5.0-9.0
6, 10	>2.00	>2.00	<5 or >9

Table 203-2

RESISTIVITY AND PH OF IMPORTED MATERIAL

SOIL SIDE	
Resistivity, R (Ohm – cm)	pH
≥ 1500	5.0-9.0
≥ 250	3.0-12.0

CONSTRUCTION REQUIREMENTS

203.04 General. The excavations and embankments shall be finished to smooth and uniform surfaces conforming to the typical sections specified. Variation from the subgrade plan elevations specified shall not be more than 0.08 foot. Where asphalt or concrete surfacing materials are to be placed directly on the subgrade, the subgrade plane shall not vary more than 0.04 foot. Materials shall not be wasted without written permission of the Engineer. Excavation operations shall be conducted so material outside of the slope limits will not be disturbed. Prior to beginning grading operations, all necessary clearing and grubbing in that area shall have been performed in accordance with Section 201.

The Contractor shall notify the Engineer at least five work days prior to beginning excavation. The Contractor shall not excavate beyond the dimensions and elevations shown in the Contract.

Archaeological and paleontological materials encountered during the work the Contractor shall immediately notify the Engineer, or other appropriate agency for contractor source pits or quarries, of the discovery of these materials.

All excavation activities in areas where asbestos is encountered or expected to be encountered shall conform to the Colorado Department of Public Health and Environment's Asbestos-Contaminated Soil Guidance Document or the State of Colorado's Asbestos Contaminated Soil Statewide Management Plan

(ACS), whichever is more recent at the time of advertisement and in accordance with the Air Quality Control Commission Regulation No. 8 Part B or Section 5.5 of the solid Waste Regulation 6 CCR 1007-2, as applicable.

203.05 Excavation shall be one or more of the following:

(a) Rock. Unless otherwise specified, rock shall be excavated to a minimum depth of 0.5 foot and a maximum depth of 1 foot below subgrade, within the limits of the roadbed. Rock removed in excess of 1 foot below subgrade will not be paid for. Backfilling of the depth in excess of 1 foot below subgrade shall be at the Contractor's expense. Approved embankment material shall be used to bring the rock-excavated areas to subgrade elevations within the tolerances specified in subsection 203.04.

Undrained pockets shall not be left in the rock surface and depressions shall be drained at the Contractor's expense.

(b) Unclassified. Excess or unsuitable excavated material, including rock and boulders, that cannot be used in embankments may be placed on the side slopes of the nearest fill if approved. Unless otherwise specified by the Engineer, intercepting ditches shall be made above the top of cut slopes and carried to outlets near the ends of the cuts. In order to blend the intersection of cut slopes with the slope of the adjacent natural ground surfaces in a uniform manner, the tops of all cut slopes, except those in solid rock, shall be flattened and rounded in accordance with typical sections and details specified. Earth overburden lying above solid rock cuts shall be treated in the same manner as earth cuts. The Engineer reserves the right to change cut slopes during the progress of excavation.

(c) Unsuitable Material. Unsuitable materials encountered in the subgrade, roadway, or embankment foundation that are determined to be detrimental to the roadway or embankment shall be removed to the depth and extents directed by the Engineer. The excavated area shall be backfilled to the finished graded section with approved material. Materials that contain organics or that cannot be dried or moisture conditioned, then compacted to the required density shall be disposed of and shall not be reused as embankment fill. Materials that do not contain organics and that can be dried or moisture conditioned and compacted to the required density may be reused as embankment fill as approved by the Engineer.

(d) Borrow. If the Contractor places more borrow than is specified or approved and causes a waste of roadway excavation, the quantity of waste will be deducted from the borrow volume. All borrow areas shall be bladed and shaped to permit accurate measurements after excavation is completed. The finished borrow areas shall be graded to a smooth and uniform surface and shall be finished so water will not collect or stand therein, unless otherwise specified.

(e) Stripping. Overburden shall be removed to the depth required for the production of acceptable material, and at least 5 feet beyond area being excavated.

(f) Potholing. All necessary potholing as determined by the Contractor and agreed to by the Engineer shall be completed under this item with appropriate equipment as approved.

The Contractor shall acquire necessary permits, locate utilities, excavate all materials of whatever character required to expose the utilities, survey the location of the utilities, and backfill the excavation to existing grade lines with the excavated or other approved materials.

The Contractor shall use extreme caution during this work. All damage to existing utility lines or adjacent facilities shall be repaired promptly at the Contractor's expense.

203.06 General Embankment Construction Requirements

Embankment construction shall include preparation of the areas upon which embankments are to be placed, construction of dikes, and placing and compacting approved material within roadway areas including holes, pits, and other depressions within the roadway area. Only approved materials shall be

used in the construction of embankments and fills.

All sod, vegetable and other organic matter, stumps, and roots shall be removed from the surface upon which the embankment is to be placed in accordance with Section 201. Unless a thickness is otherwise specified in the Contract, the upper 4 inches of the ground surface will be considered top soil and shall be removed in accordance with Section 207 prior to placement of embankment fill.

The cleared surface shall be completely broken up by plowing or scarifying to a minimum depth of 6 inches or as specified in the Contract, the moisture content increased or reduced as necessary, and compacted to the specified embankment density for the material type present.

When embankment is placed on a slope that is steeper than 4H:1V, as measured in the steepest direction, the existing slope shall be benched as the embankment is placed in layers. A 2-foot deep key shall be excavated at the base of the existing slope and backfilled with approved and compacted material. The embankment shall be placed in layers from that key. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous bench. Excavated material from benching may be placed and compacted with the embankment material at the Contractor's expense.

During the course of construction, embankment side slopes shall be built a minimum of 12 inches wider than the final grade indicated in the Contract to allow for compaction equipment to compact the full width of the embankment. Once the specified level of compaction is achieved, the side slopes shall be trimmed back to final grade. Excess material placement and removal to satisfy this requirement shall be at the Contractor's expense.

If embankment can be placed on only one side of structures such as retaining walls, abutments, wing walls, piers, or culvert headwalls, compaction shall be accomplished without initiating movement or deformation of the structure and without placing excessive pressure against the structure. When embankment is placed on both sides of a concrete wall or box type structure, the embankment shall be brought up equally on both sides of the structure.

Where embankment is to be placed and compacted and end dumping is used, the slopes of the original ground or embankment shall be deeply plowed or scarified before starting end dumping.

Embankment fill other than A-1 soil types shall not be placed within standing water, unless otherwise noted in the Contract. During the construction of the embankment, the top surface shall be maintained so that it is well drained at all times.

Frozen materials shall not be used in construction of embankments. Frozen material will be identified by the visual observation of ice crystals within the foundation or embankment material, or by measuring the temperature of the ground surface.

203.07 Embankment Placement and Compaction Requirements Materials incorporated into embankment fill shall be placed and compacted according to the following requirements:

(a) Soil Embankment. All soil embankment shall be placed in horizontal layers not to exceed 8 inches in loose lift thickness. Each layer shall be compacted prior to the placement of subsequent layers. Spreading equipment shall be used to obtain uniform thickness prior to compaction. As the compaction progresses, continuous mixing, leveling, and manipulating shall be done to assure uniform moisture and density. Additional work involved in drying soil embankment to the required moisture content shall be included in the contract price paid for excavating or furnishing the material with no additional compensation.

Soil embankment that is classified as A-1 material may be used to bridge across standing water or swampy ground within the embankment foundation, and may be placed in lift thicknesses greater than 8 inches when used for this purpose if approved by the Engineer. Soil embankment with less than or equal to 30 percent retained on the 3/4-inch sieve shall be tested for compaction using CP 80. Materials classified as AASHTO A-1, A-2-4, A-2-5, and A-3 soils shall be compacted at plus or

minus 2 percent and to at least 95 percent of maximum dry density determined in accordance with AASHTO T 180 as modified by CP 23. All other soil types shall be compacted to 95 percent of the maximum dry density determined in accordance with AASHTO T 99 as modified by CP 23. Soils with 35 percent fines or less shall be compacted at plus or minus 2 percent of OMC. Soils with greater than 35 percent fines shall be compacted at a moisture content equal to or above OMC to achieve stability of the compacted lift. Stability is defined as the absence of rutting or pumping as observed and documented by the Engineer. If the soils cannot be compacted and prove to be unstable at a moisture content equal to or above OMC, then the required moisture content for compaction may be reduced below OMC if approved by the Engineer.

Prior to placing any soil embankment with greater than 30 percent retained on the 3/4-inch sieve, the Contractor shall construct a test strip to the dimensions specified in the Contract or as directed by the Engineer. The test strip may be incorporated into the final embankment. The Contractor shall determine the moisture conditioning necessary to achieve compaction, and shall determine the equipment and number of passes necessary to achieve adequate compaction. The Contractor shall use compression-type or vibratory rollers on granular materials and sheepsfoot rollers on cohesive soils. Adequate compaction shall be demonstrated by the absence of rutting, pumping, or deflection following a proof roll of the test strip using any piece of construction equipment that exerts a minimum 18-kip per axle load. The proof roll will be observed and accepted by the Engineer. Once the test strip passes a proof roll, the Contractor may resume embankment construction using the same moisture conditioning and compaction methods that were used to construct the test strip.

Placement, moisture conditioning, and compaction of every lift of soil embankment with greater than 30 percent retained on the 3/4-inch sieve shall be observed by the Contractor's Process Control Representative, and accepted by the Engineer. Adequate compaction of each lift shall be demonstrated as the absence of rutting, pumping, or deflection as construction equipment is routed over a lift following the compactive efforts that were used and accepted for the respective test strip. The Engineer may request a proof roll at any time to document the condition of a lift.

Significant changes in the material being hauled for soil embankment with greater than 30 percent retained on the 3/4- inch sieve will require construction of a new test strip, and demonstration of adequate compaction methods using a proof roll.

Non-durable bedrock shall be watered to promote slaking and break down, and pulverized or processed to a maximum particle size of 6 inches. These materials shall be placed and compacted as soil embankment, except they shall be compacted with a heavy tamping foot roller weighing at least 30 tons. Each tamping foot shall protrude from the drum a minimum of 4 inches. Each embankment layer shall receive a minimum of four passes with the tamping foot roller.

The roller shall be operated at a uniform speed not exceeding 3 miles per hour. No additional compensation will be made for additional roller passes to achieve specified density requirements.

Non-durable Bedrock shall not be used to bridge over standing water or swampy ground within an embankment foundation. Non-durable bedrock shall also not be placed within 2 feet of the final subgrade elevation.

(b) Rock Embankment and Rock Fill. Not Used

(c) Asphalt Millings. Placement and compaction of asphalt millings shall conform to section 203.07a.

203.08 Proof Rolling Proof rolling with pneumatic tire equipment shall be performed using a minimum axle load of 18 kips per axle. A weigh ticket from an approved scale shall be furnished by the Contractor to substantiate this weight.

The subgrade shall be proof rolled after the required compaction has been obtained and the subgrade has been shaped to the required cross section. The proof roller shall be operated in a systematic manner so

that a record may be readily kept of the area tested and the working time required for the testing. Areas that are observed to have soft spots in the subgrade, where deflection is not uniform or is excessive as determined by the Engineer, shall be ripped, scarified, dried or wetted as necessary, and recompacted to the requirements for density and moisture at the Contractor's expense. After re-compaction, these areas shall be proof rolled again and all failures again corrected at the Contractor's expense.

Upon approval of the proof rolling, the subbase, base course, or initial pavement course shall be placed within 48 hours. If the Contractor fails to place the subbase, base course, or initial pavement course within 48 hours or the condition of the subgrade changes due to weather or other conditions, proof rolling and correction shall be performed again at the Contractor's expense.

203.09 Blading shall consist of furnishing motor graders of the specified horsepower rating, with operators, for shaping roadway, shoulders, or other areas as designated by the Engineer.

When scarifying is specified, the motor grader shall be equipped with an independently operated "V" type scarifier and attachments.

203.10 Dozing shall consist of furnishing crawler-type tractors of the specified horsepower rating, complete with operators and bulldozer blades. Rippers, if specified, will not be measured and paid for separately, but shall be included in the work.

METHOD OF MEASUREMENT

203.11 Items paid for by volume will be the quantities designated in the Contract. Exceptions will be made when field changes are ordered or when it is determined that there are discrepancies in the Contract in an amount of at least plus or minus twenty five (25) percent of the plan quantity.

(a) Excavation. The original cross-sections will be used for determination of volumes of excavated material removed, unless changes have been directed. These measurements will include authorized excavation of rock, shale, or other unsuitable material. All accepted stripping will be measured in stockpiled locations by cross-sectioning.

When the excavation conforms to the staked lines and grades, the original cross-sections and the staked sections shall be used for the determination of volumes excavated. Volumes will be computed from the cross-sections by the average end area or other acceptable method.

When topsoil or wetland topsoil is included as a separate pay item and is specified, the measured volume of excavation will be reduced by the volume of topsoil or wetland topsoil removed from the area shown as excavation in the Contract.

Measurements will include over-breakage in rock excavation from the back slopes to an amount not to exceed, in any half station of 50 feet, 10 percent of the actual quantity required for that half station.

(b) Embankment. If provided in the Contract, embankment material will be measured in its final compacted position in the roadway. Measurement will be made upward from the original ground line without any allowance for subsidence due to compaction of the base under the embankment. The original cross-sections will be used for determination of volumes of embankment material placed, unless changes have been directed.

The measured volume of embankment material will be increased by the volume of topsoil or wetland topsoil removed from the area below the original ground line and under the embankment.

(c) Blading and Dozing. Blading and dozing will not be measured and paid for separately but shall be included in the work.

(d) Potholing. Potholing will not be measured and paid for separately but shall be included in the work.

(e) Proof Rolling. Proof rolling will not be measured and paid for separately but shall be included in the work.

(f) Asphalt Millings. The quantity of compacted millings in place to be paid for shall be the number of cubic yards measured in place.

BASIS OF PAYMENT

203.12. The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Unclassified Excavation	Cubic Yard
Unsuitable Materials	Cubic Yard
Borrow	Cubic Yard
Asphalt Millings Surface Course	Cubic Yard

Water will not be measured and paid for separately but shall be included in the work.

Compaction will not be measured and paid for separately but shall be included in the work.

Payment for replacement of unsuitable material shall be as follows: If excavated material can be re-used as embankment fill by moisture conditioning and compaction, replacement shall be included in the cost for Unsuitable Material. If the material cannot be re-used as embankment fill, payment for replacement of unsuitable material shall be for the volume that is placed in the excavated area at the respective unit price for the material that is approved by the Engineer and used.

Reducing the size of the claystone particles, removing the oversized particles, and disposal of the oversized particles will not be measured and paid for separately but shall be included in the work.

Ripping tests or seismic tests used to evaluate whether a material meets the criteria for Rock Excavation will not be measured and paid for separately, but shall be included in the work.

Pneumatic tire equipment and load required to achieve the desired weight of proof rolling equipment will not be measured and paid for separately, but shall be included in the work.

Asphalt Millings payment shall be made at the contract unit price per cubic yard. This price shall be full compensation for furnishing all hauling, stockpiling, materials, labor, equipment, tools, and incidentals necessary to place and compact the material to a complete and neat edge.

END OF SECTION

SECTION 206 EXCAVATION AND BACKFILL FOR STRUCTURES

DESCRIPTION

206.01 This work consists of the excavation, and backfill or disposal of all material required for the construction of structures.

The excavation and disposal of excavated material for ditches and channels shall be accomplished in accordance with Section 203.

All excavation and backfill for structures below the designed slope or subgrade line provided in the Contract shall be included under this item.

Unless otherwise specified, structure excavation shall include all pumping, bailing, draining, and incidentals required for proper execution of the work.

MATERIALS

206.02 General. All structure backfill, bed course material, and filter material will be accepted in place.

(a) *Structure Backfill.*

1. Structure Backfill (Class 1), (Class 2), and (Class 3). Class 1, Class 2, and Class 3 structure backfill shall be composed of non-organic mineral aggregates and soil from excavations, borrow pits, or other sources. Material shall conform to the requirements of subsection 703.08. Class of material shall be as specified in the Contract or as designated.

   Imported material used as structure backfill for pipes (storm sewer, cross culverts, side drains, etc.) shall meet the requirements of the Class specified and the requirements of subsection 206.02(a)3.

   The Contractor may substitute Structure Backfill (Flow-Fill) conforming to subsection 206.02(a)2 for Structure Backfill (Class 1) or Structure Backfill (Class 2) to backfill culverts and sewer pipes.

   The Contractor may also substitute Structure Backfill (Class 3) as backfill for culverts and sewer pipes.

2. Structure Backfill (Flow-Fill). Flow-Fill shall be a self-leveling low strength concrete material composed of cement, fly ash, aggregates, water, chemical admixtures and/or cellular foam for air-entrainment. Flow-fill shall have a slump of 7 to 10 inches, when tested in accordance with ASTM C143 or a minimum flow consistency of 6 inches when tested in accordance with ASTM D6103. Flow-Fill shall have a minimum compressive strength of 50 psi at 28 days when tested in accordance with ASTM D4832. Flash fill is a rapid setting Flow-Fill that may be used when approved by the Engineer and will be tested, accepted, and paid for as Flow-Fill.

   Flow-Fill placed in areas that require future excavation, such as utility backfill shall have a Removability Modulus (RM) of 1.5 or less.

   Removability Modulus, RM, is calculated as follows:

   $$RM = \frac{W^{1.5} \times 104 \times C^{0.5}}{10^6}$$

   where: W = unit weight (pcf)

   C = 28-day compressive strength (psi)

   Materials for Structure Backfill (Flow-Fill) shall meet the requirements specified in the following subsections:

Fine Aggregate[1, 4]	703.01
Coarse Aggregate[2, 4]	703.02
Portland Cement	701.01
Fly Ash[3, 4]	701.02
Water	712.01
Air-Entraining Admixture	711.02
Chemical Admixtures	711.03

[1]Fine aggregate not meeting the requirements of subsection 703.01 may be used if testing indicates acceptable results for strength and air content.

[2]Coarse aggregate not meeting the requirements of subsection 703.02 may be used if testing indicates acceptable results for strength and air content.

[3]Fly ash not meeting the requirements of subsection 701.02 may be used if testing indicates acceptable results for strength and air content.

[4]For industrial by-product aggregates (foundry sand, bottom ash, etc..) and fly ash not meeting the requirements of subsection 701.02 the Contractor shall submit a report from the supplier documenting the results of testing in accordance with the Toxicity Characteristic Leaching Procedure (TCLP) described in 40 CFR 261. The report shall include the results of TCLP testing for heavy metals and other contaminants. Materials shall not exceed the TCLP limits of 40 CFR 261.24 for heavy metals.

Cellular foam shall conform to ASTM C869 and ASTM C796.

Recycled broken glass (glass cullet) is acceptable as part or all of the aggregate. Aggregate including glass must conform to the required gradations. All containers used to produce the cullet shall be empty prior to processing. Chemical, pharmaceutical, insecticide, pesticide, or other glass containers containing or having contained toxic or hazardous substances shall not be allowed and shall be grounds for rejecting the glass cullet. The maximum debris level in the cullet shall be 10 percent. Debris is defined as any deleterious material which impacts the performance of the Structure Backfill (Flow-Fill) including all non-glass constituents.

The Contractor may use aggregate which does not meet the above specifications if the aggregate conforms to the following gradation:

Sieve Size	**Percent Passing**
25.0 mm (1 inch)	100
75 µm (No. 200)	0-10[1]

[1]The amount of material passing the 75 µm (No. 200) screen may exceed 10 percent if testing indicates acceptable results for strength and air content.

The Contractor shall submit a Structure Backfill (Flow-Fill) mix design for approval prior to placement. The mix design shall include the following laboratory test data:

(1) ASTM C231, Air Content.

(2) ASTM D6023, Unit Weight.

(3) ASTM C143, Slump or ASTM D6103 flow consistency.

(4) ASTM D4832 28-day Compressive Strength.

(5) Removability Modulus (RM).

The Contractor shall submit a Process Control (PC) Plan with the mix design to the Engineer. The PC Plan shall address the batching, mixing, testing, and placement of the Structure Backfill (Flow-Fill).

3. Imported Structure Backfill for Pipes. Imported Material used as structure backfill for pipes (storm sewer, cross culverts, side drains, etc.) shall be tested for compatibility with the selected pipe material.

   When reinforced concrete pipe is used, the imported material shall be tested for sulfate and pH.

   When plastic pipe is selected, the imported material does not need to be tested for sulfates, chlorides, pH and resistivity.

   Sulfates, chlorides, pH and resistivity shall be determined by the following procedures:

   (1) Water soluble sulfates using CP-L 2103 Method B.

   (2) Chlorides using CPL 2104.

   (3) Resistivity using ASTM G57.

   (4) pH using ASTM G51.

   The average of three consecutive tests shall show the imported material's sulfate, chloride, pH and resistivity is not greater than the limits corresponding to the Pipe Class in Table 206-1 or 206-2 for the pipe class specified on the plans.

   No single test shall have a result more than 20 percent greater than that corresponding to the limit in Table 206-1 or Table 206-2 for sulfates, chlorides and resistivity. No single test shall have a result more than 5 percent outside the limit in Table 206-1 for pH.

   Structure backfill represented by failing tests shall be removed from the project and replaced at the Contractor's expense.

Table 206-1

SULFATE, CHLORIDE AND pH OF IMPORTED MATERIAL

	SOIL		
Pipe Class	Sulfate (SO4) % max	Chloride (Cl) % max	pH
0 , 7	0.05	0.05	6.0-8.5
1, 7	0.10	0.10	6.0-8.5
2, 8	0.20	0.20	6.0-8.5
3, 9	0.50	0.50	6.0-8.5
4, 9	1.00	1.00	5.0-9.0
5, 10	2.00	2.00	5.0-9.0
6, 10	>2.00	>2.00	<5 or >9

Table 206-2

RESISTIVITY AND pH OF IMPORTED MATERIAL

SOIL SIDE	
Resistivity, R (Ohm – cm)	pH
≥1500	5.0-9.0
≥250	3.0-12.0

(b) Bed Course Material. Material shall conform to the requirements of subsection 703.07. Upon approval, aggregate base course conforming to the requirements of subsection 703.03 may be used in lieu of bed course material.

(c) Filter Material. Class A, Class B, and Class C Filter Material shall conform to the requirements of subsection 703.09. Class of material shall be as specified or designated.

CONSTRUCTION REQUIREMENTS

206.03 Structure Excavation and Structure Backfill. Unsuitable foundation material shall be removed and wasted in a manner acceptable to the Engineer, and the excavated material will be paid for as structure excavation. Unsuitable foundation material which is suitable for embankments and suitable surplus excavated material shall be used in the construction of embankments. Unsuitable material removed below designed elevation shall be replaced with approved material.

If asbestos containing material (ACM) is suspected or found, the ACM and the suspected ACM shall be managed in accordance with the Air Quality Control Commission Regulation No. 8 Part B or Section 5.5 of the solid Waste Regulation 6 CCR 1007-2, which ever applies. All work conducted on site shall be in accordance with the Colorado Department of Public Health and Environment's Asbestos-Contaminated Soil Guidance Document or the State of Colorado's Asbestos Contaminated Soil Statewide Management Plan (ACS), whichever is more recent at the time of advertisement, and in accordance with subsection 250.07(d).

Rock, hardpan, or other unyielding material encountered in trenches for culvert pipe or conduit shall be removed below the designed grade for a minimum depth of 12 inches. This extra depth excavation shall be backfilled with loose Structure Backfill (Class 1) or other approved material. The base of structure backfill shall be scarified to a depth of 6 inches and compacted with moisture and density control prior to placement of any structural element or structure backfill. The type of compaction shall be the same as that required for Structure Backfill (Class 2), as specified below.

Backfill shall consist of approved materials uniformly distributed in layers brought up equally on all sides of the structure. Each layer of backfill shall not exceed 6 inches and shall be compacted to the required density before successive layers are placed.

Structure Backfill (Class 1) shall be compacted to a density of at least 95 percent of maximum dry density determined in accordance with AASHTO T 180 as modified by CP 23. Backfill shall be compacted at plus or minus 2 percent of Optimum Moisture Content (OMC).

Structure Backfill (Class 2) shall be compacted to a density of at least 95 percent of maximum dry density. The maximum dry density and OMC for A-1, A-2-4. A-2-5 and A-3 materials will be determined in accordance with AASHTO T 180 as modified by CP 23. The maximum dry density and OMC for all other materials will be determined in accordance with AASHTO T 99 as modified by CP 23. Materials shall be compacted at plus or minus 2 percent of Optimum Moisture Content (OMC). Materials having greater than 35 percent passing the 75 μm (No. 200) sieve shall be compacted at 0 to 3 percent above OMC.

Pipes, culverts, sewers, and other miscellaneous structures outside the roadway prism and not subjected to traffic loads shall be backfilled in layers as described above but shall be compacted to the density of the surrounding earth.

The excessive use of water during backfilling operations will not be permitted.

Compaction equipment or methods that produce horizontal or vertical earth pressures, which may cause excessive displacement or overturning, or may damage structures, shall not be used.

Backfill material shall not be deposited against newly constructed masonry or concrete structures, until the concrete has developed a compressive strength of 0.8f'c, except in cases where the structures support lateral earth pressure. Concrete compressive strength for structures supporting lateral earth pressure shall conform to subsection 601.12(o). Concrete compressive strength shall be determined by maturity meters.

Unless otherwise indicated in the Contract or directed, all sheeting and bracing used in making structure excavation shall be removed by the Contractor prior to backfilling.

Structure Backfill (Flow-Fill) shall not be compacted.

The maximum layer thickness for Structure Backfill (Flow-Fill) shall be 3 feet unless otherwise approved by the Engineer. The Contractor shall not place Structure Backfill (Flow-Fill) in layers that are so thick that they cause damage to culverts, pipes, and other structures or that they cause formwork or soil failures during placement. Structure Backfill (Flow-Fill) shall have an indention diameter less than 3 inches and the indention shall be free of visible water when tested in accordance with ASTM D6024 by the Contractor prior to placing additional layers of Structure Backfill (Flow-Fill). Testing Structure Backfill (Flow-Fill) in accordance with ASTM D6024 will be witnessed by the Engineer. Damage resulting from placing Structure Backfill (FlowFill) in layers that are too thick or from not allowing sufficient time between placements of layers shall be repaired at the Contractor's expense.

The Contractor shall secure culverts, pipes and other structures to prevent floating and displacement of these items during the placement of the Structure Backfill (Flow-Fill).

Prior to the placement of structure backfill (Flow-Fill), the Contractor shall sample the structure backfill (Flow-Fill) in accordance with ASTM D5971. The Contractor shall test the structure backfill (Flow-Fill) unit weight in accordance with ASTM D6023. The Contractor shall test the structure backfill (Flow-Fill) for slump in accordance with ASTM C143 or flow consistency according to ASTM D6103.

The Contractor shall sample and test the first three loads of Structure Backfill (Flow-Fill) for each placement and then randomly once every 50 cubic yards. Sampling and testing will be witnessed by the Engineer.

When Structure Backfill (Flow-Fill) is placed in areas that require future excavation, the unit weight of the placed Structure Backfill (Flow-Fill) shall not exceed the unit weight of the approved mix design by more than 2.0 pounds per cubic foot.

Structure Backfill (Flow-Fill) shall not be allowed to freeze during placement and until it has set sufficiently according to ASTM D6024. Frozen Structure Backfill (Flow-Fill) shall be removed and replaced at the Contractor's expense.

When the Contractor substitutes Structure Backfill (Flow-Fill) for Structure Backfill (Class 1) or (Class 2), the trench width may be reduced to provide a minimum 6-inch clearance between the outside diameter of the culvert and the trench wall.

206.04 Bed Course Material Not Used.

206.05 Filter Material Not Used.

METHOD OF MEASUREMENT

206.06 Structure excavation, structure backfill, and bed course material will not be measured but shall be included in the work

Compaction, water, and all other work necessary to complete the above items will not be measured and paid for separately but shall be included in the work.

END OF SECTION

SECTION 207 TOPSOIL

DESCRIPTION

207.01 This work consists of salvaging and stockpiling topsoil, and excavating suitable topsoil from stockpiles, contractor sources, available sources, or from the approved natural ground cover to place on designated areas. Placing of topsoil upon constructed cut and fill slopes after grading operations are completed is included.

MATERIALS

207.02 Topsoil shall consist of loose friable soil from the zone of major root development free of subsoil, refuse, stumps, woody roots, rocks, brush, noxious weed seed and reproductive plant parts from current state and county weed lists, heavy clay, hard clods, toxic substances, or other material which would be detrimental to its use on the project.

CONSTRUCTION REQUIREMENTS

207.03 Topsoil within the limits of the project site shall be salvaged prior to beginning hauling, excavating, or fill operations by excavating and stockpiling the material at designated locations in a manner that will facilitate measurement, minimize sediment damage, and not obstruct natural drainage. Topsoil shall be placed directly upon completed cut and fill slopes whenever conditions and the progress of construction will permit.

Topsoil shall be placed at locations and to the thickness provided in the Contract and shall be keyed and tracked to the underlying material without creating a compacted surface by the use of harrows, bulldozers, rollers, or other equipment suitable for the purpose.

Salvaged topsoil exceeding the quantity required under the Contract shall be disposed of at locations acceptable to the Engineer.

METHOD OF MEASUREMENT

207.04 Topsoil salvaged from the project site, taken from stockpiles or from approved pits, hauled and placed directly upon completed cut and fill slopes shall be measured at its source in cubic yards, as described in subsection 203.11, and paid for as Topsoil.

Topsoil secured from the Contractor's source will be measured in place by measuring random depths of topsoil, and computing the volume by multiplying the area times the average depth.

BASIS OF PAYMENT

207.05 The accepted quantities measured as provided above will be paid for at the contract unit price per cubic yard for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Topsoil	Cubic Yard

END OF SECTION

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SECTION 208 EROSION CONTROL

DESCRIPTION

208.01 This work consists of constructing, installing, maintaining, and removing when required, Best Management Practices (BMPs) during the life of the Contract to prevent or minimize erosion, sedimentation, and pollution of any State waters as defined in County and State permitting, including wetlands.

The Contractor shall coordinate the construction of temporary BMPs with the construction of permanent BMPs to assure economical, effective, and continuous erosion and sediment control throughout the construction period.

When a provision of Section 208 or an order by the Engineer requires that an action be immediate or taken immediately, it shall be understood that the Contractor shall at once begin effecting completion of the action and pursue it to completion in a manner acceptable to the Sponsor.

MATERIALS

208.02 Erosion control materials shall be submitted for review by the Engineer. Erosion control materials shall be subject to the following approval process:

Material	Approval Process	Notes:
Erosion Bales (Weed Free)	COC	The Contractor shall provide a transit certificate number, or a copy of the transit certificate as supplied from the producer.
Silt Fence	COC	
Silt Berm	APL	
Erosion Log (Type 1 and 2)	COC	
Silt Dikes	COC	
Pre-fabricated Concrete Washout Structures (above ground)	APL	
Pre-fabricated Vehicle Tracking Pad	APL	
Aggregate Bag	COC	
Storm Drain Inlet Protection (Type I, II, and III)	APL	
COC = Certificate of Compliance; APL= CDOT Approved Product List		

The material for BMPs shall conform to the following:

(a) Erosion Bales: Material for erosion bales shall consist of Certified Weed Free hay or straw. The hay or straw shall be certified under the Colorado Department of Agriculture Weed Free Forage Certification Program and inspected as regulated by the Weed Free Forage Act, Title 35, Article 27.5, CRS. Each certified weed free erosion bale shall be identified by blue and orange twine binding the bales.

The Contractor shall not place certified weed free erosion bales or remove their identifying twine until the Engineer has inspected them.

The Contractor may obtain a current list of Colorado Weed Free Forage Crop Producers who have

completed certification by contacting the Colorado Sponsor of Agriculture, Weed Free Forage Program, 305 Interlocken Pkwy, Broomfield, CO 80021, Contact: Weed Free Forage Coordinator at (303) 869-9038. Also available at www.colorado.gov/ag/csd.

Bales shall be approximately 5 cubic feet of material and weigh at least 35 pounds. Stakes shall be wood and shall be 2 inches by 2-inches nominal.

(b) Silt Fence. Silt fence posts shall be wood with a minimum length of 42 inches. Wood posts shall be 1.5-inch by 1.5-inch nominal. Geotextile shall be attached to wood posts with three or more staples per post.

Silt fence geotextile shall conform to the following requirements:

PHYSICAL REQUIREMENTS FOR SILT FENCE GEOTEXTILES

Property	Wire Fence Supported Requirements	Self-Supported Requirements Geotextile Elongation <50%	Test Method
Grab Strength, lbs	90 minimum	124 minimum	ASTM D4632
Permittivity sec-1	0.05	0.05	ASTM D4491
Ultraviolet Stability	Minimum 70% Strength Retained	Minimum 70% Strength Retained	ASTM D4355

Silt Fence (Reinforced). Silt fence posts shall be metal "studded tee" T-post with a minimum length of 66 inches. Metal posts shall be "studded tee" with 0.095-inch minimum wall thickness. Wire fabric reinforcement for the silt fence geotextile shall be a minimum of 14 gauge with a maximum mesh spacing of 6 inches. Geotextile shall be attached to welded wire fabric with ties or nylon cable ties at 12 inches on center at top, middle and bottom wire. Welded wire fabric shall be attached to the post with a minimum three 12-gauge wire ties per post. Vinyl or rubber safety caps shall be installed on all T-post.

(c) Temporary Berms. Temporary berms shall be constructed of compacted soil.

(d) Rock Check Dam. Rock Check dams shall be constructed of stone. Stone shall meet the requirements of Section 506.

(e) Sediment Trap. In constructing an excavated sediment trap, excavated soil may be used to construct the dam embankment, provided the soil meets the requirements of subsection 203.03. Outlet protection riprap shall be the size specified in the Contract and shall conform to Section 506. Erosion control geotextile shall be a minimum Class 1, conforming to subsection 712.08.

(f) Erosion Logs. Erosion logs shall be one of the following types unless otherwise shown on the plans:

(1) Erosion Log (Type 1) shall be curled aspen wood excelsior with a consistent width of fibers evenly distributed throughout the log. The casing shall be seamless, photo-degradable tube netting. The curled aspen wood excelsior shall be fungus free, resin free, and free of growth or germination inhibiting substances.

(2) Erosion Log (Type 2) shall consist of a blend of 30-40 percent weed free compost and 60-70 percent wood chips. The compost-wood blend material shall pass a 50 mm (2 inch) sieve with a minimum of 70 percent retained on the 9.5 mm (⅜ inch) sieve and comply with subsection 212.02 for the remaining compost physical properties. The compost-wood chip blend may be

pneumatically shot into a geotextile cylindrical bag or be pre-manufactured. The geotextile bag shall consist of HDPE or polypropylene mesh (knitted, not extruded) with openings of ⅛ to ⅜ inch and contain the compost- wood chip material while not limiting water infiltration.

Erosion log (Type 1 and Type 2) shall have minimum dimensions as shown in Table 208-1, based on the specified diameter of the log.

Table 208-1

DIMENSIONS OF EROSION LOGS

Diameter Type 1 (Inches)	Diameter Type 2 (Inches)	Length (feet)		Weight (minimum) (pounds/foot)	Stake Dimensions (Inches)
		Min.	Max.		
9	8	10	180	1.6	3/4 thickness by 3/4 width by 18 long
12	12	10	180	2.5	1.5 thickness by 1.25 width by 24 long
20	18	10	100	4.0	1.5 thickness by 1.5 width by 30 long

Stakes to secure erosion logs shall consist of pinewood or hardwood.

(g) Concrete Washout Structure. The Contractor shall construct a washout structure that will contain washout from concrete placement and construction equipment cleaning operations. Embankment required for the concrete washout structure may be excavated material, provided that this material meets the requirements of Section 203 for embankment.

A pre-fabricated concrete washout structure shall be used only when specified in the Contract. It shall consist of a watertight container designed to contain liquid and solid waste from concrete washout.

(h) Vehicle Tracking Pad. Aggregate for the vehicle tracking pad shall be crushed natural aggregate or crushed concrete with at least two fractured faces that meets the following gradation requirements:

Sieve Size	Percent by Weight Passing Square Mesh Sieves
75 mm (3 inch)	100
50 mm (2 inch)	0-25
19.0 mm (¾ inch)	0-15

Recycled crushed concrete or asphalt shall not be used for vehicle tracking pads.

Erosion control geotextile shall be a minimum Class 2, conforming to subsection 712.08.

(j) Aggregate Bag. Aggregate bags shall consist of crushed stone or recycled rubber filled fabric with the following properties:

Diameter (inches)	Weight (minimum) (pounds per foot)
6-8	6

10	10
12	15

Rubber used in bags shall be clean, 95 percent free of metal and particulates.

Crushed stone contained in the aggregate bags shall conform to subsection 703.09, Table 703-7 for Class C.

The aggregate bag shall consist of a woven geotextile fabric with the following properties:

Property	Requirement	Test Method
Grab Tensile Strength	90 lbs. min.	ASTM D4632
Trapezoid Tear Strength	25 lbs. min.	ASTM D4533
Mullen Burst	300 psi	ASTM D3786
Ultraviolet Resistance	70%	ASTM D4355

(k) Storm Drain Inlet Protection. Storm drain inlet protection shall consist of aggregate filled fabric with the following dimensions:

Storm Drain Inlet Protection Properties	Protection Types		
	[1]Type I	[2]Type II	[3]Type III
Diameter	4 in.	4 in.	N/A
Minimum Section Length	7 ft.	5 ft.	5 ft.
Apron Insert	---	30 in. or sized to grate	30 in or sized to grate

[1]Type I protection shall be used with Inlet Type R.
[2]Type II protection shall be used with Combination Inlet. Option A or B.
[3]Type III protection shall be used with Vane Grate Inlet only. Option A or B Note: Options A and B are shown on Standard Plan M-208-1.

The Storm Drain Inlet Protection (Type I, II and III) shall consist of a woven geotextile fabric with the following properties:

Property	Test Method	Unit	Requirement

Grab tensile strength	ASTM D4632	lbs.	minimum 350x280
Mullen Burst Strength	ASTM D3786	lbs.	400
Trapezoid Tear Strength	ASTM D4533	lbs.	minimum 60x60
Percent Open Area	COE-22125-86	%	≥ 20
Water Flow Rate	ASTM D4491	gal./min./ sq. ft.	≥ 100
Ultraviolet Resistance	ASTM D4355	%	≥ 70

Curb roll for Storm Drain Inlet Protection (Type I and II) shall have a weight >4 pounds per linear foot of device. The device shall be capable of conforming to the shape of the curb. Aggregate contained in the storm drain inlet device shall consist of gravel or crushed stone conforming Table 703-1 for Coarse Aggregate No. 6.

CONSTRUCTION REQUIREMENTS

208.03 Project Review, Schedule, and Erosion Control Management. Prior to construction, an on-site Environmental Preconstruction conference shall be held. The conference shall be attended by:

(1) The Engineer.

(2) The Superintendent.

(3) The Contractor's Stormwater Management Plan (SWMP) Administrator.

(4) Supervisors or Foremen of subcontractors working on the project.

At this Conference, the attendees shall discuss the SWMP, CDPS-SCP, sensitive habitats on-site, wetlands, other vegetation to be protected, and the enforcement mechanisms for not meeting the requirements of this specification.

Prior to beginning construction, the Contractor shall evaluate the project site for stormwater draining into or through the site. When such drainage is identified, control measures shall be used if possible to divert stormwater from running on-site and becoming contaminated with sediment or other pollutants. The diversion may be accomplished with a temporary pipe or other conveyance to prevent water contamination or contact with pollutants. Run-on water that cannot be diverted shall be treated as construction runoff and adequate control measures shall be employed.

The SWMP Administrator shall evaluate all non-stormwater coming onto the site, such as springs, seeps, and landscape irrigation return flow. If such flow is identified, control measures shall be used to protect off-site water from becoming contaminated with sediment or other pollutants.

The SWMP Administrator shall review existing inlets and culverts to determine if inlet protection is needed due to water flow patterns. Prior to beginning construction, inlets and culverts needing protection shall be protected and the location of the implemented control measure added to the SWMP Site Map.

Prior to construction, the Contractor shall implement appropriate control measures for protection of wetlands, sensitive habitat, and existing vegetation from ground disturbance and other pollutant sources, in accordance with the approved project schedule as described in subsection 208.03(b).

When additional control measures are required and approved by the Engineer, the Contractor shall implement the additional control measures and the SWMP Administrator shall record and describe them on the SWMP Site Map. The approved control measures will be measured and paid for in accordance with subsections 208.11 and 208.12.

(a) Project Review. The Contractor may submit modifications to the Contract's control measures in a

written proposal to the Engineer. The written proposal shall include the following information:

(1) Reasons for changing the control measures.

(2) Diagrams showing details and locations of all proposed changes.

(3) List of appropriate pay items indicating new and revised quantities.

(4) Schedules for accomplishing all erosion and sediment control work.

(5) Effects on permits or certifications caused by the proposed changes.

The Engineer will approve or reject the written proposal in writing within seven days after receipt of the submittal. The Engineer may require additional control measures prior to approving the proposed modifications. Additional modifications and additional control measures will be paid for at the Contract Unit Price for the specific items involved. If no items exist, they will be paid for as extra work.

(b) Erosion and Sediment Control Activities. The erosion and sediment control activities shall be included in the weekly meeting update. The project schedule shall specifically indicate the sequence of clearing and grubbing, earthwork operations, and construction of temporary and permanent erosion control features and stabilization. The project schedule shall include erosion and sediment control work for haul roads, borrow pits, storage and asphalt or concrete batch sites, and all areas within the project limits. If during construction the Contractor proposes changes which would affect the Contract's control measures, the Contractor shall propose revised control measures to the Engineer for approval in writing. If necessary, the SWMP Administrator shall update proposed sequencing of major activities in the SWMP. Revisions shall not be implemented until the proposed measures have been approved in writing by the Engineer.

(c) Erosion Control Management (ECM). Erosion Control Management for this project shall consist of SWMP Administration and Erosion Control Inspection. All ECM staff shall have working knowledge and experience in construction, and shall have successfully completed the Transportation Erosion Control Supervisory Certificate Training (TECS) as provided by CDOT. The Superintendent cannot serve in an ECM role. The Erosion Control Inspector (ECI) and the SWMP Administrator may be the same person in projects with not more than 40 acres of disturbed area.

1. SWMP Administration. The SWMP Administrator shall maintain the SWMP. Record the name of the SWMP Administrator on the SWMP Section 3.B. The SWMP Administrator shall have full responsibility to maintain and update the SWMP and identify to the Superintendent critical action items needed to conform to the CDPS-SCP as follows:

   (1) Complete the SWMP as described in subsection 208.03(d).

   (2) Participate in the Environmental Pre-construction Conference.

   (3) Attend weekly erosion and sediment control meetings.

   (4) Attend all water quality control inspections. The Contractor and the Contractor’s SWMP Administrator will be notified a minimum of five days in advance of each inspection by Engineer.

   (5) Coordinate with the Superintendent to implement necessary actions to reduce anticipated or presently existing water quality or erosion problems resulting from construction activities.

   (6) Coordinate with the Superintendent to ensure that all labor, material, and equipment needed to install, maintain, and remove control measures are available as needed.

   (7) During construction, update the SWMP Site Map to reflect current field conditions and include, at a minimum, the following:

(i) Limits of Construction (LOC).

(ii) Areas of disturbance (AD), including areas of borrow and fill.

(iii) Limits of Disturbance (LDA).

(iv) Areas used for storage of construction materials, equipment, soils, or wastes.

(v) Location of dedicated asphalt, concrete batch plants, and masonry mixing machines.

(vi) Location of construction offices and staging areas.

(vii) Location of work access routes during construction.

(viii) Location of waste accumulation areas, including areas for liquid, concrete, masonry, and asphalt.

(ix) Location of temporary, interim, and permanent stabilization.

(x) Location of outfalls.

(xi) Flow arrows that depict stormwater flow directions on-site and runoff direction.

(xii) Location of structural and non-structural control measures.

(xiii) Location of springs, streams, wetlands, and other State waters, including areas that require pre-existing vegetation be maintained within 50 horizontal feet of a receiving water, unless infeasible.

(xiv) Location of stream crossings located within the construction site boundary.

(8) The SWMP shall reflect the field conditions and shall be amended to reflect control measures, including the following:

(i) A change in design, construction, operation, or maintenance of the site which would require the implementation of new or revised control measures; or

(ii) Changes when the SWMP proves to be ineffective in achieving the general objectives of controlling pollutants in stormwater discharges associated with construction activity.

(iii) Changes when control measures are no longer necessary and are removed.

(9) Complete vegetative survey transects when required in accordance with CDOT Erosion Control and Stormwater Quality Guide.

(10) Start a new site map before the current one becomes illegible. All site maps shall remain as part of the SWMP.

(11) Document all inspection and maintenance activities. Keep the SWMP and documentation on the project site.

(12) When adding or revising control measures in the SWMP, add a narrative explaining what, when, where, why, and how the control measure is being used, and add a detail to the SWMP.

(i) How to install and inspect the control measure.

(ii) Where to install the control measure.

(iii) When to maintain the control measure.

(13) If using existing topography, vegetation, etc. as a control measure, label it as such on the SWMP Site Map; add a narrative as to when, where, why, and how the control measure is being used.

(14) Indicate control measures in use or not in use by recording them on Standard Plans M-208-1, M-216-1, and M-6151 in the SWMP.

(15) Record on the SWMP, the approved Method Statement for Containing Pollutant Byproducts.

(16) Update the potential pollutants list in the SWMP and Spill Response Plan throughout construction.

(17) Do not use vegetative buffers as a sole control measure. Use them only as the final stage of a treatment train.

2. Erosion Control Inspector.

One ECI is required for every 40 acres of total disturbed area which is currently receiving temporary and interim stabilization measures as defined in subsection 208.04(e). An ECI shall not be responsible for more than 40 acres in the project. Accepted permanent stabilization methods as defined in subsection 208.04(e) will not be included in the 40 acres.

(1) ECI duties shall be as follows:

(i) Coordinate with the SWMP Administrator on reporting the results of inspections and how to install and inspect the control measure.

(ii) Review the construction site for compliance with the Stormwater Construction Permit.

(iii) Inspect with the Superintendent and the Engineer (or their designated representatives) the stormwater management system at least every seven calendar days. Conduct post-storm event inspections within 24 hours after the end of any precipitation or snowmelt event that may cause surface erosion. If no construction activities will occur following a storm event, post-storm event inspections shall be conducted prior to commencing construction activities, but no later than 72 hours following the storm event. Document delay in inspections in the inspection report. Stormwater Field Inspection Report shall be prepared for all seven-day inspections and inspections following storm events. The Contractor shall notify the ECI when a storm event occurs.

Inspections are not required at sites when construction activities are temporarily halted, when snow cover exists over the entire site for an extended period and melting conditions do not pose a risk of surface erosion. This exception shall be applicable only during the period where melting conditions do not exist, and applies to the routine seven-day, as well as the post-storm event inspections. Document the following information on Inspection Report for use of this exclusion: dates when snow cover occurred, date when construction activities ceased, and date melting conditions began.

(2) The order of precedence for required inspections shall be as follows:

(i) Post-storm event inspections

(ii) Seven-day inspections

When one of the listed inspections is performed, the inspections listed below it need not be performed on that day if the required Sponsor and Contractor personnel participated in the inspection.

A seven-day inspection is not required on the same day Engineer's' inspections are conducted, as long as all of the inspection scope requirements for a seven-day and post-storm event inspection are met. A sheet shall be placed in the inspections area of the SWMP to refer to the date the inspection was performed.

(3) Seven-day inspections and post-storm inspections shall include inspection of the following

areas, if applicable, for evidence of, or the potential for, pollutants leaving the construction site boundaries, entering the stormwater drainage system, or discharging to State waters:

(i) Construction site perimeter

(ii) Disturbed areas

(iii) Designated haul routes

(iv) Material and waste storage areas exposed to precipitation

(v) Locations where stormwater has the potential to discharge offsite

(vi) Locations where vehicles exit the site

(4) Inspections shall include the following:

(i) Visually verify whether all implemented control measures are in effective operational condition and are working as designed in their specifications to minimize pollutant discharges.

(ii) Determine if there are new potential sources of pollutants.

(iii) Assess the adequacy of control measures at the site to identify areas requiring new or modified control measures to minimize pollutant discharges.

(iv) Identify all areas of non-compliance with the permit requirements and, if necessary, implement corrective action in accordance with the CDPS-SCP.

Follow all other agency Stormwater requirements and inspections unless a waiver or other agreement has been made.

(5) The Contractor shall report the following circumstances orally to the Engineer, CDPHE, the Contractor's Superintendent, and the SWMP Administrator within 24 hours from the time the permittee becomes aware of the circumstances, and shall mail to the Division a written report containing the information requested within five working days after becoming aware of the following circumstances:

(i) Noncompliance which may endanger health or the environment, regardless of the cause of the incident.

(ii) Unanticipated bypass which exceeds any effluent limitations in accordance with the CDPS-SCP.

(iii) Upset conditions which causes an exceedance of any effluent limitation in accordance with the CDPS-SCP.

(iv) Daily maximum violations for any of the pollutants limited by the permit. This includes any toxic pollutant or hazardous substance or any pollutant specifically identified as the method to control any toxic pollutant or hazardous substance.

(6) Document spills, leaks, or overflows that result in the discharge of pollutants on the Inspection Report. The ECI shall record the time and date, weather conditions, reasons for spill, and how it was remediated.

(d) Documentation Available on the Project. The following Contract documents and references will be made available for reference at the field office during construction:

1. SWMP. The Engineer will provide an approved SWMP design at the Pre-construction Conference, which is and shall remain the property of the Sponsor. Prior to construction, the Engineer will provide the documentation for items (1) through (4), and (18) as listed below, when

available. The Contractor shall provide the contents required for items (5) through (17). The SWMP shall be stored in the field office or at another on-site location approved by the Division. The SWMP Administrator shall modify and update the SWMP as needed to reflect actual site conditions prior to the change or as soon as practicable, but in no case more than 72 hours after the change. The following Contract documents and reports shall be kept, maintained, and updated in the SWMP under the appropriate items by the SWMP Administrator:

(1) SWMP Plan Sheets – Notes, tabulation, site description. The SWMP site description shall include, at a minimum, the following:

(i) The nature of the construction activity at the site.

(ii) The proposed schedule for the sequence for major construction activities and the planned implementation of control measures for each phase. (clearing, grading, utilities, vertical, etc.)

(iii) Estimates of the total acreage of the site, and the acreage expected to be disturbed by clearing, excavation, grading, or any other construction activities.

(iv) A summary of any existing data used in the development of the construction site plans or SWMP that describe the soil or existing potential for soil erosion.

(v) A description of the percent of existing vegetative ground cover relative to the entire site and the method for determining the percentage, in accordance with CDOT Erosion Control and Stormwater Quality Guide.

(vi) A description of any allowable non-stormwater discharges at the site, including those being discharged under a division low risk discharge guidance policy.

(vii) A description of areas receiving discharge from the site. Including a description of the immediate source receiving the discharge. If the stormwater discharge is to a municipal separate storm sewer system, the name of the entity owning the system, the location of the storm sewer discharge, and the ultimate receiving water(s).

(viii) A description of all stream crossings located within the construction site boundary.

(2) SWMP Site Maps and Project Plan Title Sheet.

(3) Specifications – Standard and project special provisions related to stormwater and erosion control.

(6) Weekly meeting sign-in sheet and weekly meeting notes.

(7) Calendar of Inspections – Calendar of inspections marking when all inspections take place.

(8) Contractor Stormwater Field Inspection Reports.

(9) All Water Quality Audit Reports and Forms relating to Water Quality.

(10) Description of Inspection and Maintenance Methods – Description of inspection and maintenance methods implemented at the site to maintain all control measures identified in the SWMP and items not addressed in the design.

(11) Spill Response Plan – Reports of reportable spills submitted to CDPHE.

(12) List and Evaluation of Potential Pollutants – List of potential pollutants and approved Method Statement for Containing Pollutant Byproducts.

(13) Other Correspondence including agreements with other MS4s, approved deferral request, CDPHE audit documentation, Water Quality Permit Transfer to Maintenance Punch List, and other miscellaneous documentation such as documented use agreements for areas outside of

the permitted area.

(14) TECS Certifications of the SWMP Administrator and all ECIs, kept current through the life of the project.

(15) Environmental Pre-construction Conference – Conference agenda with a certification of understanding of the terms and conditions of the CDPS-SCP and SWMP. All attendees shall sign the certification. A certification shall also be signed by all attendees of meetings held for new subcontractors beginning work on the project that could adversely affect water quality after the Environmental Pre-construction Conference has been held.

(16) Project Environmental Permits – All project environmental permits and associated applications and certifications, including: CDPS-SCP, Senate Bill 40, USACE 404, temporary stream crossings, dewatering, biological opinions, and all other permits applicable to the project, including any separate CDPS-SCP obtained by the Contractor for staging area on private property, asphalt or concrete batch plant, etc.

(17) Photographs Documenting Existing Vegetation – Project photographs shall include the following information with the record: project number, project code, name of the person who took the picture, date and time the picture was taken, and location and approximate station number or mile marker. The Contractor shall submit photographs documenting existing vegetation, prior to construction commencing, on paper with a maximum of four colored images per side of 8 1/2 inch by 11-inch sheet or a digital copy on CD-ROM/Flash Drive (JPG format) as directed by the Engineer.

(18) Permanent Water Quality Plan Sheets – Plan sheets and specifications for permanent water quality structures and riprap.

The Engineer will incorporate the documents and reports available at the time of award. The Contractor shall provide and insert all other documents and reports as they become available during construction. The SWMP Administrator shall finalize the SWMP for Sponsor maintenance use upon completion of the project. The Engineer shall approve SWMP completeness. Corrections to the SWMP shall be made at the Contractor's expense.

2. Reference Materials. The following Reference materials shall be used:

(1) CDOT Erosion Control and Stormwater Quality Guide.

(2) CDOT Erosion Control and Stormwater Quality Field Guide.

(e) Weekly Meetings: The Engineer, the Superintendent, and the SWMP Administrator shall conduct a weekly meeting with supervisors involved in construction activities that could adversely affect water quality. The meeting shall follow an agenda prepared by the Engineer, or a designated representative, and have a sign in sheet on which the names of all attendees shall be recorded. The SWMP Administrator shall take notes of water quality comments and action items at each weekly meeting, and place the agenda and sign in sheet in the SWMP. At this meeting the following shall be discussed and recorded in tab 6 of the SWMP:

(1) Recalcitrant, chronic, and severe inspection findings.

(2) Unresolved issues from previous inspections.

(3) Requirements of the SWMP.

(4) Problems that may have arisen in implementing the site specific SWMP or maintaining control measures.

(5) Control measures that are to be installed, removed, modified, or maintained, and associated SWMP modifications.

(6) Planned activities that will affect stormwater in order to proactively phase control measures.

All subcontractors not in attendance at the Environment Pre-construction Conference shall be briefed on the project by the Engineer, Superintendent, and the SWMP Administrator prior to start of work. The SWMP Administrator shall record the names of these subcontractors as an addendum to the list of attendees, and add it to the SWMP.

208.04 Control Measures for Stormwater. The SWMP Administrator shall modify the SWMP to clearly describe and locate all control measures implemented at the site to control potential sediment discharges.

Vehicle tracking pads shall be used at all vehicle and equipment exit points from the site to prevent sediment exiting the limits of construction (LOC) of the project site. Access shall be provided only at locations approved by the Engineer. The SWMP Administrator shall record vehicle tracking pad locations on the SWMP Site Map.

New inlets and culverts shall be protected during their construction. Appropriate protection of each culvert and inlet shall be installed immediately. When riprap is called for at the outlet of a culvert, it shall be installed within 24 hours of completion of each pipe. The Contractor shall remove sediment, millings, debris, and other pollutants from within the newly constructed drainage system in accordance with the CDPS-SCP, prior to use, at the Contractor's expense. All removed sediment shall be disposed of outside the project limits in accordance with all applicable regulations.

Concrete products wasted on the ground during construction including, but not limited to, excess concrete removed from forms, spills, slop, and all other unused concrete are potential pollutants that shall be removed from the site or contained at a preapproved containment area that has been identified in the SWMP. The concrete shall be picked up and recycled in accordance with 6 CCR 1007-2 (CDPHE Regulations Pertaining to Solid Waste Sites and Facilities) at regular intervals, as needed, or as directed by the Engineer. The uses of recycled concrete from permitted recycling facilities shall be in accordance with Section 203.

(a) Unforeseen Conditions. The Contractor shall design and implement erosion and sediment control measures for correcting conditions unforeseen during the design of the project, or for emergency situations, that develop during construction. CDOT's Erosion Control and Stormwater Quality Guide shall be used as a reference document for the purpose of designing erosion and sediment control measures. Measures and methods proposed by the Contractor shall be reviewed and approved in writing by the Engineer prior to installation.

(b) Other Agencies. If CDPHE, US Army Corps of Engineers (USACE), the Environmental Protection Agency (EPA), or a Local Agency reviews the project site and requires additional measures to prevent and control erosion, sediment, or pollutants, the Contractor shall cease and desist activities resulting in pollutant discharge and immediately implement these measures. If the work may negatively affect another MS4, the Contractor shall cease and desist activities resulting in the discharge and shall implement appropriate measures to protect the neighboring MS4, including installing additional measures. Implementation of these additional measures will be paid for at contract unit prices.

(c) Work Outside the Right of Way. Disturbed areas outside the right of way (ROW), including staging areas are the responsibility of the Contractor. These areas shall be subject to a separate CDPS-SCP and all other necessary permits, as they are considered a common plan of development if within a ¼ mile of the construction site. The Contractor shall acquire these permits and submit copies to the Engineer prior to any disturbance. These permits, shall be acquired and all erosion and sediment control work performed at the Contractor's expense. These areas are subject to inspections by the Sponsor, as agreed upon in writing. A documented use agreement between the permittee and the owner or operator of any control measures located outside of the permitted area that are utilized by

the permittee's construction site for compliance with the CDPS-SCP, but not under the direct control of the permittee shall be placed in the project's SWMP.

(d) Construction Implementation. The Contractor shall incorporate control measures into the project as outlined in the accepted schedule.

(e) Stabilization. Once earthwork has started, the Contractor shall maintain erosion control measures until permanent stabilization of the area has been completed and accepted. Clearing, grubbing and slope stabilization measures shall be performed regularly to ensure final stabilization. Failure to properly maintain erosion control and stabilization methods, either through improper phasing or sequencing will require the Contractor to repair or replace sections of earthwork at the Contractor's expense. The Contractor shall schedule and implement the following stabilization measures during the course of the project:

1. Temporary Stabilization. At the end of each day, the Contractor shall stabilize disturbed areas by surface roughening, vertical tracking, or a combination thereof. Disturbed areas are locations where actions have been taken to alter the existing vegetation or underlying soil of a site, such as clearing, grading, road bed preparation, soil compaction, and movement and stockpiling of sediment and materials. Designated topsoil distributed on the surface or in stockpiles shall not receive temporary stabilization. Other stabilization measures may be implemented, as approved. The maximum area of temporary stabilization (excluding areas of designated topsoil) shall not exceed 20 acres.
2. Interim Stabilization. As soon as it is known with reasonable certainty that work will be temporarily halted for 14 days or more, sediment and material stockpiles and disturbed areas shall be stabilized using one or more of the following methods:
   (1) Application of 1.5 tons per acre of mechanically crimped certified weed free hay or straw in combination with an approved organic mulch tackifier.
   (2) Placement of bonded fiber matrix in accordance with Section 213.
   (3) Placement of mulching (hydraulic) wood cellulose fiber mulch with tackifier, in accordance with Section 213.
   (4) Application of spray-on mulch blanket in accordance with Section 213. Magnesium Chloride, Potassium Chloride, and Sodium Chloride or other salt products shall not be used as a stabilization method.
   (5) Topsoil stockpiles shall receive interim stabilization unless specified in accordance with Section 207 as a different material than the other disturbed areas on-site.
3. Summer and Winter Stabilization. Summer and winter stabilization is defined as stabilization during months when seeding is not permitted. As soon as the Contractor knows shutdown is to occur, interim stabilization shall be applied to the disturbed area. Protection of the interim stabilization method is required. Reapplication of interim stabilization may be required as directed.
4. Permanent Stabilization. Permanent stabilization is defined as the covering of disturbed areas with topsoil, seeding, mulching with tackifier, soil retention coverings, and such non-erodible methods as riprap, road shouldering, etc., or a combination thereof as required by the Contract. Other permanent stabilization techniques may be proposed by the Contractor, in writing, and shall be used if approved in writing by the Engineer. Permanent stabilization requirements shown on the plans shall be completed within four working days of the placement of the topsoil in accordance with Section 207.
5. Final Stabilization. Final stabilization is achieved when all ground-disturbing activities at the site

have been completed, and uniform vegetative cover has been established with an individual plant density of at least 70 percent of predisturbance levels, or equivalent permanent physical erosion reduction methods have been employed.

(f) Maintenance. Erosion and sediment control practices and other protective measures identified in the SWMP as control measures for stormwater pollution prevention shall be maintained in effective operating condition until the CDPS-SCP has been transferred to Sponsor. Control measures shall be continuously maintained in accordance with good engineering, hydrologic, and pollution control practices, including removal of collected sediment when silt depth is 50 percent or more of the effective height of the erosion control device. When possible, the Contractor shall use equipment with an operator rather than labor alone to remove the sediment.

Maintenance of erosion and sediment control devices shall include replacement of such devices upon the end of their useful service life as recommended by the Contractor and approved by the Engineer. Maintenance of rock check dams and vehicle tracking pads shall be limited to removal and disposal of sediment or addition of aggregate. Damages resulting from failure to maintain control measures shall be repaired at the Contactor's expense.

Complete site assessment shall be performed as part of comprehensive inspection and maintenance procedures to assess the adequacy of control measures at the site and the necessity of changes to those control measures to ensure continued effective performance. Where site assessment results in the determination that new or replacement control measures are necessary, the control measures shall be installed to ensure continuous effectiveness. When identified, control measures shall be maintained, added, modified or replaced as soon as possible, immediately in most cases.

Approved new or replaced control measures will be measured and paid for in accordance with subsections 208.11 and 208.12. Devices damaged due to the Contractor's negligence shall be replaced at the Contractor's expense.

From the time seeding and mulching work begins until project acceptance the Contractor shall maintain all seeded areas. Damage to seeded areas or to mulch materials shall be immediately restored. Damage to seeded areas or to mulch materials due to Contractor negligence shall be immediately restored at the Contractor's expense. Restoration of other damaged areas will be measured and paid for under the appropriate bid item.

Temporary control measures may be removed upon completion of the project, as determined by the Water Quality Partial Acceptance walk-through. If removed, the area in which these control measures were constructed shall be returned to a condition similar to that which existed prior to its disturbance. Removed control measures shall become the property of the Contractor.

If the Contractor fails to complete construction within the approved contract time, the Contractor shall continue erosion and sediment control operations at its expense until acceptance of the work.

Sediment removed during maintenance of control measures and material from street sweeping may be used in or on embankment, provided it meets the requirements of Section 203 and is distributed evenly across the embankment.

Whenever sediment collects on the paved surface, the surface shall be cleaned. Street washing will not be allowed. Storm drain inlet protection shall be in place prior to shoveling, sweeping, or vacuuming. Sweeping shall be completed with a pickup broom or equipment capable of collecting sediment. Sweeping with a kick broom will not be allowed.

Material from pavement saw cutting operations shall be cleaned from the roadway surface during operations using a vacuum. A control measure, such as a berm, shall be placed to contain slurry from joint flushing operations until the residue can be removed from the soil surface. Aggregate bags, erosion logs or other permeable control measures shall not be used. Material containment and

removal will not be paid for separately, but shall be included in the work.

208.05 Construction of Control Measures Control measures shall be constructed in accordance with the plans, and with the following:

(a) Seeding, Mulching, Soil Retention Blanket. Seeding, mulching, sodding, and soil retention blanket installation shall be performed in accordance with Sections 212, 213, and 216.

(b) Erosion Bales. The bales shall be anchored securely to the ground with wood stakes.

(c) Silt Fence. Silt fence shall be installed in locations specified in the Contract.

(*d) Rock Check Dam*. Rock shall be installed at locations shown on the plans. Rock check dams shall conform to the dimensions shown on the plans.

(e) Rip Rap Outlet Protection. Geotextile used shall be protected from cutting or tearing. Overlaps between two pieces of geotextile shall be 1-foot minimum. Riprap size shall be as shown on the plans.

(f) Storm Drain Inlet Protection. Prior to installation, the Contractor shall sweep the surface of the area in which the storm drain inlet protection devices are to be installed such that the pavement is free of sediment and debris. The ends of the inlet protection Type 1 and Type 2 shall extend a minimum of 1 foot past each end of the inlet.

The Contractor shall remove all accumulated sediment and debris from the surface surrounding all storm drain inlet protection devices after each rain event or as directed. The Contractor shall remove accumulated sediment from each Type II and III containment area when it is more than one third full of sediment, or as directed.

The Contractor shall protect storm drain facilities adjacent to locations where pavement cutting operations involving wheel cutting, saw cutting, sand blasting, or abrasive water jet blasting are to take place.

(g) Erosion Logs. Erosion logs shall be embedded 2 inches into the soil. Stakes shall be embedded so that the top of the stake does not extend past the top erosion log more than 2 inches, at the discretion of the Engineer, a shallower stake depth may be permitted if adverse site conditions are encountered, e.g. rock or frozen ground.

The Contractor shall maintain the erosion logs during construction to prevent sediment from passing over or under the logs.

(h) Concrete Washout Structure. The concrete washout structure shall meet or exceed the dimensions shown on the plans. Work on this structure shall not begin until the Engineer provides written acceptance of location.

Implement control measures designed for concrete washout waste. If the bottom of the excavated structure is within 5 feet of anticipated high ground water elevation or the soil does not have adequate buffering capacity to meet water quality standards, an impermeable synthetic liner shall be installed with the minimum properties shown in Table 208-5 or use a prefabricated washout.

Meet the following requirements:

(1) The structure shall contain all washout water.

(2) Stormwater shall not carry wastes from washout and disposal locations.

(3) The site shall be located a minimum of 50 horizontal feet away from State waters and shall meet all requirements for containment and disposal.

(4) The site shall be signed as “Concrete Washout”

(5) The site shall be accessible to appropriate vehicles.

(6) Freeboard capacity shall be included in the structure design to reasonably ensure the structure will not overtop during or because of a precipitation event.

(7) The Contractor shall prevent tracking of washout material out of the washout structure.

(8) Do not add solvents, flocculants, and acid to wash water.

(9) Surround the structure on three sides by a compacted berm.

(10) The structure shall be fenced with orange plastic construction fencing to provide a barrier to construction equipment and to aid in identification of the concrete washout area.

(11) Concrete waste, liquid and solid, shall not exceed ⅔ the storage capacity of the washout structure.

(i) Vehicle Tracking Pad (VTP). Vehicle tracking pads shall be constructed to the minimum dimensions shown in the Contract, unless otherwise directed by the Engineer. Construction of approved vehicle tracking pads shall be completed before any disturbance of the area.

The Contractor shall maintain each vehicle tracking pad during the entire time that it is in use for the project. The vehicle tracking pad shall be removed at the completion of the project unless otherwise directed by the Engineer. Additional aggregate may be required for maintenance and will be paid for under Pay Item, Maintenance Aggregate (Vehicle Tracking Pad).

(j) Aggregate Bag. Aggregate bags shall be placed on a stable surface, consisting of hardscape or compacted gravel. If approved by the Engineer, the aggregate bag may be placed on compacted dirt areas, where bags conform to the surface and can effectively minimize sediment transport. Aggregate bags shall not be placed in concentrated flow areas. Aggregate bags shall be placed to conform to the surface without gaps to ensure that discharge water does not cause erosion.

(k) Surface roughening. Surface roughening creates horizontal grooves along the contour of the slope. Roughening may be accomplished by furrowing, scarifying, ripping, or disking the soil surface to create a 2 to 4-inch minimum variation in soil surface.

(l) Vertical Tracking. Vertical tracking involves driving a tracked vehicle up and down the soil surface and creating horizontal grooves and ridges along the contour of the slope. Sandy soils or soils that are primarily rock need not be tracked.

208.06 Materials Handling and Spill Prevention. The SWMP Administrator shall clearly describe and record on the SWMP, all practices implemented at the site to minimize impacts from procedures or significant material that could contribute pollutants to runoff. Areas or procedures where potential spills can occur shall have a Spill Response Plan in place as specified in subsection 208.06(c). Construction equipment, fuels, lubricants, and other petroleum distillates shall not be stored or stockpiled within 50 horizontal feet of any State waters or more if the Contractor determines necessary. Equipment fueling and servicing shall occur only within approved designated areas.

(a) Bulk Storage Structures. Bulk storage structures for petroleum products and other chemicals shall have impervious secondary containment or equivalent adequate protection so as to contain all spills and prevent any spilled material from entering State waters. Secondary containment shall be capable of containing the combined volume of all the storage containers plus at least 10 percent freeboard. For secondary containment that is used and may result in accumulation of stormwater within the containment, a plan shall be implemented to properly manage and dispose of all accumulated stormwater which is deemed to be contaminated (e.g., has an unusual odor or sheen).

(b) Lubricant Leaks. The Contractor shall inspect equipment, vehicles, and repair areas daily to ensure petroleum, oils, and lubricants (POL) are not leaking onto the soil or pavement. Absorbent material or containers approved by the Engineer shall be used to prevent leaking POL from reaching the soil or pavement. The Contractor shall have onsite approved absorbent material or containers of sufficient

capacity to contain any POL leak that can reasonably be foreseen. The Contractor shall inform all Spill Response Coordinators in accordance with the Spill Response Plan if unforeseen leakage is encountered. All materials resulting from POL leakage control and cleanup shall become the property of the Contractor and shall be removed from the site. Control, cleanup, and removal of by-products resulting from POL leaks shall be performed at the Contractor's expense.

(c) Spill Response Plan. A Spill Response Plan shall be developed and implemented to establish operating procedures for handling potential pollutants and preventing spills.

The Response Plan shall contain the following information:

(1) Identification and contact information of each Spill Response Coordinator.

(2) Locations of areas on the project site where equipment fueling and servicing operations are permitted.

(3) Location of clean-up kits.

(4) Quantities of chemicals and locations stored on-site.

(5) Label system for chemicals and Safety Data Sheets (SDS) for products.

(6) Clean-up procedures to be implemented in the event of a spill that does not enter State waters or ground water.

(7) Procedures for spills of any size that enter surface waters or ground water, or have the potential to do so. CDOT's Erosion Control and Stormwater Quality Guide contains spill notification contacts and phone numbers required in the Spill Response Plan.

(8) A summary of the employee training provided.

Information in items (1) through (8) shall be updated in the SWMP when they change.

208.07 Stockpile Management. Material stockpiles shall be located 50 horizontal feet away from State waters, and shall be confined so that no potential pollutants will enter State waters and other sensitive areas as defined in the Contract. Locations shall be approved by the Engineer.

Erodible stockpiles (including topsoil) shall be contained with acceptable control measures at the toe (or within 20 feet of the toe) throughout construction. Control measures shall be approved by the Engineer. The SWMP Administrator shall describe, detail, and record the sediment control devices on the SWMP.

208.08 Limits of Disturbance. The Contractor shall limit construction activities to those areas within the limits of disturbance shown on the plans and cross-sections. Construction activities, in addition to the Contract work, shall include the on-site parking of vehicles or equipment, on-site staging, on-site batch plants, haul roads or work access, and all other activities which would disturb existing soil conditions. Staging areas within the LDA shall be as approved by the Engineer. Construction activities beyond the limits of disturbance due to Contractor negligence shall be restored to the original condition by the Contractor at the Contractor's expense. The SWMP Administrator shall tabulate additional disturbances not identified in the CDPS-SCP application and indicate changes to locations and quantities on the SWMP. The Contractor shall report the changes and additional disturbances to the Engineer, Water Quality Control Division of CDPHE, and all other involved agencies.

The Contractor shall pursue stabilization of all disturbances to completion.

208.09 Regulatory Mechanism for Water Quality. The Engineer will identify and document findings not in compliance with the Water Quality Specifications, as specified in subsection 208.09(a)7. The Engineer will immediately notify the Contractor of these findings. Failure by the Contractor to clarify a finding location with the Engineer shall not interrupt the timelines noted in subsection 208.09(b).

Timelines noted in subsection 208.09(b) do not indemnify the Contractor from failing to comply with

CDPS-SCP timelines for corrective actions. The CDPS-SCP (Part I.D.8) states corrective actions "…must be addressed as soon as possible, immediately in most cases, to minimize the discharge of pollutants."

(a) Definitions.

1. Compliance Assistance. A low risk event. Compliance assistance events are not considered Findings and not subject to the Regulatory Mechanism noted in subsection 208.09(b).
2. Deferment. A request from the Contractor to the Engineer to delay implementation of corrective actions for Regular Findings pertaining to Water Quality Specifications. Deferments may only be granted due to extraordinary circumstances. However, it is at the Engineer's discretion to approve or reject these requests.
3. Finding. An incident discovered through inspection by the Engineer observation, which is noncompliant with the Water Quality Specifications. A Finding will be classified as one of the following:
   (1) Regular Finding. A situation upon inspection that is in noncompliance with the Water Quality Specifications.
   (2) Severe Finding. A discharge outside the project's Limits of Construction (LOC), to State waters or to a live inlet where the pollutant cannot be reclaimed.
   (3) Chronic Finding. A Chronic Finding is assessed when the same Regular Finding at the same location is documented twice in the last three Engineer's water quality control inspections. Engineer observed findings outside these inspections will not apply.
4. Engineer documented findings from a water quality inspection in accordance with subsection 208.03(c).
5. Location. The place where the finding was observed; can be a document (e.g., stormwater management plan [SWMP]) or physical location. A physical location must be described with enough detail to guide an independent party to the spot of the finding. Physical locations must be supported with at least one photograph.
6. Recalcitrance. Contractor has shown willful negligence or misrepresentation or unwillingness to adhere to the Water Quality Specifications.
7. Water Quality Specifications. Sections 208 and 216.

(b) Liquidated Damages and Stop Work Orders. The Contractor will be subject to Liquidated Damages for incidents of failure to comply with the Water Quality Specifications and implement corrective actions to resolve noncompliance in the time frame established in subsection 208.09(b and c). Liquidated damages will not be considered a penalty but will be assessed to recover costs associated with environmental damages, and engineering and administrative expenses incurred by the Sponsor for the Contractor's failure to comply with the Water Quality Specifications. Liquidated damages will accumulate for each finding, for each cumulative day that the finding remains uncorrected. Liquidated damages associated with incidents pertaining to this subsection do not indemnify the Contractor of other Liquidated Damages associated with this project.

In addition to Liquidated Damages, the Contractor will be subject to a project-wide Stop Work Order for recalcitrance and the Engineer may, in writing, issue a Stop Work Order for Chronic and Severe Findings.

Findings are closed when the corrective action is complete and accepted by the Engineer. The Engineer will notify the Contractor when the corrective action is accepted or denied. Liquidated damages will be assessed by the type of finding as follows and will continue until the corrective action is approved by the Engineer.

1. Regular Finding. The time required to repair a Regular Finding shall begin at 11:59 PM on the date issued. The Contractor shall have no more than a seven-day grace period to correct the Regular Finding before Liquidated Damages are assessed. The grace period extends until 11:59 PM on the seventh day after issued.

   The Engineer will notify the Contractor that Liquidated Damages are accruing at $1,500 per day for each full or partial calendar day a Regular Finding remains uncorrected after the seven-day grace period. At 11:59 PM on the 14th day after issued, each uncorrected, undeferred Regular Finding will be assessed as recalcitrant and the Engineer will issue a project-wide stop work order. The Contractor shall fix each recalcitrant finding and submit a plan to avoid future instances of each recalcitrance to the Engineer for approval. The recalcitrance plan shall be in writing, signed by the Superintendent and shall include:

   (1) Each Recalcitrant Finding.

   (2) Why the corrective action for each Recalcitrant Finding was not implemented within 14 days.

   (3) How the Contractor will avoid future recalcitrance.

   The Engineer will discuss the recalcitrance plan and may meet with the Superintendent to recommend modifications, if needed. The Engineer will issue acceptance or rejection of the recalcitrance plan within 24 hours of the Contractor submitting a plan or resubmitting a modified plan.

   The Contractor will neither be reimbursed for costs incurred to fix each Recalcitrant Finding pertaining to a control measure in the SWMP plan nor costs to prepare the recalcitrance plan. The Contractor shall propose additional control measures, if needed, according to subsection 208.04(a). The project-wide Stop Work Order and Liquidated Damages will be assessed until approval of the corrective action for each Recalcitrant Finding and approval of the Contractor's recalcitrance plan by the Engineer is given. After written approval by the Engineer, the project-wide Stop Work Order will be lifted and accrual of Liquidated Damages will cease.

2. Severe Finding. In response to a Severe Finding, the Engineer will issue and immediately assess Liquidated Damages of $3,500 per Severe Finding. Severe Findings shall not be eligible for the seven-day grace period (subsection 208.09(b)1). Liquidated damages will accrue at $3,500 per Severe Finding per calendar day beginning at 11:59 PM of date issued.

   (A) If the Severe Finding is a discharge to State waters, the Contractor shall prevent any further discharge and shall reclaim discharge which has not yet entered State waters. The Contractor shall report the discharge to CDPHE in accordance with CDPS-SCP requirements.

   (B) If the Severe Finding is a discharge outside the LOC that does not enter State waters, the Contractor shall fully reclaim the discharge before it enters State waters and implement relevant CDPS-SCP noncompliance notification procedures.

   The Engineer may require the Contractor to submit a plan for permanent stabilization of disturbed areas outside the LOC per 208.04(e)4 for approval. Permanent stabilization plans pertaining to Severe Findings and subsequent stabilization activities are not subject to 208.09(b).

   The Contractor shall not be reimbursed for activities undertaken to reclaim the discharge, stabilize areas outside the LOC and implement relevant CDPS-SCP noncompliance notification procedures.

3. Chronic Finding. In response to a Chronic Finding, the Engineer will issue and immediately assess Liquidated Damages of $1,500 per Chronic Finding. Chronic Findings shall not be eligible for the seven-day grace period (subsection 208.09(b)). Liquidated damages will accrue at $1,500 per Chronic Finding per day beginning at 11:59 PM of date issued.

When the Chronic Finding is comprised of two Severe Findings, the Engineer will assess Liquidated Damages in accordance with this specification.

(c) Deferment. If the Contractor seeks deferment, the Superintendent shall submit a deferment request to the Engineer by 11:59 PM of the day after the issuance. Chronic and Severe Findings are not eligible for deferment. The deferment request shall be in writing, signed by the Superintendent and shall include:

(1) Regular Findings to be deferred

(2) The reasons why the Findings cannot be corrected in seven days

(3) An action plan containing:

(i) Methodology to protect water quality until each deferred Finding is corrected and accepted.

(ii) Milestones to measure progress toward completion.

(iii) Additional control measures to be implemented until each deferred Finding is corrected and accepted.

(iv) Corrective completion dates for each Finding

The Engineer will discuss the deferment request and may meet with the Superintendent to recommend modifications to the action plan. The Engineer will issue acceptance or rejection o the deferment request by 11:59 PM of the third day after the Regular Finding is issued. The Sponsor will not accept a deferment for operational error, lack of resources, improperly installed control measures, inadequate control measures, lack of preventative maintenance, careless or improper operation, or other non-proactive reason.

Preparation of deferment documentation and additional materials, including additional control measures, required to complete the action plan shall be at the Contractor's expense. Time frames noted in subsection 208.09(b)1 will not be stopped during the deferment review period, therefore, Liquidated Damages will be assessed beginning 11:59 PM on calendar day seven if the deferment request is rejected and, furthermore, a rejected deferment plan (subsection 208.09(c)) shall not absolve the Contractor from recalcitrance.

The Engineer will assess Liquidated Damages of $1,500 per calendar day, and partial day, for each uncorrected Deferred Finding. These Liquidated Damages will start on the date the uncorrected work was deferred to be completed (subsection 208.09(c)(3)). In addition, Liquidated Damages of $1,500 per calendar day will be assessed retroactively to 11:59 PM of the day the finding was originally noted.

(d) Exemptions. The Engineer will exempt from subsection 208.09(b) situations of Compliance Assistance, Documented Upset Conditions, Documented Reportable Spills and Documented Winter Exemptions. Release from subsection 208.09(b) does not exempt the Contractor from compliance with CDPS-SCP, Part I.D.8.

1. Documented Upset Condition. The Contractor shall report, both verbally and in writing, the Upset Condition to CDPHE per CDPS-SCP Part II.A.6 and subsection 208.03(c) and provide written documentation to the Engineer. The Engineer will recognize the exemption to the Regulatory Mechanism. The Contractor shall also update the SWMP with the documented Upset Condition.

2. Documented Reportable Spills. The Contractor shall report, both verbally and in writing, the Reportable Spill to CDPHE and provide written documentation to the Engineer. The Contractor shall also update the SWMP with the documented Reportable Spill.

3. Winter Exemptions. The Contractor is unable to address findings noted on the water quality control inspection due to:

(1) Snow covers the entire site for an extended period and;

(2) No construction activity and;

(3) Melting conditions posing a risk of surface erosion do not exist.

The Contractor shall request a Winter Exemption to the Sponsor. If approved, the Engineer will recognize the exemption to subsection 208.09(b). The Contractor shall also update the SWMP with the documented Winter Exemption. Liquidated Damages, if assessed, will only accrue up to the point where the Winter Exemptions are approved.

4. Compliance assistance during Engineer's water quality control inspections.

208.10 Items to Be Completed Prior to Requesting Partial Acceptance of Water Quality Work.

(a) Reclamation of Washout Areas. After concrete operations are complete, washout areas shall be reclaimed in accordance with subsection 208.05(n) at the Contractor's expense.

(b) Survey. When Permanent Water Quality (PWQ) control measures are required on the project and once built, the Contractor shall survey the control measures to confirm that the PWQ control measures conform to the configuration, grade, and volume shown on the plans. The survey shall conform to Section 625. The results of the survey shall be submitted in accordance with CDOT's Survey Manual (AutoCAD to GIS and TMOSS Codes), or GIS with attribute tables, showing both designed and final elevations and configurations. The Contractor's Surveyor shall submit electronically sealed control measure drawings.

PWQ control measures that do not meet the Contract requirements will be identified in writing by the Engineer, and shall be repaired or replaced at the Contractor's expense. Correction surveys shall be performed at the Contractor's expense to confirm the locations, dimensions, and volume certification (for water quality capture volume structures only) of each PWQ control measure.

(c) Locations of Temporary Control Measures. The Engineer will identify locations where modification, cleaning, or removal of temporary control measures are required and will provide these in writing to the Contractor. Upon completion of work required, the SWMP Administrator shall modify the SWMP to provide an accurate depiction of control measures to remain on the project site.

Complete and approve all punch list and walkthrough items by the Engineer and Maintenance.

METHOD OF MEASUREMENT

208.11 Erosion Control will not be measured but will be paid for on a lump sum basis and prorated across the project duration based on percentage of contract complete for each payment period.

BASIS OF PAYMENT

208.12 Work to furnish, install, maintain, remove and dispose of erosion and sediment control features specified in the contract, including all required permits, fees, and reports, may be paid for at the lump sum contract price for erosion control (complete in place).

Payment will be made under:

Pay Item	Pay Unit
Erosion Control (Complete in place)	Lump Sum

The lump sum price for Erosion Control (complete in place) shall be full compensation for the Erosion Control Supervisor and all materials, labor and equipment required to furnish, install, maintain, remove and dispose of erosion and sediment control features and Best Management Practices (BMPs) in accordance with the Storm Water Management Plan (SWMP), State and local permits, and the contract documents.

Payment for Erosion Control Management (ECM) will be full compensation for all labor, materials and equipment necessary for the SWMP Administrator and Erosion Control Inspectors to perform all the work described in this specification. This includes assembling items (5) – (18) in subsection 208.03(d)1 and required updates to the SWMP Notebook on site.

Payment will be made for BMPs replaced as approved by the Engineer. Temporary erosion and sediment BMPs required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or ordered by the Sponsor or for the Contractor's convenience, shall be performed at the Contractor's expense. If the Contractor fails to complete construction within the contract time, payment will not be made for Section 208 pay items for the period of time after expiration of the contract time. These items shall be provided at the Contractor's expense.

END OF SECTION

SECTION 209 WATERING

DESCRIPTION

209.01 This work consists of applying water to soils or aggregates for moisture and density control and dust palliatives.

MATERIALS

209.02 Water applied for moisture and density control, as dust palliative, and for pre-wetting shall be free from injurious matter. Water for landscaping shall be free from oil, acids, alkalis, salts, or any substance injurious to plant life.

When the water source proposed for use by the Contractor is not of known quality and chemical content, samples of the water shall be submitted for approval prior to use.

CONSTRUCTION REQUIREMENTS

209.03 Moisture and Density Control. Sprinkling equipment shall deliver uniform and controlled distribution of water without ponding or washing. Water for finishing operations shall be uniformly applied by spraying across the full width of the course.

209.04 Pre-wetting. Not Used.

METHOD OF MEASUREMENT

209.05 The quantity of water required for all items of work will not be measured.

BASIS OF PAYMENT

209.06 The furnishing and application of water for moisture and density control will not be measured or paid for separately but shall be included in the work.

END OF SECTION

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SECTION 212 SEEDING, FERTILIZER, AND SOIL CONDITIONER

DESCRIPTION

212.01 This work consists of soil preparation, application of fertilizer, soil conditioners, or both, and furnishing and placing seed. The work shall be in accordance with the Contract and accepted horticultural practices.

MATERIALS

212.02 Seed, Soil Conditioners, Fertilizers, and Sod.

(a) Seed. All seed shall be furnished in bags or containers clearly labeled to show the name and address of the supplier, the seed name, the lot number, net weight, origin, the percent of weed seed content, the guaranteed percentage of purity and germination, pounds of pure live seed (PLS) of each seed species, and the total pounds of PLS in the container. All seeds shall be free from noxious weed seeds in accordance with current state and local lists. The Contractor shall furnish to the Engineer a signed statement certifying that the seed is from a lot that has been tested by a recognized laboratory for seed testing within thirteen months prior to the date of seeding. The Engineer may obtain seed samples from the seed equipment, furnished bags, or containers to test seed for species identification, purity, and germination. Seed tested and found to be less than 10 percent of the labeled certified PLS and different than the specified species will not be accepted. Seed which has become wet, moldy, or damaged in transit or in storage will not be accepted.

Seed types and amount of PLS required per acre shall be provided in accordance with the Contract.

Seed and seed labels shall conform to all current State and Federal regulations and will be subject to the testing provisions of the Association of Official Seed Analysis. Computations for quantity of seed required on the project shall include the percent of purity and percent of germination.

The formula used for determining the quantity of PLS shall be:

Bulk Pounds of Seed Species • (Percent Purity • Percent Germination) = Pounds of PLS

(b) Soil Conditioners and Fertilizer.

1. Fertilizer: Fertilizer (plant nutrients) shall conform to the applicable State fertilizer laws. It shall be uniform in composition, dry, and free flowing, and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis. Fertilizer which becomes caked or damaged will not be accepted.

2. Soil Conditioner: Soil conditioner shall consist of compost, biological nutrient, biological culture or humic acid based material.

   Humic acid based material (Humate) shall include the following:

   (1) A pH of 3 to 5.

   (2) Maximum 20 percent inert ingredient.

   (3) Minimum 80 percent organic matter with 40 percent minimum humic acid.

   Compost shall be weed–free, organic compost derived from a variety of feed stocks including agricultural, biosolids, forestry, food, leaf and yard trimmings, manure, tree wood with no substances toxic to plants. Material shall be aerobically composted in a facility permitted by the Colorado Department of Public Health and Environment (CDPHE) to produce or sell compost in accordance with House Bill (HB) 1181. The Contractor shall submit a copy of this permit to the Engineer for approval and the project records. The compost shall be tested in accordance with the U.S. Composting Council’s Test Methods for Examining of Composting and Compost (TMECC) manual.

The compost manufacturer shall be a participating member of in the U.S. Composting Council's Seal of Testing Assurance Program (STA). The Contractor shall provide a participation certificate and test data on a Compost Technical Data Sheet.

Compost shall have the following physical properties:

Compost Parameters	**Reported as**	**Requirement**	**Test Method**
pH	pH units	6.0 – 8.5	TMECC 04.11-A
Soluble Salts (Electrical Conductivity)	dS m-1 or mmhos cm-1	Maximum 10dS/m	TMECC 04.10-A
Moisture Content	%, wet weight basis	30 – 60%	TMECC 03.09-A
Organic Matter Content	%, dry weight basis	30 – 65%	TMECC 05.07-A
Particle Size (sieve sizes)	%, dry weight basis for each sieve fraction	Passing 1 inch – 100% 1/2 inch – 95%	TMECC 02.02-B
Man-made Inert Contamination	%, dry weight basis	< 1%	TMECC 03.08-A
Stability (Respirometry)	mg CO2-C per g TS per day mg CO2-C per g OM per day	8 or below	TMECC 05.08-B
Select Pathogens	(PASS/FAIL) Limits: Salmonella <3 MPN/4grams of TS, or Coliform Bacteria <1000 MPN/gram	Pass	TMECC 07.01-B Fecal Coliforms, or 07.02 Salmonella
Trace Metals	(PASS/FAIL) Limits (mg kg-1, dw basis): As 41, Cd 39, Cu 1500, Pb 300, Hg 17, Ni 420, Se 100, Zn 2800	Pass	TMECC 04.06
Maturity (Bioassay) Percent Emergence Relative Seedling Vigor	 %, (average) %, (average)	 > 80% > 80%	TMECC 05.05-A
The Contractor shall provide a CTR confirming that the material has been tested in accordance with TMECC.			

CONSTRUCTION REQUIREMENTS

212.03 Seeding Seasons Seeding in areas that are not irrigated shall be restricted according to the following time table and specifications.

Zone	**Spring Seeding**	**Fall Seeding**

Areas other than the Western Slope		
Below 6000 feet	Spring thaw[1] to June 1	September 15 until consistent ground freeze[2]
6000 to 7000 feet	Spring thaw to June 1	September 1 until consistent ground freeze
7000 to 8000 feet	Spring thaw to July 15	August 1 until consistent ground freeze
Above 8000 feet	Spring thaw to consistent ground freeze	
Western Slope		
Below 6000 feet	Spring thaw to May 1	August 1 until consistent ground freeze
6000 to 7000 feet	Spring thaw to June 1	September 1 until consistent ground freeze
Above 7000 feet	Spring thaw to consistent ground freeze	

[1] "Spring thaw" shall be defined as the earliest date in a new calendar year in which seed can be buried 1/2 inch into the surface soil (topsoil) thru normal drill seeding methods.

[2] "Consistent ground freeze" shall be defined as that time during the fall months in which the surface soil (topsoil), due to freeze conditions, prevents burying the seed 1/2 inch thru normal drill seeding operations. Seed shall not be sown, drilled, or planted when the surface soil or topsoil is in a frozen or crusted state.

Seeding accomplished outside the time periods listed above will be allowed only when ordered by the Engineer or when the Contractor's request is approved in writing. When requested by the Contractor, the Contractor must agree to perform the following work at no cost to the Sponsor: reseed, remulch, and repair areas which fail to produce species indicated in the Contract.

When seeding is ordered by the Engineer outside the time periods listed above, the cost of additional material will be paid for by the Sponsor. The Contractor will not be responsible for failure of the seeded area to produce species indicated in the Contract due to reasons beyond the control of the Contractor.

The seeding, the soil conditioning, and the fertilizing application rate shall be as specified. The Engineer may establish test sections for adjusting the seeding and the fertilizing equipment to assure the specified rate. The Engineer may order equipment readjustment at any time.

Seed, soil conditioner and fertilizer shall not be applied during inclement weather including rain and high winds, or when soil is frozen or soil moisture is too high to evenly incorporate seed, soil conditioner or fertilizer.

212.04 Lawn Grass Seeding. Not Used.

212.05 Sodding. Not Used.

212.06 Native Seeding. Areas that are unirrigated shall be seeded in accordance with subsection 212.03.

(a) Soil Preparation. Slopes flatter than 2:1, shall be tilled into an even and loose seed bed 4 inches deep. Slopes 2:1 or steeper shall be left in a roughened condition. Slopes shall be free of clods, sticks, stones, debris, concrete, and asphalt in excess of 4 inches in any dimension, and brought to the desired line and grade.

(b) Fertilizing and Soil Conditioning. Prior to seeding, fertilizer, soil conditioner, or both shall be applied. The fertilizer and soil conditioner type and rate of application shall be as designated in the Contract. Fertilizer called for on the plans shall be worked into the top 4 inches of soil at the rate specified in the contract. Biological nutrient, culture or humic acid based material called for on the plans shall be applied in a uniform application onto the soil service. Organic amendments shall be

applied uniformly over the soil surface and incorporated into the top 6 inches of soil. No measurable quantity of organic amendment shall be present on the surface after incorporation.

(c) Seeding. Seeding shall be accomplished within 24 hours of tilling or scarifying to make special seed bed preparation unnecessary. The seeding application rate shall be as designated in the Contract. All slopes flatter than 2:1 shall be seeded by mechanical power drawn drills followed by packer wheels or drag chains. Mechanical power drawn drills shall have depth bands set to maintain a planting depth of at least 1/4 inch and shall be set to space the rows not more than 7 inches apart. Seed that is extremely small shall be sowed from a separate hopper adjusted to the proper rate of application.

If strips greater than 7 inches between the rows have been left unplanted or other areas skipped, the Engineer will require additional seeding at the Contractor's expense.

When requested by the Contractor and approved by the Engineer, seeding may be accomplished by broadcast or hydraulic type seeders at twice the rate specified in the Contract at no additional cost to the project.

All seed sown by broadcast-type seeders shall be "raked in" or covered with soil to a depth of at least 1/4 inch. Broadcasting seed will be permitted only on small areas not accessible to machine methods.

Hydraulic seeding equipment and accessories shall conform to the equipment and accessories described in subsection 212.04(c).

Seeded areas damaged due to circumstances beyond the Contractor's control shall be repaired and reseeded as ordered. Payment for this corrective work, when ordered, shall be at the contract prices.

Multiple seeding operations shall be anticipated as portions of job are completed to take advantage of growing conditions and to comply with Section 208 and subsection 212.03.

METHOD OF MEASUREMENT

212.07 The quantities of native seeding will not be measured but shall be the quantities designated in the Contract, except that measurements will be made for revisions requested by the Engineer, or for discrepancies of plus or minus five percent of the total quantity designated in the Contract. The quantity of native seeding shall include soil preparation, fertilizer, soil conditioner, and seed applied, completed, and accepted.

When soil conditioner is measured and paid for separately, it will be measured by the actual number of acres to which soil conditioner is applied and will be paid for as Soil Conditioning.

The Contractor shall furnish the Engineer with seed certifications and analysis, fertilizer analysis, and bag weight tickers prior to placing any seed or fertilizer. Any seed or fertilizer placed by the Contractor without the Engineer’s approval will not be paid for.

Measurement for acres will be by slope distances.

BASIS OF PAYMENT

212.08 The accepted quantities of native seeding and soil conditioning will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Seeding (Native)	Acre
Soil Conditioning	Acre

Soil preparation, water, seed, fertilizer, and soil conditioner, incorporated into the seeding or soil conditioning will not be paid for separately but shall be included in the work.

Adjusting or readjusting seeding or fertilizing equipment will not be paid for separately but shall be included in the work.

END OF SECTION

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SECTION 216 SOIL RETENTION COVERING

DESCRIPTION

216.01 This work consists of furnishing, preparing, applying, placing, and securing soil retention blankets for erosion control on roadway slopes or channels as designated in the Contract.

MATERIALS

216.02. Soil retention covering shall be a soil retention blanket as specified in the Contract. It shall be one of the products listed on CDOT's Approved Products List and shall conform to the following:

(a) Soil Retention Blanket. Soil retention blanket shall be composed of degradable natural fibers mechanically bound together between two slowly degrading synthetic or natural fiber nettings to form a continuous matrix and shall conform to the requirements of Tables 216-1 and 216-2. The blanket shall be of consistent thickness with the fiber evenly distributed over the entire area of the mat.

When specified, lightweight polypropylene netting shall be 1.5 pounds per 1,000 square feet; heavyweight netting shall be 2.9 pounds per 1,000 square feet.

When biodegradable blanket is specified, the thread shall be 100 percent biodegradable; polypropylene thread is not allowed.

Blankets and nettings shall be non-toxic to vegetation and shall not inhibit germination of native seed mix as specified in the Contract. The materials shall not be toxic or injurious to humans. Class 1 blanket shall be an extended term blanket with a typical 24-month functional longevity. Class 2 blanket shall be a long-term blanket with a typical 36-month functional longevity. The class of blanket is defined by the physical and performance characteristics.

1. Soil Retention Blanket (Coconut). Soil Retention Blanket (Coconut) shall be a machine-produced mat consisting of 100 percent coconut fiber. It shall be biodegradable.

Netting shall be as follows:

When biodegradable netting is specified, the top and bottom netting shall be 100 percent biodegradable organic jute fiber. Netting shall be constructed using a weave which is unattached at the intersections, and which allows the strands of the net to move independently of each other.

Table 216-1

PHYSICAL REQUIREMENTS FOR SOIL RETENTION BLANKET –

BIODEGRADABLE BLANKETS

Photo/Bio Degradable Class	Min. Roll Width	Minimum Thickness ASTM D6525	Acceptable Matrix Fill	Material Min. Mass per Unit Area ASTM D6475	Size of Net Opening
					Bio-degradable
2	6.5 ft.	200 mils	Coconut	8oz/sy	Minimum: 0.50"x0.50"
					Maximum: 0.5"x1.0"

Table 216-2

PERFORMANCE REQUIREMENTS FOR SOIL RETENTION BLANKET – BIODEGRADABLE BLANKETS

Photo/Bio Degradable Class	Slope Application "C" Factor[1] ASTM D6459	Minimum Tensile Strength MD[2] ASTM D6818
2	< 0.10 at 3:1	10.42 lbs./in
Notes: 1. "C" Factor is calculated as ratio of soil loss from soil retention blanket protected slope (tested at specified or greater gradient, 3H:1V) to ratio of soil loss from unprotected (control) plot in large-scale testing. 2. MD is for machine direction testing (along the length of the roll).		

Blankets shall be tested for physical properties and have published data from an independent testing facility.

Large scale testing of Slope Erosion Protection ("C" factor) shall be performed by an independent testing facility.

(*b*) *Turf Reinforcement Mat*. Not Used.

(c) *Staples*. Staples shall be made of ductile steel wire, 0.165 inches in diameter, 8 inches long and have a 1-inch crown. "T" shaped staples will not be permitted.

A sample of the staples and a Certificate of Compliance (COC) including the manufacturer's product data showing that the product meets the Contract requirements shall be submitted for approval at the Environmental Pre-construction Conference. Installation of the blanket will not begin until approval has been received from the Engineer in writing.

(d) *Earth Anchors*. Not Used.

CONSTRUCTION REQUIREMENTS

216.03. The Contractor shall install soil retention coverings in accordance with Standard Plan M-216-1 and the following procedure:

(1) Prepare soil in accordance with subsection 212.06(a).

(2) Apply topsoil or soil conditioning as directed in the Contract to prepare seed bed.

(3) Place seed in accordance with the Contract.

(4) Unroll the covering parallel to the primary direction of flow.

(5) Ensure that the covering maintains direct contact with the soil surface over the entirety of the installation area.

(6) Do not stretch the material or allow it to bridge over surface inconsistencies.

(7) Staple the covering to the soil such that each staple is flush with the underlying soil.

(8) Ensure that staples are installed full depth to resist pull out. No bent over staples will be allowed. Install seams, and terminal ends as shown on the plans.

When applicable, the covering shall be unrolled with the heavyweight polypropylene netting on top and the lightweight polypropylene netting in contact with the soil.

216.04 Slope Application. Soil retention coverings shall be installed on slopes as follows:

The upslope end shall be buried in a trench 3 feet beyond the crest of the slope if possible. Trench depth shall be a minimum of 6 inches unless required by the manufacture to be deeper. Before backfilling begins, staples shall be placed across the width of the trench. The trench shall then be backfilled to grade with soil amended with soil conditioning or topsoil, compacted by foot tamping, and seeded. Fabric shall be brought back over trench and secured with staples or earth anchors at 1 foot on center.

There shall be an overlap wherever one roll of fabric ends and another begins with the uphill covering placed on top of the downhill covering. Staples shall be installed in the overlap.

There shall be an overlap wherever two widths of covering are applied side by side.

Staples shall be installed in the overlap. Staple checks shall be installed on the slope length at a maximum of every 35 feet. Each staple check shall consist of two rows of staggered staples.

The down slope end shall be buried in a trench 3 feet beyond the toe of slope. Before backfilling begins, staples shall be placed across the width of the trench. The trench shall then be backfilled to grade with soil amended with soil conditioning or topsoil, compacted by foot tamping, and seeded. Fabric shall be brought back over the trench and secured with staples. If a slope runs into State waters or cannot be extended 3 feet beyond the toe of slope, the end of covering shall be secured using a staple check as described above.

Coverings shall be securely fastened to the soil by installing staples at the minimum rate shown on the Drawings. Staple spacing shall be reduced where required due to soil type or steepness of slope.

216.05 Channel Application. Soil retention coverings shall be installed as follows on a channel application:

Coverings shall be anchored at the beginning and end of the channel across its entire width by burying the end in a trench. Trench depth shall be a minimum of 6 inches, unless a larger depth is specified by the manufacturer's recommendations. Before backfilling begins, staples shall be placed across the width of the trench. The trench shall then be backfilled to grade with soil amended with soil conditioning or topsoil and compacted by foot tamping, and seeded. Fabric shall be brought back over the trench and stapled.

Covering shall be unrolled in the direction of flow and placed in the bottom of the channel first. Seams shall not be placed down the center of the channel bottom or in areas of concentrated flows when placing rolls side by side.

There shall be an overlap wherever one roll of covering ends and another begins with the upstream covering placed on top of the downstream covering. Two rows of staggered staples shall be placed.

There shall be an overlap wherever two widths of covering are applied side by side. Staples shall be placed in the overlap.

The covering shall have a channel check slot every 30 feet along the gradient of the flowline. Check slots shall extend the entire width of the channel. The covering shall be buried in a trench. Before backfilling begins, staples shall be placed across the width of the trench. The trench shall then be backfilled to grade with soil amended with soil conditioning or topsoil, compacted by foot tamping, and seeded. Fabric shall be brought back over the trench and continued down the channel.

Coverings shall be securely fastened to the soil by installing staples at the minimum rate shown on the plans. Staple spacing shall be reduced where needed due to soil type or high flows.

216.06 Maintenance. The Contractor shall maintain the soil retention coverings until all work on the Contract has been completed and accepted. Maintenance shall consist of the repair of areas where damage is due to the Contractor's operations. Maintenance shall be performed at the Contractor's expense. Repair of those areas damaged by causes not attributable to the Contractor's operations shall be repaired by the Contractor and will be paid for at the contract unit price. Areas shall be repaired to reestablish the condition and grade of the soil and seeding prior to application of the covering.

METHOD OF MEASUREMENT

216.07 Soil retention coverings, including staples, complete in place and accepted, will be measured by the square yard of finished surface, excluding overlap, which is installed and accepted.

BASIS OF PAYMENT

216.08 The accepted quantities of soil retention coverings will be paid for at the contract unit price per square yard.

Payment will be made under:

Pay Item	Pay Unit
Soil Retention Blanket (Coconut)	
(Biodegradable Class 2)	Square Yard

Preparation of seedbed, fertilizing, and seeding will be measured and paid for in accordance with Section 212.

Staples will not be measured and paid for separately, but shall be included in the work.

END OF SECTION

SECTION 304 AGGREGATE BASE COURSE

DESCRIPTION

304.01 This work consists of furnishing and placing one or more courses of aggregate and additives, if required, on a prepared subgrade.

MATERIALS

304.02 Aggregate. The aggregates shall meet the requirements of subsection 703.03.

Acceptance will be based on random samples taken from each lift.

304.03 Commercial Mineral Fillers. Portland cement shall conform to subsection 701.01. Hydrated lime shall conform to subsection 712.03.

CONSTRUCTION REQUIREMENTS

304.04 Placing. If the required compacted depth of the aggregate base course exceeds 6 inches, it shall be constructed in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches. When vibratory or other approved types of special compacting equipment are used, the compacted depth of a single layer may be increased to 8 inches upon request, provided that specified density is achieved and written approval is given.

304.05 Mixing. The Contractor shall mix the aggregate by methods that ensure a thorough and homogenous mixture.

304.06 Shaping and Compaction. Compaction of each layer shall continue until a density of at least 95 percent of the maximum density has been achieved as determined in accordance with AASHTO T180 as modified by CP 23. The moisture content shall be at ± 2 percent of optimum moisture content. The surface of each layer shall be maintained during the compaction operations so that a uniform texture is produced, and the aggregates are firmly keyed. Moisture conditioning shall be performed uniformly during compaction.

The surface of the base course will be tested with a 10-foot straightedge, or other approved device. The surface shall be tested prior to the application of any pavement. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall not exceed ¼ inch.

All testing will be the responsibility of the Contractor performed with prior notice to the Engineer for observation. All irregularities exceeding the specified tolerance shall be corrected to the satisfaction of the Engineer at no additional cost to the Sponsor.

The above compaction and straightedge requirements shall not apply to shoulder gravel. Compaction of shoulder gravel shall be accomplished by wheel rolling, as directed.

METHOD OF MEASUREMENT

304.07 Aggregate base course will be measured by the cubic yard compacted in place.

BASIS OF PAYMENT

304.08 The accepted quantities of aggregate base course, of the class specified, will be paid for at the contract price bid per cubic yard, as shown in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Aggregate Base Course (Class 6)	Cubic Yard
Shoulder Aggregate Surface Course (Class 6)	Cubic Yard

Water will not be measured and paid for separately but shall be included in the work.

END OF SECTION

SECTION 306 RECONDITIONING

DESCRIPTION

306.01 This work consists of blading, shaping, wetting, and compacting the existing subgrade with moisture and density control.

CONSTRUCTION REQUIREMENTS

306.02 The top 12 inches of the existing subgrade shall be reconditioned by blading and rolling. Sufficient water shall be added to meet the density requirements as specified in the Contract. The reconditioned surface shall not vary above or below the lines and grades as staked by more than 0.08 foot. The surface shall be tested for smoothness and density prior to the application of any base course material. Where asphalt-surfacing materials are to be placed directly on the subgrade, the subgrade plane shall not vary more than 0.04 foot. All irregularities exceeding the specified tolerance shall be corrected to the satisfaction of the Engineer at no additional cost. The surface shall be satisfactorily maintained until base course has been placed.

METHOD OF MEASUREMENT

306.03 Reconditioning will be measured by the square yard of subgrade and shall include blading, shaping, scarifying, compacting the subgrade, finishing, and maintenance of the finished surface.

BASIS OF PAYMENT

306.04 The accepted quantities of reconditioning will be paid for at the contract unit price for reconditioning.

Payment will be made under:

Pay Item	**Pay Unit**
Subgrade Reconditioning	Square Yard

Water will not be measured and paid for separately but shall be included in the work.

END OF SECTION

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SECTION 401 PLANT MIX PAVEMENTS–GENERAL

DESCRIPTION

401.01 These specifications include general requirements that are applicable to all types of hot mix asphalts irrespective of gradation of aggregate, kind and quantity of asphalt cement, or pavement use. Deviations from these general requirements will be indicated in the specific requirements for each type.

This work consists of one or more courses of asphalt mixture constructed on a prepared foundation in accordance with these specifications and the specific requirements of the type under contract, and in conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established.

MATERIALS

401.02 Composition of Mixtures. The asphalt plant mix shall be composed of a mixture of aggregate, filler or additives if required and approved, asphalt cement, and reclaimed material if permitted and used.

(a) Mix Design. The Contractor shall submit the following to the Engineer:

(1) A proposed hot mix asphalt mix design prepared in accordance with Colorado Procedure 52, including a proposed job-mix gradation for each mixture required by the Contract which shall be wholly within the Master Range Table in subsection 703.04 before the tolerances shown in Section 401 are applied. The weight of lime shall be included in the total weight of the material passing the 75 µm (No. 200) sieve.

(2) The name of the refinery supplying the asphalt cement and the source of the anti-stripping additive.

The Contractor's proposed job-mix formula for each hot mix asphalt grading will be tested by the Contractor's QC lab utilizing materials actually produced and stockpiled for use on the project.

The job-mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size, a single percentage of asphalt cement to be added to the aggregate, and a single temperature for the mixture at the discharge point of the plant.

(b) Mixtures Furnished to the Project. After the job-mix formula is established, all mixtures furnished for the project shall conform thereto within the ranges of tolerances listed in Table 401-1.

Table 401-1

TOLERANCES FOR HOT MIX ASPHALT

Asphalt Content	± 0.3%
Asphalt Recycling Agent	± 0.2%
[1] **Hot Mix Asphalt – Item 403, Gradations**	
[2] Passing the 9.5 mm (3/8 inch) and larger sieves	± 6%
[2] Passing the 4.75 mm (No. 4) and 2.36 mm (No. 8) sieves	± 5%
[2] Passing the 600 µm (No. 30) sieve	± 4%
[2] Passing the 75 µm (No. 200) sieve	± 2%
[1]When 100% passing is designated, there shall be no tolerance. When 90 – 100% passing is designated, 90% shall be the minimum; no tolerance shall be used. [2]These tolerances apply to the Contractor's Process Control Testing.	

The job-mix formula for each mixture shall be in effect unless modified in writing on Form 43.

Should a change in sources of materials be made, a new job-mix formula shall be established before the new material is used. This new job-mix formula shall be in effect until modified by the Engineer. Requests made in writing by the Contractor for changes in the job-mix formula will be considered. The job-mix formula may be changed by the Engineer if the change will produce a mixture of equal or better quality and will:

(1) Permit better utilization of available material, or

(2) Result in a saving in cost to the Sponsor through an adjustment in unit price.

Tests for cleanliness, abrasion loss, and percent of fractured faces will be made on representative samples of aggregate taken during production or from the stockpiles.

Hot mix asphalt (HMA) will be tested for moisture susceptibility by the Contractor's QC lab in accordance with Table 401-2. If a sample fails to meet the criteria shown in Table 401-2, the Contractor shall take corrective action before being permitted to continue production. If proper corrective action cannot be readily determined, the Engineer will suspend the use of such material until Laboratory tests indicate that the corrective measures taken by the Contractor will provide material that is in compliance.

If one or more samples fail to meet the requirements of Table 401-2, material from the area represented by the failing sample will be evaluated as follows:

If the area represented by the failing sample contains 2,000 tons of the new pavement or less, then the result for the failing sample shall be considered a lot of one and will be evaluated by the Engineer.

Table 401-2

Grading	Test Procedure	Minimum Test Result	Sampling Frequency
All Gradings	CP L-5109 Method B	70	One per 10,000 tons or fraction thereof (minimum)

401.03 Aggregates. Aggregates shall meet the applicable requirements of subsection 703.04.

401.04 Mineral Filler. Mineral filler shall meet the requirements of subsection 703.06.

401.05 Hydrated Lime. Hydrated lime shall meet the requirements of subsection 712.03.

401.06 Asphalt Cements. The type and grade of asphalt cement will be specified in the Contract. The asphalt cement shall meet the applicable requirements of Section 702.

CONSTRUCTION REQUIREMENTS

401.07 Weather Limitations and Placement Temperatures. Hot mix asphalt shall be placed only on properly prepared unfrozen surfaces which are free of water, snow, and ice. The hot mix asphalt shall be placed only when both the air and surface temperatures equal or exceed the temperatures specified in Table 401-3 and the Engineer determines that the weather conditions permit the pavement to be properly placed and compacted.

Table 401-3

Placement Temperature Limitations in °F

Compacted Layer Thickness in inches	Minimum Surface and Air Temperature ºF	
	Top Layer	Layers Below Top Layer
< 1½	60	50
1½ - < 3	50	40

3 or more	45	35
Note: Air temperature is taken in the shade. Surface is defined as the existing base on which the new pavement is to be placed.		

If the temperature falls below the minimum air or surface temperatures, paving shall stop.

401.08 Asphalt Mixing Plant. The asphalt mixing plant shall be capable of producing a uniform material, have adequate capacity, and be maintained in good mechanical condition. Defective parts shall be replaced or repaired immediately if they adversely affect the proper functioning of the plant or plant units, or adversely affect the quality of the hot asphalt plant mix.

Dust, smoke, or other contaminants shall be controlled at the plant site to meet all air quality requirements in accordance with State and County permits.

Acceptable safety equipment shall be provided by the Contractor to accommodate sampling and testing.

Hot asphalt plant mix shall not be stored longer than nine hours unless additional protective measures are used and approved.

When hot asphalt plant mix is obtained from a commercial plant, the Contractor shall make arrangements for approved laboratory facilities at the plant site for testing hot asphalt paving mixtures.

401.09 Hauling Equipment. Trucks used for hauling asphalt mixtures shall have tight, clean, smooth metal beds thinly coated with a minimum amount of paraffin oil, lime solution, or other approved release agent. Petroleum distillates such as kerosene or fuel oil will not be permitted. Each truck shall have a cover of canvas or other suitable material to protect the mixture from the weather.

401.10 Asphalt Pavers. Self-propelled asphalt pavers shall be provided and equipped with an activated screed assembly, heated if necessary, capable of spreading and finishing the asphalt plant mix material in lane widths applicable to the typical section and thicknesses shown in the Contract. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of asphalt plant mix material in widths shown in the Contract.

The paver's receiving hopper shall have sufficient capacity for a uniform spreading operation and shall have an automatic distribution system that will place the mixture uniformly in front of the screed.

The screed or strike-off assembly shall produce the specified finished surface without tearing, shoving, or gouging the mixture.

The paver shall include an approved longitudinal paver wedge system to create a sloped safety edge as shown on the plans. The wedge system shall be attached to the screed and shall compact the HMA to a density at least as dense as the compaction imparted to the rest of the HMA layer by the paving screed. The system shall provide a sloped safety edge equal to 32 degrees plus or minus 5 degrees measured from the pavement surface cross slope extended. A single plate strike off shall not be used. The system shall be adjustable to accommodate varying paving thicknesses. The Engineer may allow the Contractor to use handwork for short sections or to saw cut the sloped safety edge after paving operations are completed in areas such as transitions at driveways, intersections, interchanges.

The Contractor shall submit the proposed paver wedge system for approval at the Pre-construction Conference. The Engineer may require proof that the system has been used on previous projects with acceptable results or may require a test section constructed prior to the beginning of work to demonstrate that it creates an acceptable wedge shape and compaction. Paving shall not begin until the system is approved in writing by the Engineer. The safety edge may be constructed on each lift of HMA or on the full-specified plan depth on the final lift. The finished shape of the safety edge shall extend for the full depth of the asphalt pavement or for the top 5 inches whichever is less.

The paver shall be capable of operating at forward speeds consistent with uniform and continuous laying

of the mixture. Stop and go operations of the paver shall be avoided.

The asphalt paver shall be equipped with a means of preventing the segregation of the coarse aggregate particles from the remainder of the asphalt plant mix when that mix is carried from the paver hopper back to the paver augers. The means and methods used shall be approved by the paver manufacturer and may consist of chain curtains, deflector plates, or other such devices and any combination of these.

The following specific requirements shall apply to the identified asphalt pavers:

(1) Blaw-Knox asphalt pavers shall be equipped with the Blaw-Knox Materials Management Kit (MMK).

(2) Cedarapids asphalt pavers shall be those that were manufactured in 1989 or later.

(3) Caterpillar asphalt pavers shall be equipped with deflector plates as identified in the December 2000 Service Magazine entitled “New Asphalt Deflector Kit {6630, 6631, 6640}”.

Prior to the start of using the paver for placing plant mix, the Contractor shall submit for approval a full description in writing of the means and methodologies that will be used to prevent asphalt paver segregation. Use of the paver shall not commence prior to receiving approval from the Engineer.

The Contractor shall supply a Certificate of Compliance that verifies that the approved means and methods used to prevent asphalt paver segregation have been implemented on all pavers used on the project.

Pavers shall be equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, and maintaining the screed at the specified longitudinal grade and transverse slope. The sensor shall be constructed to operate from either or both sides of the paver and shall be capable of working with the following devices:

(1) Ski-type device at least 30 feet in length.

(2) Short ski or short shoe.

(3) At least 5,000 feet of control line and stakes.

The type or types of devices to be furnished shall be as provided in the Contract. The controls shall be capable of maintaining the screed at the specified transverse slope within plus or minus 0.1 percent.

Manual operation will be permitted for constructing irregularly shaped and minor areas.

If the automatic controls fail or malfunction the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained.

If the Contractor fails to obtain and maintain the specified surface tolerances, the paving operations shall be suspended until satisfactory corrections, repairs, or equipment replacements are made.

Placement of hot mix asphalt on a waterproofed bridge deck shall be accomplished with equipment that will not damage the membrane or protective covering.

401.11 Tack Coat. When ordered by the Engineer or specified in the Contract, a tack coat shall be applied between pavement courses and paid for in accordance with Section 407.

401.12 Surface Conditioning. Irregularities in the existing pavement or base shall be brought to uniform grade and cross section. Prior to placing tack coat and beginning overlay work, the surface to be tack coated shall be swept to remove accumulations of loose gravel and debris. Asphalt plant mix shall be placed only on properly constructed surfaces that are free from substances that would adversely affect the pavement quality. Contact surfaces of curbing, gutters, manholes, and other structures shall be painted with a uniform coating of asphalt cement prior to placing asphalt mixture against them.

401.13 Preparation of Asphalt Cement. The asphalt cement shall be heated to the specified temperature without local overheating and shall be continuously supplied to the mixer at a uniform temperature within

the specified range.

401.14 Preparation of Aggregates. Heating and drying of the aggregates shall be accomplished without damaging the aggregate. When hydrated lime is used it shall be added to the aggregate in accordance with one of the following methods:

(1) Lime Slurry Added to Aggregate. The hydrated lime shall be added to the aggregate in the form of a slurry and then thoroughly mixed in an approved pugmill. The slurry shall contain a minimum of 70 percent water by weight.

(2) Dry Lime Added to Wet Aggregate. The dry hydrated lime shall be added to the blended aggregate wetted a minimum of 2 percent above the surface saturated dry condition (SSD), and then thoroughly mixed in an approved pugmill. The Engineer will not require the Contractor to increase the moisture above 5 percent total, although the Contractor may elect to do so if the added water is necessary to meet the minimum Lottman specification (See Table 401-2).

The Contractor may request that the 2 percent above SSD requirement be waived, provided the requirements of CPL 5150 have been met. If the HMA fails to meet the minimum TSR requirements defined in Table 401-2 at any point during production, the Contractor shall immediately be required to add the minimum amount of moisture as defined above.

The lime-aggregate mixture may be fed directly into the hot plant after mixing or it may be stockpiled for not more than 90 days before introduction into the plant for mixing with the asphalt cement. The hydrated lime may be added to different sized aggregates and stockpiled, by adding 75 percent of the lime to the aggregate passing the 4.75 mm (No. 4) sieve and 25 percent to the aggregate retained on the 4.75 mm (No. 4) sieve.

In order to ensure the required lime and water quantities are introduced, lime and water feed for lime operation shall have control systems that change introduction rates in conjunction with changes in plant mix production. The control systems shall be documented in the Contractor's PC Plan.

When a test for aggregate percent moisture falls below the required minimum, the Contractor will receive a warning. When two consecutive tests for aggregate percent moisture fall below the required minimum, a follow up test will immediately be performed. A failure on the follow up test will result in suspension of work. Production will remain suspended until the source of the problem is identified and corrected. Each time production is suspended, corrective actions shall be proposed in writing by the Contractor and approved in writing by the Engineer before production may resume.

401.15 Mixing. The dried aggregates and asphalt shall be combined in the mixer in the quantities required to meet the job-mix formula.

The materials shall be mixed until the aggregate is completely and uniformly coated, and the asphalt is uniformly distributed throughout the aggregate.

The minimum temperature of the mixture when discharged from the mixer and when delivered for use shall be as shown in Table 401-5:

Table 401-5

Asphalt Grade	**Minimum Mix Discharge Temperature, ºF[1]**	**Minimum Delivered Mix Temperature, ºF[2]**
PG 58-28	275	235
[1] The maximum mix discharge temperature shall not exceed the minimum discharge temperature by more than 30 ºF. [2] Delivered mix temperature shall be measured behind the paver screed.		

Hot mix asphalt mixture shall be produced at the lowest temperature within the specified temperature range that produces a workable mix and provides for uniform coating of aggregates (95 percent minimum in accordance with AASHTO T 195), and that allows the required compaction to be achieved.

Storing or holding of asphalt mixture will be permitted provided the characteristics of the mixture are not altered. If storing or holding of the mixture causes segregation, excessive heat loss, or adversely affects the quality of the finished product, corrective action shall be taken. Unsuitable mixture shall be disposed of at the Contractor's expense.

When placing hot asphalt mixture over bridge decks covered by waterproofing membrane, the minimum temperature of the mixture when rolling operations begin shall be 250 ºF. The job-mix formula temperature may be increased up to 30 ºF to obtain this temperature.

401.16 Spreading and Finishing. Asphalt pavers shall be used to distribute the mixture to the established grade and required thickness over the entire width or partial width as practicable.

The longitudinal joint in both a new pavement and an overlay pavement layer shall offset the joint in the layer immediately below by 6 inches. In every pavement layer, the longitudinal joints shall not be constructed in the wheel paths. The Contractor shall submit a longitudinal joint and pavement marking plan three days prior to the Pre-paving Conference. The plan shall show the location and configuration of the proposed longitudinal joints and pavement markings, and shall detail the methods to be used to field establish a control line. The Contractor shall use a continuous string line to delineate every longitudinal joint during paving operations. All exposed string line shall be picked up and disposed of at the end of each day's paving. Paving shall not commence until the plan has been approved in writing by the Engineer. The joints in the top layer of pavement shall be located as follows unless otherwise approved in writing by the Engineer:

(1) For 2-lane roadways, offset 6 to 12 inches from the center of pavement and from the outside edge of travel lanes.

(2) For roadways of more than 2 lanes, offset 6 to 12 inches from lane lines and outside edge of travel lanes. Longitudinal joints shall not cross the centerline, lane line, or edge line unless approved by the Engineer. Where paving operations are on the present traveled roadway, the Contractor shall arrange paving operations so there will be no exposed longitudinal joints between adjacent travel lanes at the end of a day's run. With the approval of the Engineer, the Contractor may leave an exposed longitudinal joint conforming to the following:

    (1) When the thickness of the pavement course being placed is 1.5 inches or less a vertical exposed longitudinal joint may be constructed.

    (2) When the thickness of the pavement course being placed is greater than 1.5 inches the joint shall be constructed according to one of the following:

        (i) The entire joint shall be tapered 3:1 or flatter. A taper steeper than 3:1 shall be considered vertical.

        (ii) The top portion of the longitudinal joint may be vertical. The vertical portion shall be a maximum of 1.5 vertical inches. The remainder of the joint, below the vertical portion, shall be tapered 3:1 or flatter.

    On areas where the use of mechanical spreading and finishing equipment is impracticable, the mixture shall be dumped, spread, raked, screeded, and luted by hand tools to the required compacted thickness and grades.

    Production of the mixture shall be maintained so pavers can be used in echelon to place the wearing course in adjacent lanes.

    The asphalt mixture shall be transported and placed on the roadway without segregation. All

segregated areas behind the paver shall be removed immediately upon discovery. The segregated material shall be replaced with specification material before the initial rolling has taken place. If more than 50 square feet of segregated pavement is ordered removed and replaced in any continuous 500 linear feet of paver width laydown, operations shall be discontinued until the source of the segregation has been found and corrected.

If at any time, the Engineer observes segregated areas of pavement, he will notify the Contractor immediately. After rolling, segregated areas will be delineated by the Engineer and evaluated as follows:

(1) The Engineer will delineate the segregated areas to be evaluated and inform the Contractor of the location and extent of these areas within two calendar days, excluding weekends and holidays, of placement.

(2) In each segregated area or group of areas to be evaluated, the Contractor shall take three 4-inch cores at random locations designated by the Engineer. In accordance with CP 75, the Contractor shall also take three 4-inch cores at random locations designated by the Engineer in non-segregated pavement adjacent to the segregated area. These cores shall be within 30 feet of the boundary of the segregated area and in the newly placed pavement. The coring shall be in the presence of the Engineer and the Engineer will take immediate possession of the cores.

(3) Gradation of the aggregate of the cores will be determined by the Contractor's QC lab in accordance with CP 46.

(4) The core aggregate gradations from the segregated area will be compared to the core aggregate gradations of the corresponding non-segregated area.

(5) Two key sieves of the core gradations from the segregated area will be compared to the core gradations from the corresponding non-segregated area to determine the difference. If differences for both key sieves exceed the allowable difference specified in the table below, the area is segregated.

SEGREGATION DETERMINATION

Mix Grading	Key Sieves	Allowable Difference, %
SX	2.36 mm (#8), 4.75 mm (#4)	9

(6) Segregated areas in the top lift shall be removed and replaced at the Contractor's expense. The Engineer may approve a method equivalent to removal and replacement that results in a non-segregated top lift. Segregated areas, in lifts below the top lift that are smaller than 50 square feet shall be corrected by the Contractor at the Contractor's expense in a manner acceptable to the Engineer. Segregated areas larger than 50 square feet in any lift shall be removed and replaced by the Contractor at the Contractor's expense.

If the area is determined to be segregated, the coring shall be at the expense of the Contractor. If the area is determined to be non-segregated, the Engineer will reimburse the Contractor $1,000 for obtaining the six cores.

The Engineer will perform a systematic segregation check in accordance with CP 58 as early in the project as is feasible to determine if temperature segregation problems exist. Temperature segregation will be of concern on the project if, across the width of the mat, temperatures vary by 25 °F or more. Densities will not need to be taken in the systematic segregation check. The Engineer will discuss the temperature findings of the systematic segregation check with the Contractor. The Engineer may evaluate the HMA for low density due to temperature segregation whenever industry best practices, are not being followed or the Engineer suspects temperature segregation is occurring. The Engineer will first meet with the

Contractor to discuss the paving practices that are triggering the temperature investigation. Areas across the mat, excluding the outside 1 foot of both edges of the mat, that are more than 25 °F cooler than other material across the width may be marked for density testing. Material for temperature comparison will be evaluated in 3-foot intervals behind the paver across the width of the mat. The material shall be marked and tested in accordance with CP 58. If four or more areas within a lot of 500 tons have densities of less than 93 percent of the material's maximum specific gravity for SMA mixes or less than 92 percent of the material's maximum specific gravity for all other HMA mixes, a 5 percent price disincentive will be applied to the 500-ton lot. The 500-ton count begins when the Engineer starts looking for cold areas, not when the first cold area is detected. This price disincentive will be in addition to other identified disincentives. Only one area per delivered truck will be counted toward the number of low density areas. Temperature segregation checks will be performed only in areas where continuous paving is possible.

401.17 Compaction. The hot mix asphalt shall be compacted by rolling. Both steel wheel and pneumatic tire rollers will be required. The number, weight, and type of rollers furnished shall be sufficient to obtain the required density while the mixture is in a workable condition. Compaction shall begin immediately after the mixture is placed and be continuous until the required density is obtained. When the mixture contains unmodified asphalt cement (PG 58-28), and the surface temperature falls below 185 °F, further compaction effort shall not be applied unless approved, provided the Contractor can demonstrate that there is no damage to the finished mat.

All roller marks shall be removed with the finish rolling. Use of vibratory rollers with the vibrator on will not be permitted during surface course final rolling and will not be permitted on any rolling on bridge decks covered with waterproofing membrane.

The longitudinal joints shall be compacted to a target density of 92 percent of the theoretical maximum specific gravity. The tolerance shall be plus or minus 4 percent. 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. Density (percent relative compaction) will be determined in accordance with CP 44.

The Contractor shall obtain one 6-inch diameter core at a random location within each longitudinal joint sampling section for determination of the joint density. The Contractor shall mark and drill the cores at the location directed by the Engineer and in the presence of the Engineer. The Engineer will take possession of the cores for testing. The Contractor may take additional cores at his own expense. Coring locations shall be centered on the visible line where the joint between the two adjacent lifts abuts the surface. The center of all joint cores shall be within 1 inch of this visible joint line. Core holes shall be repaired by the Contractor using materials and methods approved by the Engineer. PC and OA joint coring shall be completed within five calendar days of joint construction.

Longitudinal joint coring applies to all pavement layers. When constructing joints in an echelon paving process, the joints shall be clearly marked to ensure consistent coring location. In small areas, such as intersections, where the Engineer prescribes paving and phasing methods, the Engineer may temporarily waive the requirement for joint density testing.

Along forms, curbs, headers, walls, and all other places not accessible to the rollers, the mixture shall be thoroughly compacted with mechanical tampers.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective, shall be immediately removed and replaced with fresh hot mixture, and compacted to conform to the surrounding area.

All hot mix asphalt (HMA) materials or work will be evaluated for conformity to the Contract. The Contractor shall determine the necessary roller compaction process needed to produce a target pavement density of 94.0 percent of the average daily theoretical maximum specific gravity (RICE) values in accordance with Colorado Procedure 44 Method B. During the first day of production, three stratified

random locations will be selected by the Engineer. At each location, a minimum of three 4-inch diameter cores shall be taken by the Contractor within an 18-square foot area of pavement. The Contractor's QC lab will take possession of the set of three cores from each location and determine the intermediate percent relative compaction for each core. Each set of three cores will be averaged to produce the percent compaction for each location. A minimum of three locations will be used to measure the percent compaction of the first day of production. All coring shall be completed by the Contractor and submitted to the Engineer.

Full production of the thin lift shall not begin until the required project compaction process is successfully established by the Contractor and approved by the Engineer. The approved compaction process shall be used for the duration of the thin lift paving. Changes to the thin lift mixture shall require a new roller compaction process.

During production, density tests shall be taken at a frequency of one set of three cores per 500 tons of HMA placed. Each 4-inch diameter core in the set shall be taken by the Contractor within an 18 square foot area of pavement at each stratified random location. The Contractor's QC lab will take possession of a set of three cores from each location to determine the intermediate percent compaction for each core. Each set of three cores will be averaged to produce the percent compaction for each location.

The Engineer will be immediately notified when the Contractor's QC lab locates areas of in-place density less than 89.8 percent of average RICE for the material. The actual area of pavement to be removed full width and replaced will be determined by the Contractor, taking one 4-inch diameter exploratory core at 50-foot intervals or less in each direction from the affected location until two successive locations are found in each direction which are greater than 90.9 percent of the average RICE for the material.

401.18 Joints. Placing of the hot mix asphalt shall be continuous, and rollers shall not pass over the unprotected end of a freshly laid mixture. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. A coat of asphalt cement shall be applied to contact surfaces of all joints just before additional mixture is placed against the previously compacted material. Location and configuration of longitudinal joints shall be in accordance with subsection 401.16.

401.19 Pavement Samples. The Engineer may take samples of the compacted pavement at random locations on the project for testing. Where samples have been taken, new material shall be placed and compacted by the Contractor to conform with the surrounding area.

401.20 Surface Smoothness. Not Used.

METHOD OF MEASUREMENT

401.21 Hot mix asphalt and asphalt cement will be measured by the ton. Batch weights will not be permitted as a method of measurement. The tonnage shall be the weight used in the accepted pavement. Deduction will not be made for the weight of asphalt cement in the mixture.

BASIS OF PAYMENT

401.22 All work performed and measured as described above will be paid for as provided in the respective sections for each type specified.

Water used in the mixing plant, in accordance with subsection 401.14, to bring the lime-aggregate mixture to approved moisture content will not be measured and paid for separately but shall be included in the work.

Facilities for testing hot asphalt plant mix at the site of the commercial plant will not be paid for separately, but shall be included in the work.

Coring for in-place density, coring for longitudinal joint density, core hole repair, and associated expenses will not be paid for separately but shall be included in the work. Traffic control for this work will be paid for in accordance with the contract.

All costs associated with the construction of the safety edge specified in subsection 401.10 will not be paid for separately, but shall be included in the work.

END OF SECTION

SECTION 403 HOT MIX ASPHALT

DESCRIPTION

403.01 This work consists of constructing one or more courses of hot mix asphalt (HMA) on a prepared base in accordance with these specifications, and in conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established.

The asphalt pavement shall be composed of a mixture of aggregate, filler if required, and asphalt cement.

Hot Mix Asphalt (Patching) consists of those quantities required for the replacement of unstable corrugated areas in the existing pavement, pipe trenches, areas removed for curb and gutter forms, areas between the curb and gutter or sidewalk and the existing paved parking lots, and areas designated on the plans. These quantities will be restricted to small areas which require hand placement methods and where conventional paving equipment cannot be utilized.

MATERIALS

403.02 The materials shall conform to the requirements of subsections 401.02 through 401.06.

CONSTRUCTION REQUIREMENTS

403.03 The construction requirements shall be as prescribed in subsections 401.07 through 401.20.

Areas to be patched shall be excavated and squared to a neat line, leaving the sides of the excavation vertical. Prior to placement of the patch, the exposed sides of the existing pavement shall be thoroughly coated with emulsified asphalt (slow-setting). Hot mix asphalt shall then be placed and compacted in succeeding layers not to exceed 3 inches in depth.

METHOD OF MEASUREMENT

403.04 Hot mix asphalt will be measured as prescribed in subsection 401.21.

BASIS OF PAYMENT

403.05 The accepted quantities of hot mix asphalt will be paid for in accordance with subsection 401.22, at the contract unit price per ton for the asphalt mixture.

Payment will be made under:

Pay Item	Pay Unit
Hot Mix Asphalt (Grading SX) (75) (58-28)	Ton

Aggregate, asphalt cement, asphalt recycling agent, additives, hydrated lime, and all other work necessary to complete each hot mix asphalt item will not be paid for separately but shall be included in the unit price bid.

Excavation, preparation, and tack coat of areas to be patched will not be measured and paid for separately, but shall be included in the work.

END OF SECTION

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SECTION 407 TACK COAT

DESCRIPTION

407.1 This work consists of preparing and treating an existing surface with asphalt material, and blotter material, if required, in accordance with these specifications and in conformity with the lines shown on the plans or established.

MATERIALS

407.2 Asphalt Material. The type and grade of asphalt material for tack coating will be specified in the Contract.

The asphalt material for all coatings shall meet the applicable requirements of Section 702. The asphalt material for tack coating may be conditionally accepted at the source. The rejuvenating agent shall be accepted before loading into the distributor.

407.3 Blotter Material. Not Used.

CONSTRUCTION REQUIREMENTS

407.04 Weather Limitations. Tack coat shall not be applied under the following conditions:

(1) When the surface is wet.

(2) When weather conditions would prevent the proper construction of the tack coat.

407.05 Equipment. The Contractor shall provide equipment for heating and uniformly applying asphalt material.

The distributor and equipment shall be capable of uniformly distributing asphalt material at even temperature and uniform pressure on variable widths of surface up to 15 feet at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard. The allowable variation from any specified rate shall not exceed plus or minus 0.02 gallon per square yard. Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.

The distributor for rejuvenating agent shall also be equipped with the following:

(1) Heating facilities with controls to reach a temperature of 130 °F.

(2) Circulating system to maintain proper mixture of the rejuvenating agent.

407.06 Preparation of Surface. Preparation of the surface to be treated shall include all work necessary to provide a smooth, dry, uniform surface. The work shall include patching, brooming, shaping to required grade and section, compaction, and removal of unstable corrugated areas.

The edges of existing pavements which are to be adjacent to new pavement shall be cleaned to permit the adhesion of asphalt materials.

407.07 Application of Asphalt Material. Asphalt material shall be applied by a pressure distributor in a uniform and continuous spread. When traffic is maintained, not more than ½ of the width of the section shall be treated in one application, or sufficient width shall be left to adequately handle traffic. Care shall be taken so the application of asphalt material at the junctions of spreads is not in excess of the specified quantity. Excess asphalt material shall be removed or distributed as directed. Skipped areas or deficiencies shall be corrected.

Skipped areas or deficiencies shall be corrected. Asphalt material shall not be placed on any surface where traffic will travel on the freshly applied material.

The rate of application, temperatures, and areas to be treated shall be approved prior to application of the coating.

Tack coat shall consist of emulsified asphalt (CSS-1h) mixed at a rate of one gallon of water for each gallon of emulsion. Tack coat shall be uniformly applied between layers of hot bituminous pavement at a rate of 0.1 gallon per square yard. Tack coat shall also be applied to the edges of existing pavements which are to be adjacent to new pavement.

407.08 Application of Blotter Material. Not Used.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

407.09 Asphalt material will be measured and paid for in accordance with Section 411.

END OF SECTION

SECTION 411 ASPHALT MATERIALS

DESCRIPTION

411.01 This work consists of furnishing asphalt materials of all types and the application of these materials in accordance with these specifications and details shown on the plans.

MATERIALS

411.02 All asphalt materials shall conform to the requirements of Section 702.

The type and grade of asphalt material will be specified in the Contract.

CONSTRUCTION REQUIREMENTS

411.03 Asphalt materials shall be fortified when required by the Contract with an additive of an approved type. Additive shall be uniformly blended with asphalt materials at the refinery, or through an approved in-line blender as specified in the Contract.

Asphaltic application methods which result in the discoloration of concrete structures, concrete curbs, and concrete gutters will not be permitted. Coatings shall be applied so as to cause the least inconvenience to traffic and to permit one- way traffic. Traffic will be permitted to travel on fresh asphalt material when it can be accomplished without pickup or tracking of the asphalt material.

Asphaltic materials used as fuel or lubricant shall be stored separately.

Emulsified asphalt for tack coat shall be diluted before use as shown in the Contract or as directed.

METHOD OF MEASUREMENT

411.04 Asphalt cement will be measured by the ton by one of the following methods as determined by the Engineer:

The pay quantity of asphalt cement will be determined by multiplying the total accepted tons of paving mix by the weighted average of all asphalt content percentages obtained from the field acceptance tests for that item.

Emulsified asphalt and liquid asphaltic materials will be measured by the gallon.

The pay quantity for emulsified asphalt shall be the number of gallons before dilution with water.

BASIS OF PAYMENT

411.05 The accepted quantities, measured as provided above, will be paid for at the contract unit price per ton or gallon as the case may be, for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Tack Coat (CSS-1h)	Gallon

Water used to dilute emulsified asphalt will not be paid for separately but shall be included in the work.

END OF SECTION

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SECTION 420 GEOSYNTHETICS

DESCRIPTION

420.01 This work consists of furnishing and installing geotextiles and geomembranes for paving, impervious lining, erosion control, drainage, separators, and landscape weed barrier.

MATERIALS

420.02 Geotextiles and geomembranes shall meet the applicable requirements of subsections 712.07 and 712.08 for the use intended. Geotextiles for erosion control for drainage or for separators may be Class 1, Class 2, or Class 3, conforming to subsection 712.08, if the class is not specified on the plans. Paving geotextile shall be a minimum Class 3, conforming to subsection 712.08.

CONSTRUCTION REQUIREMENTS

420.03 Areas on which the geosynthetic is to be placed shall have a uniform slope, be reasonably smooth, free from mounds and windrows, and free of any debris or projections which could damage the material.

Riprap or cobbles placed on the geosynthetic shall not be dropped from a free fall greater than 3 feet. The cushion layer or initial layer of riprap may require careful placement without free fall to avoid geosynthetic damage. Geosynthetics damaged or displaced before or during placement of overlying layers shall be replaced or repaired in accordance with the requirements of this section and to the satisfaction of the Engineer, at the Contractor's expense.

420.04 Paving. Not Used.

420.05 Impervious Lining. Not Used.

420.06 Erosion Control and Drainage. Geotextiles for erosion control or drainage shall be loosely laid (not stretched) with the roll direction the same as the anticipated water flow, and in a manner that avoids any rupture of the cloth.

The geotextile may be anchored in place with securing pins at 3-foot spacing along but not closer than 2 inches to all edges and to the extent necessary to prevent displacement. When shown on the plans, erosion control geotextile may be held in place using 6 inches of clean embankment with a minimum 6-inch trench at the top of the slope. Overlaps shall be at least 12 inches on slopes 3:1 and flatter, and at least 24 inches on slopes steeper than 3:1. Laps shall be made with the uphill layer on top. Sewn seams in accordance with the manufacturer's recommendations may be used in place of overlaps. Full rolls shall be used whenever possible in order to minimize the number of roll end laps. Lengths and widths of individual sheets shall be at the Contractor's option.

420.07 Geotextile Separator. The geotextile shall be unrolled as smoothly as possible on the prepared subgrade in the direction of construction traffic. The geotextile shall be placed by machinery or by hand labor. The geotextile shall not be dragged across the subgrade. Wrinkles and folds in the geotextile (not associated with roadway curves) shall be removed by stretching and staking as required. The geotextile may be held in place prior to placement of cover by pins, staples or piles of fill or rock. On curves, the geotextile may be folded to conform to the curve. The fold or overlap shall be in the direction of construction and held in place as prescribed above. Adjacent geotextile rolls shall be overlapped in the direction of subbase placement using the guidelines in Table 420-1. Before covering, the condition of the geotextile will be inspected by the Engineer to determine that no holes, rips or other defects exist. If any defects are observed, the section of the geotextile containing the defect shall be repaired by placing a new layer of geotextile extending beyond the defect in all directions a minimum distance equal to the overlap shown in Table 420-1. Alternatively, the defective section may be replaced.

Either sewn seams or overlaps (unsewn seams) shall be used in construction. The widths of the overlaps shall conform to Table 420-1. Sewn seams shall be in accordance with the manufacturer's

recommendations.

The first lift of cover material shall be end-dumped or spread over the geotextile from the edges of the geotextile. The height of the dumped pile shall be limited to avoid local bearing capacity failures. The first lift of cover material shall be graded to a 12-inch thickness or to top of grade whichever is less and compacted. Equipment shall not be on the treated area with less than the minimum thickness of compacted cover material over the geotextile. Small dozer equipment or front end loader shall be used to spread the cover material.

Construction vehicles shall be limited in size and weight such that rutting in the initial lift is no deeper than 3 inches. If rut depths exceed 3 inches, the Contractor shall use a smaller size and weight of construction vehicles. Ruts shall be filled in with cover material.

Compaction of lifts shall be accomplished without damaging the geotextile.

Construction equipment shall not make turns on the first lift of cover material.

Table 420-1

MINIMUM REQUIRED OVERLAP

Subgrade Strength R-Value	Overlap Width (Unsewn Seam) Inches
5 – 10	30
10 – 20	24
>20	18

420.08 Landscape Weed Barrier. Not Used.

METHOD OF MEASUREMENT

420.09 Geomembranes and geotextiles will be measured by the square yard of surface area covered, complete in place.

BASIS OF PAYMENT

420.10 The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule. Payment will be made under:

Pay Item	**Pay Unit**
Geotextile (Separator) (Class 2)	Square Yard

Securing pins, adhesives, sewn seams, asphalt cement, brooming, skilled technician, and other work and materials necessary for placement will not be measured and paid for separately but shall be included in the work.

END OF SECTION

SECTION 603 CULVERTS AND SEWERS

DESCRIPTION

603.01 This work consists of the construction of culverts (cross drains), side drains, storm drains, and sanitary sewers hereinafter referred to as "conduit", where a specific pipe material is required. Work shall be in accordance with these specifications and in conformity with the lines and grades shown on the plans or established.

MATERIALS

603.02 Materials shall meet the requirements shown on the plans and in the following subsections:

Reinforced Concrete Pipe	706.02
Pipe Joint Sealing Compounds	705.04
Gaskets	705.03
Resilient Compression Ring Material	705.05

Plastic end sections shall not be used.

CONSTRUCTION REQUIREMENTS

603.03 General. Pipe shall be protected during handling against impact shocks and free fall.

603.04 Excavation. Trenches shall be excavated to a width sufficient to allow for proper jointing of the conduit and thorough compaction of the bedding and backfill material under and around the conduit.

The completed trench bottom shall be firm for its full length and width. The trench for cross drains shall have a minimum longitudinal camber of 1 percent of the length of the pipe. Camber may be increased to suit the height of fill and supporting soil.

When conduits are to be installed in new embankments, the embankment shall first be constructed to the required height of at least 0.3 times the outside diameter or raise of the conduit, and for a distance each side of the conduit location of at least 5 times the diameter or span of the conduit, after which the trench shall be excavated and the conduit installed.

Excavation shall be by open cut from the surface, except when pipe jacking is specified or directed in writing by the Engineer.

603.05 Bedding for Concrete Conduit. Bedding shall be prepared in accordance with details as shown on the plans. The bed shall consist of a layer of loose structure backfill at least 3 inches in thickness. Recesses shall be made to accommodate the bell of bell-and-spigot pipe. Adjustments to line and grade shall be made by scraping or filling under the body of the conduit. Wedging or blocking the bell will not be permitted.

603.06 Placing Conduit. The conduit laying shall begin at the downstream end of the conduit line. The lower segment of the conduit shall be in contact with the prepared bedding throughout its full length. Bell or groove ends of concrete conduits and outside circumferential laps of metal or plastic conduits shall be placed facing upstream.

Paved or partially lined conduit shall be placed so that the longitudinal centerline of the paved segment coincides with the flow line.

603.07 Joining Conduit. Joint systems for storm drains shall be watertight.

(a) *Concrete Conduit.* Conduit sections shall be joined in such a manner that the ends are fully entered and the inner surfaces are reasonably flush and even.

At locations where rubber gaskets are specified in the Contract for conduits used for storm drains and

cross culverts, rubber gaskets conforming to subsection 705.03 shall be used. At locations where the type of joint is not otherwise specified in the Contract for conduit used for storm drains and cross culverts, joints shall be made with joint sealing compound. Primer shall be furnished when recommended by the manufacturer of the joint sealing compound. Primer shall conform to and shall be applied in accordance with the manufacturer's recommendations to both surfaces of the conduit sections being joined, for the full circumference. Sealing compound shall be applied according to the manufacturer's recommendations. When a specific type of sealing compound is desired, it shall be as shown in the Contract.

Rubber gaskets conforming to subsection 705.03 shall be used for concrete pipe sanitary sewer joints.

(b) *Metal Conduit.* Not Used.

(c) *Plastic Conduit.* Not Used.

603.08 Elongation. Not Used.

603.09 Backfilling. After the conduit or section of conduit is placed, it shall be inspected before any backfill is placed. Reinforced concrete pipe (RCP) shall be visually inspected by the Engineer.

Conduit found to be damaged shall be replaced, and conduit found to be out of alignment or unduly settled shall be taken up and relaid. The trench shall then be backfilled per the Drawings.

Special care shall be taken when backfilling around conduit to bring the backfill materials up on both sides of the conduit, evenly and simultaneously. Protection of conduits during construction shall be the Contractor's responsibility. Damage to the conduit due to the Contractor’s operations shall be repaired or replaced at the Contractor's expense.

Trenches in existing streets shall be resurfaced as soon as practicable with the type and thickness of bases and pavement shown in the Contract or as designated.

After culvert pipe is backfilled and earthwork over the pipe is complete to the top of the subgrade, the pipe deflection shall be measured in the presence of the Engineer. The maximum allowable deflection shall be 5 percent. Deflection is a reduction in the inside diameter of the pipe measured in any direction. Measurement shall be made using a mandrel, laser profile, or other method approved by the Engineer. Measurement shall be made 30 days or more following the pipe installation. Pipe having any deflections in excess of 5 percent at any location within the pipe shall be removed and reinstalled. Pipe that is permanently deformed or damaged in any way shall be replaced. Replaced pipe shall be retested 30 days or more after the installation in accordance with the method described above.

603.10 Deflection Testing of Plastic Pipe. After plastic pipe is backfilled and earthwork over the pipe is complete to the top of the subgrade, the pipe deflection shall be measured in the presence of the Engineer. The maximum allowable deflection shall be 5 percent. Deflection is a reduction in the nominal diameter of the pipe measured in any direction. Measurement shall be made using a mandrel, laser profile, or other method approved by the Engineer. Measurement shall be made 30 days or more following the pipe installation. Pipe having any deflections in excess of 5 percent at any location within the pipe shall be removed and reinstalled at the Contractor’s expense. Pipe that is permanently deformed or damaged in any way shall be replaced at the Contractor’s expense. Replaced pipe shall be retested 30 days or more after the installation in accordance with the method described above.

603.11 Repair of Damaged Culvert. Damaged pipe shall not be repaired. The Engineer will determine when the pipe is either acceptable or unacceptable. Unacceptable pipe shall be removed and replaced.

METHOD OF MEASUREMENT

603.12 Conduit used for culverts and storm drains of the different types and sizes will not be measured but will be the net length of pipe called for on the plans, except when field changes are ordered or when there are errors on the plans. In case of exceptions, the quantity to be measured shall be the actual net

length of the conduit measured along the bottom centerline. Extra length of the conduit due to joint creep will not be measured and paid for.

End sections will be measured by the number of units installed.

Relaid pipe will be measured and paid for in accordance with Section 210.

BASIS OF PAYMENT

603.13 The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule. Except as otherwise indicated on the plans or in the special provisions, all joints, elbows, concrete collars, connecting bands, and other connecting devices will not be paid for separately but shall be included in the work.

Payment will be made under:

Pay Item	Pay Unit
12 Inch RCP (Class III) (Complete In Place)	Linear Foot
12 Inch Reinforced Concrete End Section	Each

Structure excavation and structure backfill will not be measured separately, but shall be included in the cost of the item.

END SECTION

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SECTION 612 DELINEATORS AND REFLECTORS

DESCRIPTION

612.01 This work consists of the installation and furnishing of delineators and reflectors in accordance with these specifications and in conformity with the lines, grades and details shown on the plans or established.

MATERIALS

612.02 Materials for the various types of delineators and reflectors shall be as follows:

(a) *Delineators.*

1. Steel Posts. Details for each type of delineator are shown on the plans. Posts shall conform to the requirements shown on the plans, and reflectors shall conform to the requirements in subsections 713.07 and 713.10.
2. Flexible Posts. Not Used.
3. Reflector Strip. Not Used.

(b) *Median Barrier Reflector.* Not Used.

CONSTRUCTION REQUIREMENTS

612.03 Spacing, location, color of reflectors and placement of delineator posts shall be as shown on the plans.

METHOD OF MEASUREMENT

612.04 Delineators and reflectors for median barrier will be measured by the actual number of the various types installed and accepted.

BASIS OF PAYMENT

612.05 The accepted quantities will be paid for at the contract unit price each for the pay items listed below that are included in the bid schedule.

Payment will be made under:

Pay Item	**Pay Unit**
Delineator (Type I) (Double Height) (Crystal)	Each

Payment will be full compensation for all work, materials, and equipment required to install delineators.

END OF SECTION

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SECTION 614 TRAFFIC CONTROL DEVICES

DESCRIPTION

614.01 This work consists of the construction of traffic signs and sign structures, traffic signals and systems, barricades, rumble strips, masking sign legends on new sign panels, providing and installing multi-directional steel sign break-away assemblies, and modification of sign posts and legends. This work shall be done in accordance with these specifications, the latest revision of the "Manual on Uniform Traffic Control Devices (MUTCD)for Streets and Highways" published by the FHWA and adopted by CDOT, the latest revision of the Colorado Supplement thereto, and in conformity with the details shown on the plans or established.

This work includes the installation of single or double tubular steel sign posts, supporting tubular sockets, and concrete footings at locations shown on the plans.

MATERIALS

614.02 Sign Posts. Steel for Sign Posts shall conform to the material grade and type specified in the Contract.

614.03 Overpass Mounted Sign Bracket. Not Used.

614.04 Sign Panels. Sign panel materials shall conform to Section 713 and to the details shown on the plans. Sign panels shall be produced in accordance with the retroreflective sheeting manufacturer's recommendations. Layout and font design shall conform to the "Standard Highway Signs" published by FHWA. Font selection for guide sign legends shall conform to the most recent version of the "CDOT Sign Design Manual". Sign layouts for special signs shall be in accordance with the detailed sign layouts proved on the plans or by the Engineer.

Silk screen and digital process figures shall be in accordance with the plans and series figures described in the current editions of "Standard Highway Signs", published by the FHWA, and the "Colorado Supplement to Standard Highway Signs".

All exposed lockbolt fastener heads on the faces of the sign panels shall be covered with material matching the background of the panel.

All sign panels shall be identified with the month and year that the sign was manufactured. The date shall be located on the lower right side of the back of the sign panel and shall be approximately 1/4 inch high. The date shall be stamped or adhered onto the sign panel material for a permanent record. This work will be paid for as part of the Item.

614.05 Sign Illumination and Illuminated Signs. Not Used.

614.06 Flashing Beacon. Not Used.

614.07 Barricades. Not Used.

614.08 Traffic Signal Materials. Not Used.

CONSTRUCTION REQUIREMENTS

614.09 Highway Signs and Traffic Signals. Not Used

614.10 Traffic Signal Systems - Construction. Not Used

614.11 Barricades. Construction shall conform to the requirements of Section 508.

614.12 Rumble Strips. Not Used

METHOD OF MEASUREMENT

614.13 Ground sign panels will be measured by the square feet of facing. For signs other than rectangular

or triangular shape, the area in square feet will be computed from dimensions of the smallest rectangular shape from which a panel can be fabricated. Sign panels shall include all mounting and backing angles required.

Sign panels shall include background, message, backing zees (Classes 2 and 3), date of manufacture, and all necessary hardware.

When called for on the plans, sign posts, sockets and footings, wedges and mounting clamps will be regarded as a single assembly, and will be measured by the actual number of Steel Sign Support (Post and Socket) that are installed and accepted.

BASIS OF PAYMENT

614.14 The accepted quantities will be paid for at the contract price per unit of measurement for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Reinstall Salvaged Gas Line Marker	Each
Steel Sign Support (2-Inch Square) (Post & Socket)	Each
Sign Panel (Class I)	Square Foot

All costs associated with the manufacturer's representative and obtaining the required documentation for tubular steel sign supports will not be measured and paid for separately but shall be included in the work.

END OF SECTION

SECTION 625 CONSTRUCTION SURVEYING

DESCRIPTION

625.01 This work consists of the construction surveying, calculating, and staking necessary for the construction of all elements of the project. The work shall be done under the supervision of a Professional Land Surveyor (PLS) or Professional Engineer (PE) who is experienced and competent in road and bridge construction surveying and licensed in the State of Colorado.

Locating, preserving, referencing, installing and restoring land monuments such as Primary Control monuments from which the right of way or any land boundary will be calculated, described or monumented, Public Land Survey System (PLSS) monuments, General Land Office (GLO) monuments, Bureau of Land Management (BLM) monuments, Mineral Survey (MS) monuments, Right-of-way (ROW) monuments, property boundary monuments, easement monuments, and other monuments that are required by law or regulation to be established by a PLS, and the determination of any land boundary, shall be done in accordance with Section 629, under the supervision of a Professional Land Surveyor (PLS) who is experienced and competent in Right of Way and boundary surveying and licensed in the State of Colorado.

The PLS shall be available to review work, resolve problems, and make decisions in a timely manner.

Unless specified otherwise in the Contract, all survey procedures shall be in conformance with the CDOT Survey Manual.

If the Revision of Project Plans and Other Data states 3D modeling data is available, the Contractor may choose to perform 3D Engineered Construction Surveying (3DECS).

3DECS is the use of global positioning and or robotic instruments to guide construction equipment operations by comparing 3D model information in real time. For 3DECS, either the construction equipment is fed modeling information and makes automatic adjustments (machine control) or the equipment operator is fed the information and makes physical adjustments.

Adobe Sign software shall be used for electronic seals by the Contractor's Engineer, a Professional Engineer, or a Professional Land Surveyor. Electronic signatures and seals shall comply with the requirements of the Architects, Professional Engineers, and Professional Land Surveyors Rules and Regulations, 4 CCR 730-1.

MATERIALS AND EQUIPMENT

625.02 The Contractor shall furnish all personnel, survey equipment, safety equipment, materials, and traffic control necessary to perform the required construction surveying and staking. All surveying equipment, including Electronic Distance Meters (EDM), total stations, theodolites, levels, rods, tapes, tripods, tribrachs, and Global Positioning System (GPS) receivers and equipment, shall be checked and calibrated in accordance with the CDOT Survey Manual, Chapter 6, Section 6.1.10, and documented in the survey records prior to the start of work and every six months thereafter.

EDM and total stations shall be checked and calibrated on a National Oceanic and Atmospheric Administration/ National Geodetic Survey (NOAA / NGS) calibrated baseline in accordance with the CDOT Survey Manual, Chapter 2, Section 2.1 and 2.2, and documented in the survey records prior to the start of work and every six months thereafter.

GPS receivers and equipment shall be checked and calibrated on a NOAA / NGS calibrated baseline in accordance with the CDOT Survey Manual Chapter 3 and documented in the survey records prior to the start of work and every six months thereafter.

Levels shall be checked and calibrated in accordance with the CDOT Survey Manual, Chapters 5 and 6, and documented in the survey records prior to the start of any level circuit.

If any survey equipment is found to be functioning outside the manufacturer's specified tolerance, certification from an approved repair facility showing that the instruments have been repaired, properly adjusted, or both if necessary shall be included in the survey records and submitted to the Engineer before being used.

Traffic control shall be in accordance with Section 630.

CONSTRUCTION REQUIREMENTS

625.03 General. The Sponsor's surveyor will establish Primary horizontal and vertical control for the project. All available information defining the extent of that control is provided on the plans in accordance with the CDOT Survey Manual Chapter 6 or is available from the Engineer.

625.04 Contractor Surveying. The Contractor shall perform all construction surveying and staking necessary for construction of the project. Construction surveying and staking shall be based on the Primary Horizontal and Vertical Control established by the Surveyor. Bid items which require stakes to be set by the Contractor's Surveyor are shown on the Surveyor Tabulation Sheet of the plans and shall be in accordance with the CDOT Survey Manual Chapter 6.

If the Contractor uses 3D Engineered Surveying the following shall apply:

(1) All surveying shall be based on the Primary Horizontal and Vertical Control established by the Sponsor's surveyor.

(2) The Contractor shall provide construction stakes for the control points of the project centerline or Engineer approved offset line (i.e. POT, POC, PCC, PC, PT, TS, ST, SC, CS per the Survey Manual) and angle points, all of which shall be established from primary control monuments and their assigned coordinates as shown on the plans.

(3) Staking for the project centerline or offset, shall be established from the project centerline control points as shown on the plans in order to provide a method of machine control equipment checks, inspection, and field verification.

(4) The maximum staking interval for the project centerline shall be 500 feet on tangents and 100 feet on curves or as specified on the survey tabulation sheet. All project centerline control points as shown on the plans shall be staked.

(5) Within the first week of the Contractor utilizing 3DECS, the Contractor shall check their 3DECS system and verify on writing to the Engineer that the accuracy of the system complies with the contract requirements.

At no cost to the Sponsor, the Contractor shall revert to traditional surveying and disband using 3DECS should the Engineer determine the existence of contractor quality or accuracy issues related to 3DECS.

The Contractor shall check all Sponsor-established Primary horizontal and vertical control points in accordance with the CDOT Survey Manual Chapter 6, and verify and document in the survey records their horizontal accuracy tolerance in accordance with the CDOT Survey Manual Chapter 5, and their vertical accuracy tolerance in accordance with the CDOT Survey Manual Chapter 6, for a CDOT Class A - Primary Survey prior to using them for construction surveying control.

625.05 Staking. Acceptable staking placement intervals for the various construction survey items are described in the CDOT Survey Manual Chapter 6. Staking placement intervals specified on the Survey Tabulation Sheet have precedence over those in the CDOT Survey Manual. Stationing shall be established in the field on centerline or an approved offset.

625.06 Accuracy and Tolerances. Horizontal and vertical accuracy tolerances for Secondary Control surveys and monuments, and for each construction item being staked shall be as specified in the Contract or in the CDOT Survey Manual Chapter 6. If a discrepancy should occur, the higher degree of accuracy or

the more restrictive tolerance shall apply.

Horizontal accuracy tolerances for Primary Control surveys and monuments shall be as specified in the CDOT Survey Manual Chapter 5. Vertical accuracy tolerances for Primary Control surveys and monuments shall be as specified in the CDOT Survey Manual Chapters 5 and 6.

Horizontal accuracy tolerances for Secondary Control surveys and monuments shall be as specified in the CDOT Survey Manual Chapter 6. Vertical accuracy tolerances for Secondary control surveys, monuments, and/or Secondary benchmarks shall be as specified in the CDOT Survey Manual Chapter 6.

3D Engineered surveying accuracy and tolerances shall be the same as the staking accuracy and tolerances stated in the CDOT Survey Manual.

625.07 Responsibility and Inspection. Supervision and coordination of construction surveying and staking is the Contractor's responsibility. The Engineer may inspect the Contractor's surveying; however, such inspection will not relieve the Contractor of any responsibility for accuracy or completeness of work. The Contractor shall check the work to verify the accuracy and include documentation of this check in the Survey Records. All Contractor surveying inaccuracies, errors, or omissions shall be corrected at the Contractor's expense. Engineer's inspection or the Contractor's corrections shall not entitle the Contractor to additional payment or contract time extension.

625.08 Reset Monuments and Stakes. Primary and Secondary Control monuments, benchmarks, and other significant stakes that are damaged, destroyed, or made inaccessible by the progress of construction shall be replaced, transferred or re-established at the Contractor's expense in accordance with the CDOT Survey Manual Chapter 6.

A supplemental or amended Project Control Diagram shall be submitted to the for any replaced, transferred or re-established Primary Control monuments in accordance with the CDOT Survey Manual Chapter 6.

Locating, preserving, referencing, installing and restoring land monuments such as Primary Control monuments from which the right of way or any land boundary will be calculated, described or monumented, PLSS monuments, GLO monuments, BLM monuments, MS monuments, ROW monuments, property boundary monuments, easement monuments, and other monuments that are required by law or regulation to be established by a PLS, shall be done in accordance with Section 629, under the supervision of a PLS who is experienced and competent in Right of Way and boundary surveying and licensed in the State of Colorado.

625.09 Changes. All changes in lines and grades required by field conditions and all discrepancies in grades, alignment, location or dimensions detected by the Contractor shall be immediately submitted to the Engineer in writing. No changes in given data or plans will be allowed unless approved by the Engineer in writing. All changes shall be documented in the survey records.

625.10 Pay Quantities Measurements. The Engineer will perform all interim and final measurements to determine contract pay quantities. The Contractor shall establish and maintain Primary and Secondary Control points and stationing as required for these measurements.

625.11 Survey Records. Survey records shall be completed as the work is done. Field survey notes for construction surveying and checking by the Contractor shall be recorded in survey records in conformance with the format given in the CDOT Survey Manual Chapter 6, Section 6.1.15. Survey field books shall be indexed in accordance with the Survey Manual Chapter 2.

The Contractor shall make all survey records generated available to the Engineer for inspection or reproduction at all times. The Contractor shall submit all survey records to the Engineer before final project acceptance. All survey records are considered property of the Sponsor. The responsible PLS or PE identified in subsection 625.01 shall electronically seal all survey records.

The electronic format shall contain the information and format as required in the Survey Manual Chapter 2 and Chapter 6, including stakeout data and the raw data from the actual placement of stakes. The records shall be electronically sealed by the PLS in responsible charge identified in subsection 625.01.

Initial staking for major structures (overhead signs, concrete box culverts, bridges, and all other structures assigned a structure number) shall be done in accordance with the CDOT Survey Manual Chapter 6, from two independent setups. An independent check shall be made by the Contractor and shown in the survey records for all bridge structures.

METHOD OF MEASUREMENT

625.12 Construction surveying will not be measured but will be paid for on a lump sum basis.

BASIS OF PAYMENT

625.13 Payment for construction surveying will be the contract lump sum bid and will be full compensation for all surveying work necessary to complete the project as shown on the plans, to include all resetting of stakes, marks, monuments Secondary and Primary Control points, and preparing supplemental or amended Project Control Diagrams.

Construction surveying required by plan force account or by additional work beyond the scope of the original Contract will be paid for at a negotiated rate. That rate shall also apply to reductions in construction surveying as impacted by reductions or deletions to the original contract work. Any survey work not performed to the contract requirements shall be subject to price reduction or rejection.

Partial payment for construction surveying, as determined by the Engineer, will be made as the work progresses. The Contractor shall submit a schedule of estimated contractor construction surveying time as required on the Survey Tabulation Sheet before the first partial payment is made. Copies of the Survey Records for all completed survey work shall be submitted to the Engineer prior to payment of the monthly estimate.

Before final payment is made, the Contractor’s responsible P.L.S. shall complete and electronically seal all survey records and the Project Control Diagram (supplemental or amended). Submit the survey records and the supplement or amended Project Control Diagram to the Engineer for review.

Payment will be made under:

Pay Item	Pay Unit
Construction Surveying	Lump Sum

Traffic control for construction surveying will be measured and paid for in accordance with Section 630.

All costs associated with 3DECS surveying will not be measured and paid for separately, but shall be included in the work.

END OF SECTION

SECTION 626 MOBILIZATION

DESCRIPTION

626.01 This work consists of the mobilization of personnel, equipment and supplies at the project site in preparation for work on the project. This item shall also include the establishment of the Contractor's offices, buildings and other necessary facilities, and all other costs incurred or labor and operations that must be performed prior to beginning the other items under the Contract.

BASIS OF PAYMENT

626.02 Partial payments for mobilization will be made once each month as the work progresses. These partial payments will be made as follows:

(1) When 5 percent of the original contract amount is earned, 25 percent of the amount bid for mobilization, or 2½ percent of the original contract amount, whichever is less, will be paid.

(2) When 10 percent of the original contract amount is earned, 50 percent of the amount bid for mobilization, or 5 percent of the original contract amount, whichever is less, will be paid.

(3) When 25 percent of the original contract amount is earned, 60 percent of the amount bid for mobilization, or 6 percent of the original contract amount, whichever is less, will be paid.

(4) When 50 percent of the original contract amount is earned, 100 percent of the amount bid for mobilization, or 10 percent of the original contract amount, whichever is less, will be paid.

(5) Upon completion of all work on the project, payment on any amount bid for mobilization in excess of 10 percent of the original contract amount will be paid.

(6) The total sum of all payments shall not exceed the original contract amount bid for the item, regardless of the fact that the Contractor may have, for any reason, shut down the work on the project or moved equipment away from the project and then back again.

For the purpose of this Section the term “original contract amount” as used above shall mean the amount bid for the construction items in the Contract not including the amount bid for mobilization. Payments for materials on hand, will not be included as a percent of original contract amount earned until said materials on hand have been incorporated into the work and accepted and paid for as contract items.

These payments shall be independent of partial payments. Payment will be full compensation for all work necessary to complete the item.

Payment will be made under:

Pay Item	Pay Unit
Mobilization	Lump Sum

Nothing herein shall be construed to limit or preclude partial payments for other items as provided for by the Contract.

END OF SECTION

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SECTION 627 PAVEMENT MARKING

DESCRIPTION

627.01 This work consists of furnishing and applying pavement marking, and furnishing, installing, and removing temporary pavement marking in accordance with these specifications, the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), the Colorado supplement thereto, and in conformity to the lines, dimensions, patterns, locations and details shown on the plans or established.

MATERIALS

627.02 Materials shall conform to the requirements of the following subsections:

Paint	708.05
Glass Beads	713.08

CONSTRUCTION REQUIREMENTS

627.03 General. All pavement markings shall be placed in accordance with the following requirements. When the term "full compliance" is used, it means the pavement markings shall meet the requirements of Standard Plan S-627-1 and the Contract Drawings.

(a) Pavement Marking Plan. Not Required.

(b) Roadways Closed to Traffic During Construction. Full-compliance final markings shall be in place prior to opening the roadway to traffic.

Pavement markings on detour routes shall be full-compliance markings.

(c) Roadways Constructed Under Traffic. Full compliance final pavement markings shall be placed within two weeks after final surfacing is completed. Full compliance pavement markings shall also be placed on any roadways opened to traffic when the project pavement work is discontinued for more than two weeks.

(d) Temporary Pavement Markings. Not Used.

(e) *Pavement Marking for Seal Coats (Section 409).* Not Used.

627.04 Pavement Marking with Low Temperature Acrylic Paint and High Build Acrylic Paint. Striping shall be applied on asphalt or Portland cement concrete pavements when the air and pavement temperatures are as follows: for high-build waterborne paint, at least 45 °F and expected to remain 45 °F or above for at least 24 hours; for low temperature waterborne paint, at least 35 °F and expected to remain 35 °F or above for at least 24 hours. The pavement surface shall be dry and clean, and free of all latent materials, in accordance with the manufacturer's recommendations. Weather conditions shall be conducive to satisfactory results.

Glass beads shall be applied into the paint by means of a low pressure, gravity drop bead applicator.

The Contractor shall use equipment that meets the following requirements, as approved:

(1) Equipment shall permit traffic to pass safely within the limits of the roadway surface and shoulder while operating.

(2) Equipment shall be designed for placement of both solid and broken line stripes with a reasonably clean-edged stripe of the width and location as shown on the contract and no overspray on the road surface.

(3) Equipment shall have a glass bead dispenser directly behind and synchronized with the paint applicator. Each applicator shall have individual control and automatic skip control that will paint a strip with a gap as shown in the Contract.

(4) The equipment may be equipped with a heat exchanger to heat the paint to reduce drying time.

(5) The operation shall include a trailing vehicle equipped with a flashing arrow board.

The Contractor shall prevent traffic from crossing a wet stripe. Stripes that have been marred or picked up by traffic before they have dried shall be repaired at the Contractor's expense. Removal of paint from vehicles that crossed wet paint shall be at the Contractor's expense. The water-based paint and stripes shall fall within the following minimum and maximum ranges:

Description		**Pavement Marking Paint**	
		Low Temp	High Build
Alignment	Lateral Deviation	2.0 inch per 200 feet Max	
Coverage Rate	Sq. Ft. per Gallon	89-93	67-70
Thickness	Mil	17-18	23-24
Width	Inches	Per Plans ± 0.25	Per Plans ± 0.25
Dry Time	Minutes	5-10	7-12
Beads	Application Rate, lbs./gal	7-8	9-10

Equipment shall have a bead dispenser directly behind, synchronized with the paint applicator and shall be capable of painting a clean-edged stripe of the designated width plus or minus 1/4 inch with no overspray on the road surface. For centerlines and lane lines, an automatic skip control shall be used. Machines having multiple applicators shall be used for centerlines with "no passing zones." In areas where machines are not practical, suitable hand-operated equipment shall be used as directed by the Engineer. Stripes shall be protected until dry.

627.05 Modified Epoxy Pavement Marking. Not Used.

627.06 Thermoplastic Pavement Marking. Not Used.

627.07 Methyl Methacrylate Pavement Marking. Not Used.

627.08 Preformed Plastic Pavement Marking. Not Used.

627.09 Preformed Thermoplastic Pavement Marking. Not Used.

627.10 Pavement Marking Tape. Not Used.

627.11 Raised Pavement Markers. Not Used.

METHOD OF MEASUREMENT

627.12 The types of pavement marking described herein will be measured by the following units, complete in place and accepted.

Pavement marking paint will be measured by square foot used including glass beads. Material used in excess of coverage limit prescribed will not be measured.

BASIS OF PAYMENT

627.13 The accepted quantities will be paid for at the contract price per unit of measurement for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	**Pay Unit**
6" Yellow Solid Double Centerline	Square Foot
6" Yellow Dashed Single Centerline	Square Foot

4” White Edge Line	Square Foot
24” White Stop Bar	Square Foot

Waterblasting will not be measured and paid for separately, but shall be included in the work

Glass beads and cleaning with high-pressure water blast or air blast shall be included in the cost of the work.

Control points and Contractor pavement marking plans will not be measured and paid for separately, but shall be included in the work.

END OF SECTION

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SECTION 630 CONSTRUCTION ZONE TRAFFIC CONTROL

DESCRIPTION

630.01 This work consists of furnishing, installing, moving, maintaining, and removing temporary traffic signs as required by the Manual on Uniform Traffic Control Devices for Streets and Highways and the Colorado Supplement thereto, in accordance with the Contract. Devices shall comply with the performance criteria contained in NCHRP Report 350 (only applicable for devices developed prior to 2011) or Manual for Assessing Safety Hardware (MASH) (acceptable for all devices). Devices temporarily not in use shall, as a minimum, be removed from the work area. Moving will include devices removed from the project and later returned to use.

This work also includes Traffic Control Management and flagging.

MATERIALS

630.02 Signs and Barricades. Construction traffic sign and barricade materials shall conform to the applicable portions of Section 614 with the following exception: Sign panels may be fabricated from plywood, aluminum, steel, or other suitable materials provided they are stable and durable enough to meet the other requirements of Section 614. Traffic control devices deemed inadequate by the Engineer shall not be used and shall be removed from the project site.

Temporary sign support assembly shall be timber, perforated square metal tubing inserted into a larger base post or slip base, or perforated metal U-channel with a slip base. The temporary sign support assembly shall conform to NCHRP (only applicable for sign support assemblies developed prior to 2011) or MASH (acceptable for all sign support assemblies), and AASHTO requirements regarding temporary sign supports during construction.

If U-Channel posts with a slip base are selected, they shall be used only in multi-post applications, as shown on Standard Plan S-630-4.

Retro-reflective sheeting shall conform to the requirements of subsection 713.04.

Retro-reflective sheeting types shall be as defined in the CDOT Retroreflective Sheeting Materials Guide.

Retro-reflective sheeting shall be one of the types specified for the particular application in Table 630-1.

Retro-reflective sheeting for all signs requiring an orange background shall be Fluorescent.

Table 630-1

RETROREFLECTIVE SHEETING TYPES

Sheeting	**Type IV**	**Type VI (Roll-up sign material)**	**Type Fluorescent[1]**
Application	Work Zone	Work Zone	Work Zone
All Orange Construction Signs			X
Orange Construction Signs that are used only during daytime hours for short term or mobile operations		X[4]	X
Barricades (Temporary)	X		X
Vertical Panels	X		X
Flaggers Stop/Slow Paddle	X		X
Drums and Tubular Markers[2]	X[6]		X
Non-orange Fixed Support signs with prefix "W"	X		
Special Warning Signs			X
STOP sign (R1-1) YIELD sign (R1-2) WRONG WAY sign (R5-1a) DO NOT ENTER sign (R5-1) EXIT sign (E5-1a)	X		
DETOUR sign (M4-9) or (M4-10)			X
All other fixed support signs3	X		X
All other signs used only during working hours	X		X
All other signs that are used only during daytime hours for short term or mobile operations	X	X[5]	X

[1] Fluorescent Sheeting shall be of a brand that is on the CDOT Approved Products List.
[2] Drum and Tubular Marker sheeting shall be manufactured for flexible devices, and sheeting materials shall conform to Section 713.
[3] Fixed support signs are defined as all signs that must remain in use outside of working hours. They shall be mounted in accordance with Standard Plan S-630-1.
[4] RS 24 only.
[5] White only.
[6] For projects advertised prior to September 1, 2017, Type IV or Fluorescent sheeting will be permitted. For projects advertised

The Contractor shall provide sign panel legend for standard signs in accordance with "Standard Highway Signs" published by the FHWA and the Colorado Supplement thereto, and sign panel legend for special signs in accordance with the detailed sign layouts provided by the Engineer.

630.03 Electronic Advance Warning Signs. Not Used.

630.04 Temporary Traffic Signals. Not Used.

630.05 Traffic Cones. Traffic cones shall not be used outside of working hours unattended. The minimum cone height shall be 28 inches.

When traffic cones are used during night time, they shall be reflectorized. The reflectorized material shall be selected from the Colorado Approved Products List and shall have a smooth, sealed outer surface that will display the same approximate color day and night. Reflectorization of cones shall be provided by a

white band at least 6 inches wide placed no more than 3 to 4 inches from the top, and an additional white band, 4 inches wide, placed a minimum of 2 inches below the 6-inch band.

Tubular markers shall be 3 to 3 1/2 inches in diameter, shall be 36 inches plus or minus 1/2 inch in height, predominantly orange in color, and shall be reflectorized.

630.06 Channelizing Device (Fixed). Not Used.

630.07 Temporary Channelizing Devices.

(a) Stackable Vertical Panels. Stackable vertical panels shall comply with the crash test requirements contained in NCHRP Report 350 (only applicable for vertical panels developed prior to 2011) or MASH (acceptable for all vertical panels) and shall meet MUTCD requirements for vertical panels. Vertical panels shall be retroreflectorized with Type IV sheeting, in accordance with subsection 630.02. The stackable vertical panels shall have the following properties:

Property	Specification
Panel Material	Low density polyethylene
Color	Orange and white stripes with orange or white frame and black ballast
Vertical Panel Height	24, 36, 42 in.
Ballast Type*	Rectangular or Square
Ballast Weight*	9 - 30 lbs.

* NOTE: The ballast type and weight shall be as shown in the contract or as approved by the Engineer.

Markings for vertical panels shall be alternating orange and white retro-reflective stripes, sloping downward at an angle of 45 degrees in the direction of vehicular traffic. The width of the stripes shall conform to the requirements of the MUTCD.

Vertical panels shall be retroreflectorized with Type IV Sheeting. The stackable vertical panels shall be selected from CDOT's Approved Products List and shall have a smooth, sealed outer surface that will display the same approximate color day and night.

(b) Stackable Tubular Markers. Stackable tubular markers shall comply with the crash test requirements contained in NCHRP Report 350 (only applicable for stackable tubular markers developed prior to 2011) or MASH (acceptable for all stackable tubular markers) and shall conform to MUTCD requirements for tubular markers. The stackable tubular markers shall have the following properties:

Property	Specification
Tubular Section	Low density polyethylene
Color	Orange Tubular Marker with Black Base
Height (min.)	42 in
Ballast Type*	Rectangular, Octagonal or Square
Ballast Weight*	15 - 40 lbs.

* NOTE: The ballast type and weight shall be as shown in the contract or as approved by the Engineer.

Tubular Markers shall be retroreflectorized as shown in Table 630-1. The stackable tubular markers shall be selected from CDOT's Approved Products List and shall have a smooth, sealed outer surface

that will display the same approximate color day and night.

630.08 Temporary Barrier Not Used.

630.09 General. All traffic control devices shall be provided with all components necessary to comprise a complete installation. Traffic control devices deemed inadequate by the Engineer shall not be used and shall be removed from the project site.

Work zone devices designated by FHWA as Category I, II, or III, shall comply with the performance criteria contained in NCHRP Report 350 (only applicable for devices developed prior to 2011) or MASH (acceptable for all devices). Devices designated as Category IV, including but not limited to portable or trailer-mounted devices such as flashing arrow panels, temporary traffic signals, area lighting supports, and changeable message signs are not required to meet NCHRP 350 or MASH requirements.

Except for Category IV devices, the Contractor shall obtain and present to the Engineer the manufacturer's written NCHRP 350 (only applicable for devices developed prior to 2011) or MASH (acceptable for all devices) certification for each work zone device before it is first used on the project.

Portable devices that require weight to prevent overturning shall be weighted with appropriately sized sand bags.

Traffic control devices that are damaged, weathered, worn, or otherwise determined to be unacceptable, shall be replaced at the Contractor's expense.

CONSTRUCTION REQUIREMENTS

630.10 Transportation Management Plan. Not Used.

630.11 Traffic Control Management. The Contractor shall designate an individual, other than the superintendent, to be the Traffic Control Supervisor. The Traffic Control Supervisor shall be certified as a worksite traffic supervisor by an authorized entity and shall have a current flagger certification from an authorized entity. A copy of the Traffic Control Supervisor's certifications shall be provided to the Engineer at the Pre-construction Conference and shall be available at all times on the worksite.

The Contractor's Superintendent, and all others serving in a similar supervisory capacity, shall have completed an approved Traffic Control Supervisor training as offered by the authorized entities. The certifications of completion or certifications of achievement for all appropriate staff shall be submitted to the Engineer at the Pre-construction Conference.

The Traffic Control Supervisor's duties shall include:

(1) Preparing, revising, and implementing each required Method of Handling Traffic in accordance with the Traffic Control Plan.

(2) Directly supervising project flaggers.

(3) Coordinating all traffic control operations, including those of subcontractors and suppliers.

(4) Coordinating project activities with appropriate police and fire control agencies.

(5) Preparing a traffic control diary on every calendar day traffic control devices are in use. This diary shall be submitted to the Engineer daily. The diary shall include the following information as a minimum:

   (i) Date

   (ii) For Traffic Control Inspection, the time of the inspection

   (iii) Project number

   (iv) Traffic Control Supervisor's name

(v) Description of traffic control operations (lane closures, shoulder closures, pilot car operations, detours, etc.) including location, setup and takedown time, and approved Method of Handling Traffic (MHT) number

(vi) Types and quantities of traffic control devices used in accordance with the approved MHT

(vii) List of flaggers and uniformed traffic control (UTC) used, including start time, stop time, and number of flagging hours and UTC hours used

(viii) Traffic control problems (traffic accidents; damaged, missing or dirty devices, etc.) and corrective action taken

(6) Inspecting traffic control devices on every calendar day that traffic control devices are in use, masked, or turned away from traffic. These inspections shall include at least one night inspection per week. The TCS or another representative who is certified as a work site traffic supervisor shall perform these inspections.

(7) Ensuring that traffic control devices are functioning as required.

(8) Overseeing all requirements covered by the Contract that contribute to the convenience, safety and orderly movement of traffic. Have an up-to-date copy of the MUTCD and applicable standards and specifications available at all times on the project.

(9) Attending all project scheduling meetings.

(10) Supervising the cleaning and maintenance of all traffic control devices.

A certified worksite traffic supervisor shall be responsible for Traffic Control Management (TCM) on a 24-hour-per-day basis. The TCS shall be on the work site at all times when Traffic Control Management (TCM) is performed and shall be on call at all times. Upon request of the Engineer, the TCS may be required to be on the project site at times other than normal working hours. During non-work periods, the TCS shall respond to the job site within 45 minutes. The TCS may appoint a qualified representative to serve as the TCS for periods of time as approved by the Engineer. The qualified representative shall be certified as a TCS, and shall assume all duties and responsibilities of the TCS. The Contractor shall maintain a 24-hour telephone number at which the TCS can be contacted. The TCS shall not act as a flagger except in an emergency or in relief for short periods of no more than 15 minutes over a 60-minute period.

630.12 Temporary Masking Signs. Not Used

630.13 General. Portable construction traffic signs shall be removed when not required. Permanently mounted construction traffic signs shall be masked or turned away from traffic when not required. When work is suspended, or the project is in free time, and there is no condition requiring traffic control devices or construction traffic signs, all of the construction traffic signs shall be masked or turned away from traffic. If this condition is to exist for more than 30 days, all construction traffic signs shall be removed. When storing portable signs or supports within the project they shall be removed beyond the clear zone and shall not be visible to traffic. The minimum clear zone distance shall be 18 feet, measured from the edge of traveled way. If the signs cannot be stored at least 18 feet from the traveled way, they shall be removed. Signs shall not be stored on the paved surface. All storage areas shall be approved. When masking is used, it shall be done in accordance with subsection 630.12.

Perforated square metal tubing or U-channel shall be installed for temporary sign supports according to the manufacturer's recommendations and as shown on the Plans.

The Contractor shall be responsible for all maintenance of the signs and posts. If a sign or post is damaged during construction, the contractor shall be responsible for replacing and maintaining the sign and posts at no additional cost to the Project.

The retroreflective surfaces of all signs and other traffic control devices shall be cleaned as frequently as necessary to preserve their legibility and retroreflectivity. However, all devices shall be cleaned a minimum of once every two weeks.

Vertical panels fabricated with vehicle wheel rims, and steel drum channelizing devices shall not be used.

630.14 Flagging. Flagging shall be performed as described in the latest edition of part VI of the MUTCD as adopted by CDOT.

All traffic control personnel shall wear safety apparel and hardhats meeting the requirements of the latest version of the ISEA "American National Standard for High-Visibility Safety Apparel and Headwear". Safety apparel shall be labeled as meeting the standard performance for Class 2 or Class 3 risk exposure. The apparel and hardhat background material color shall be either fluorescent orange-red or fluorescent yellow-green as defined in the standard. The retroreflective material shall be either orange, yellow, white, silver, yellow-green, or a fluorescent version of these colors, and shall be visible at a minimum distance of 1,000 feet.

Night time flagging stations shall be illuminated with flood lights unless otherwise approved and shall not be paid for separately.

(a) The Contractor shall provide all flagging through the project necessary to assure proper safety to traffic. All flagging personnel shall have completed CDOT's minimum training requirements for flaggers within two years prior to starting work on the project.

(b) Reimbursement for flagging shall be limited to the following areas:

  (1) The entire construction area under contract and for a distance of 500 feet outside the project limits or approach to project; except that if the project consists of two or more sections, the limits will apply to each section individually.

  (2) Those areas beyond the above-described limits where the Engineer determines the use of flaggers are necessary to provide adequate warning to traffic.

  (3) A detour provided on the plans or approved by the Engineer for by-passing all or any portion of the construction irrespective of whether the detour termini are within the project limits.

(c) The cost of all flagging for haul routes from the Contractor's materials sources to the limits of the project shall be at the Contractor's expense.

(d) The authorized duties of flaggers consist of directing the traveling public and the construction traffic that affects the traveling public within the project limits.

630.15 Emergency Pull-Off Area (Temporary). Not Used

630.16 Temporary Portable Rumble Strip. Not Used

630.17 Rolling Roadblock. Not Used

METHOD OF MEASUREMENT

630.18 Construction Zone Traffic Control Management will be paid as a lump sum. This includes activities such as flagging operations, , and setting up or removal of construction zones, shoulder closures, lane closures or detours throughout the duration of the project. Traffic control devices that are left in place during non-working hours, including configurations such as lane closures, temporary channelization or detours, are not considered active traffic control.

Resetting, repairing, or replacing traffic control devices is considered maintenance of the devices. Cleaning and maintaining of traffic control devices are not considered traffic control activities subsidiary to the Traffic Control Management item.

Flagging will not be measured separately but will be included in TCM item.

BASIS OF PAYMENT

630.19 The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under

Pay Item	Pay Unit
Construction Zone Traffic Control Management	Lump Sum

Flagger hand devices will not be measured and paid for separately, but shall be included in the work.

If the Contractor fails to complete construction within the approved contract time, Construction Zone Traffic Control will continue to be provided at the Contractor's expense.

Two-way radios will not be measured and paid for separately, but shall be included in the work.

END OF SECTION

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SECTION 701 HYDRAULIC CEMENT

DESCRIPTION

701.01 Hydraulic Cement. Hydraulic cement shall conform to the requirements of the following specifications for the type specified or permitted:

Portland Cement	ASTM C150
Blended Hydraulic Cement	ASTM C595

All concrete, including precast pipe shall be constructed with one of the following hydraulic cements unless permitted otherwise.

ASTM C150 Type I

ASTM C150 Type II

ASTM C595 Type IL(MS)

ASTM C595 Type IL(HS)

Cement shall be from a preapproved source listed on CDOT's Approved Products List.

The cement shall be subject to sampling and testing by the Contractor's QC lab. Test results that do not meet the physical and chemical requirements may result in the suspension of the use of the cement until the corrections necessary have been taken to ensure that the material meets the specifications.

The Contractor shall provide suitable means for storing and protecting the cement against dampness. Cement which has become partially set or which contains lumps of caked cement shall not be used.

Cement salvaged from discarded or used bags shall not be used.

701.02 Fly Ash.

Fly ash for concrete shall conform to the requirements of ASTM C618, Class C or Class F with the following exceptions:

(1) The loss on ignition shall not exceed 3.0 percent.

(2) The CaO in Class F fly ash shall not exceed 18 percent.

Blending of pozzolans according to ASTM D5370 is permitted to meet the requirements of ASTM C618.

Fly ash shall be from a preapproved source listed on CDOT's Approved Products List.

Preapproval shall include submission of a report from the supplier documenting the results of testing the fly ash from that source in accordance with the Toxicity Characteristic Leaching Procedure (TCLP) described in 40 CFR 261, Appendix II. The report shall include the results of TCLP testing for heavy metals and other contaminants found in the fly ash. The report shall list the contaminants tested, and the allowable levels for each contaminant tested. A new report shall be submitted for each preapproved source annually. Additional TCLP testing may be required when the Engineer suspects that the fly ash source may have been contaminated.

The fly ash shall be subject to sampling and testing by the Contractor's QC lab. Test results that do not meet the physical and chemical requirements may result in the suspension of the use of fly ash until the corrections necessary have been taken to ensure that the material meets the specifications.

701.03 Silica Fume. Silica fume for concrete shall conform to the requirements of ASTM C1240.

Silica Fume shall be from a preapproved source listed on CDOT's Approved Products List.

The silica fume shall be subject to sampling and testing by the Contractor's QC lab. Test results that do

not meet the physical and chemical requirements may result in the suspension of the use of the silica fume until the corrections necessary have been taken to ensure that the material meets the specifications.

701.04 High-Reactivity Pozzolans. High-Reactivity Pozzolans (HRP) shall conform to the requirements of AASHTO M 321. HRPs include but are not limited to metakaolin, rice hull ash, zirconium fume, ultra-fine fly ash, and fume from the production of 50 percent ferrosilicon (with SiO2 less than 85 percent).

HRPs shall meet the following optional requirement of AASHTO M 321: The sulfate expansion at 14 days shall not exceed 0.045 percent.

HRP shall be from a preapproved source listed on CDOT's Approved Products List.

The HRP shall be subject to sampling and testing by the Contractor's QC lab. Test results that do not meet the physical and chemical requirements may result in the suspension of the use of HRP until the necessary corrections have been taken to ensure that the material conforms to the specifications.

701.05 Slag Cement. Slag cement shall conform to the requirements of ASTM C989. Slag cement shall be Grade 100 or Grade 120. Slag cement shall have a maximum Aluminum Oxide content of 11.0 percent.

Slag cement shall be from a pre-approved source listed on CDOT's Approved Products List.

Slag Cement shall be subject to sampling and testing by the Contractor's QC lab. Test results that do not meet the physical and chemical requirements may result in the suspension of the use of Slag Cement until the necessary corrections have been taken to ensure that the material conforms to the specifications.

END OF SECTION

SECTION 702 BITUMINOUS MATERIALS

DESCRIPTION

702.01 Asphalt Cements.

(a) Superpave Performance Graded Binders. Superpave Performance Graded Binders shall conform to the requirements listed in Table 702-1. (Taken from AASHTO M 320)

Asphalt cement shall not be acid modified or alkaline modified.

Asphalt cement shall not contain any used oils that have not been refined. Modifiers that do not comply with environmental rules and regulations including 40 CFR Part 261.6(a) (3) (IV), and part 266/Subpart C shall not be added. Modifiers shall not be carcinogenic.

The supplier of the PG binder shall be certified in accordance with CP 11.

Table 702-1

SUPERPAVE PERFORMANCE GRADED BINDERS

Property	Requirement for PG Binder	AASHTO Test No.
	58-28	
Original Binder Properties		
Flash Point Temp., °C, minimum	230	T 48
Viscosity at 135 °C, Pa●s, maximum	3	T 316
Dynamic Shear, Temp. °C, where G*/Sin δ @ 10 rad/s ≥ 1.00 kPa	58	T 315
Ductility, 4 °C (5 cm/min.), cm minimum	-	T 51
Toughness, joules (inch- lbs)	-	CP-L 2210
Tenacity, joules (inch-lbs)	-	CP-L 2210
Acid or Alkali Modification (pass-fail)	Pass	CP-L 2214
RTFO Residue Properties		CP-L 2215
Mass Loss, percent maximum	1.00	CP-L 2215
Dynamic Shear, Temp. °C, where G*/Sin δ @ 10 rad/s ≥ 2.20 kPa	58	T 315
Elastic Recovery, 25 °C, percent min.	-	T 301
Ductility, 4 °C (5 cm/min.), cm minimum	-	T 51
PAV Residue Properties, Aging Temperature 100 °C		R 28
Dynamic Shear, Temp. °C, where G*●Sin δ @ 10 rad/s ≤ 5000 kPa	19	T 315
Creep Stiffness, @ 60 s, Test Temperature in °C	-18	T 315
S, maximum, MPa	300	T 313
m-value, minimum	0.300	T 313

Acceptance Samples of the PG binder will be taken on the project in accordance with the Schedule in the *Field Materials Manual*.

The Contractor's QC lab will test for acid modification and alkaline modification during the binder

certification process. Thereafter, the Contractor's QC lab will randomly test for acid modification and alkaline modification.

(b) Damp Proofing. Asphalt for damp proofing shall conform to the requirements of ASTM D449, and the asphaltic primer shall conform to the requirements of ASTM D41.

702.02 Emulsified Asphalts. Emulsified asphalts shall conform to AASHTO M 140 or M 208 for the designated types and grades. Emulsified asphalt and aggregate used for surface seals shall be sampled and will be tested for information only in accordance with CP-L 2213.

Emulsified asphalt (HFMS-2S) with a residual penetration greater than 300 dmm shall conform to all properties listed in AASHTO M 140, Table 1 except that ductility shall be reported for information only.

(a) Emulsion for Tack Coats. Emulsions for tack coats shall conform to the requirements listed in Table 702-2 or 702-3, prior to dilution.

Table 702-2

TACK COAT EMULSIONS

Property		CSS-1h	SS-1h	AASHTO Test No.
Tests on Emulsion:				
Viscosity, at 25 ºC, Saybolt-Furol, s	min	20	20	T 59
	max	100	100	
Storage stability, 24 hr, % max[1]		1.0	1.0	T 59
Particle charge test		Positive		T 59
Sieve test, % max		0.10	0.10	T 59
Oil Distillate by volume, % max		3.0	3.0	T-59
Residue by distillation/ evaporation, % min[3]		57[3]	57[3]	T 59/ CP-L 2212[2]
Tests on residue:				
Penetration, 25 ºC, 100g, 5s, min, dmm		40	40	T 49
Penetration, 25 ºC, 100g, 5s, max, dmm		120	120	T 49
Ductility, 25 ºC, 5 cm/min, cm, min		40	40	T 51
Solubility, in trichloroethylene% min		97.5	97.5	T 44

1. If successful application is achieved in the field, the Engineer may wave this requirement.
2. CP-L 2212 is a rapid evaporation test for determining percent residue of an emulsion and providing material for tests on residue. CP-L 2212 is for acceptance only. If the percent residue or any test on the residue fails to meet specifications, the tests will be repeated using the distillation test in accordance with AASHTO T-59 to determine acceptability.
3. For polymerized emulsions the distillation and evaporation tests will be performed in accordance with AASHTO T-59 or CP-L 2212 respectively with modifications to include 205 ± 5 ºC (400 ± 10 ºF) maximum temperature to be held for 15 minutes.

(b) Emulsion for Prime Coat. Not Used.

702.03 (unused)

702.04 Hot Poured Joint and Crack Sealant. Hot poured material for filling joints and cracks shall conform to the requirements of ASTM D6690, Type II or Type IV. The concrete blocks used in the Bond Test shall be prepared in accordance with CP-L 4101.

Sealant material shall be supplied pre-blended, pre-reacted, and prepackaged. If supplied in solid form the sealant material shall be cast in a plastic or other dissolvable liner having the capability of becoming part of the crack sealing liquid. The sealant shall be delivered in the manufacturer's original sealed container.

Each container shall be legibly marked with the manufacturer's name, the trade name of the sealer, the manufacturer's batch or lot number, the application temperature range, the recommended application temperature, and the safe heating temperature.

The sealant shall be listed in CDOT's Approved Products List prior to use.

END OF SECTION

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SECTION 703 AGGREGATES

703.01 General. All sieve sizes and designations described in this section refer to laboratory sieves having square openings and conforming to ASTM E11.

The grading and composition requirements for coarse and fine aggregates for concrete are set forth in Table 703-1.

Table 703-1

CONCRETE AGGREGATE GRADATION TABLE

Percentage Passing Designated Sieves and Nominal Size Designation

Sieve Size	Coarse Aggregates (from AASHTO M43)									Fine Aggregate
	No. 3	No. 357	No. 4	No. 467	No. 57	No. 6	No. 67	No. 7	No. 8	
	50 mm to 25.0 mm (2" to 1")	50 mm to 4.75 mm (2" to No. 4)	37.5 mm to 19.0 mm (1½" to ¾")	37.5 mm to 4.75 mm (1½" to #4)	25.0 mm to 4.75 mm (1" to #4)	19.0 mm to 9.5 mm (¾" to ⅜ ")	19.0 mm to 4.75 mm (¾" to #4)	12.5 mm to 4.75 mm (½" to #4)	9.5 mm to 2.36 mm (⅜ " to #8)	4.75 mm to 150 µm (#4 to #100)
63 mm (2½")	100	100								
50 mm (2")	90 – 100	95 – 100	100	100						
37.5 mm (1½")	35 – 70		90 – 100	95 – 100	100					
25.0 mm (1")	0 – 15	35 – 70	20 – 55		95 – 100	100	100			
19.0 mm (¾")			0 – 15	35 – 70		90 – 100	90 – 100	100		
12.5 mm (½")	0 – 5	10 – 30			25 – 60	20 – 55		90 – 100	100	
9.5 mm (⅜")			0 – 5	10 – 30		0 – 15	20 – 55	40 – 70	85 – 100	100
4.75 mm (#4)		0 – 5		0 – 5	0 – 10	0 – 5	0 – 10	0 – 15	10 – 30	95 – 100
2.36 mm (#8)					0 – 5		0 – 5	0 – 10	80 – 100	
1.18 mm (#16)									0 – 5	50 – 85
600 µm (#30)										25 – 60
300 µm (#50)										10 – 30
150 µm (#100)										2 – 10

703.02 Fine Aggregate for Concrete. Fine aggregate for concrete shall conform to the requirements of AASHTO M 6, Class A. The minimum sand equivalent, as tested in accordance with Colorado Procedure 37 shall be 80 unless otherwise specified. The fineness modulus, as determined by AASHTO T 27, shall not be less than 2.50 or greater than 3.50 unless otherwise approved.

703.03 Coarse Aggregate for Concrete. Coarse aggregate for concrete shall conform to the requirements of AASHTO M 80, Class A, except that the percentage of wear shall not exceed 45 when tested in accordance with AASHTO T 96.

703.04 Aggregate for Bases. Aggregates for bases except Aggregate Base Course (RAP) shall be crushed stone, crushed slag, crushed gravel, natural gravel, or crushed reclaimed concrete. Aggregate Base Course (RAP) shall be 100 percent crushed recycled asphalt pavement material. All materials except Aggregate Base Course (RAP) shall conform to the quality requirements of AASHTO M 147 except that the requirements for the ratio of minus 75 µm (No. 200) sieve fraction to the minus 425 µm (No. 40) sieve fraction, stated in 3.2.2 of AASHTO M 147, shall not apply.

The requirements for the Los Angeles wear test (AASHTO T 96 & ASTM C535) shall not apply to Class 1, 2, and 3. Aggregates for bases shall meet the grading requirements of Table 703-2 for the class specified for the project, unless otherwise specified.

The liquid limit shall be as shown in Table 703-2 and the plasticity index shall not exceed six when the aggregate is tested in accordance with AASHTO T 89 and T 90 respectively.

Table 703-2

CLASSIFICATION FOR AGGREGATE BASE COURSE

Sieve Size	Mass Percent Passing Square Mesh Sieves						
	LL not greater than 35			LL not greater than 30			
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
150mm (6")			100				
100mm (4")		100					
75mm (3")		95-100					
60mm (2 ½")	100						
50mm (2")	95-100			100			
37.5mm (2")				90-100	100		
25mm (1")					95-100	100	100
19mm (3/4")				50-90		95	
4.75mm (#4)	30-65			30-50	30-70	30-65	
2.36mm (#8)						25-55	20-85
75 µm (#200)	3-15	3-15	20 max	3-12	3-15	3-12	5-15
NOTE: Class 3 material shall consist of bank or pit run material.							

Aggregate Base Coarse (RAP) shall be 100 percent reclaimed asphalt pavement material conforming to the requirements of Table 703-3.

Table 703-3

CLASSIFICATION FOR RAP AGGREGATE BASE COURSE

Sieve Size	Mass Percent Passing Square Mesh Sieves
	ABC (RAP)
50 mm (2")	100
25 mm (1")	85-100
19 mm (¾")	75-100
12.5 mm (½")	55-90
9.5 mm (⅜")	45-80
4.75 mm (#4)	25-55
1.18 mm (#16)	5-25
75 µm (#200)	0-5

703.05 Aggregates for Hot Mix Asphalt. Aggregates for hot mix asphalt (HMA) shall be of uniform quality, composed of clean, hard, durable particles of crushed stone, crushed gravel, natural gravel, or crushed slag. Excess of fine material shall be wasted before crushing. A percentage of the aggregate retained on the 4.75 mm (No. 4) sieve for Gradings S, SX and SG shall have at least two mechanically induced fractured faces when tested in accordance with Colorado Procedure 45. This percentage will be specified in Table 403-1, as revised for the project in Section 403. The angularity of the fine aggregate shall be a minimum of 45.0 percent when determined according to AASHTO T 304. Grading SF mixes may not require fine aggregate angularity of 45.0 percent. Aggregate samples representing each aggregate stockpile shall be non-plastic if the percent of aggregate passing the 2.36 mm (No. 8) sieve is greater than or equal to 10 percent by weight of the individual aggregate sample. Plasticity will be determined in accordance with AASHTO T 90. The material shall not contain clay balls, vegetable matter, or other deleterious substances.

The aggregate for Gradings ST, S, SX, and SG shall have a percentage of wear of 45 or less when tested in accordance with AASHTO T 96.

Table 703-4

MASTER RANGE TABLE FOR HOT MIX ASPHALT

Sieve Size	Percent by Weight Passing Square Mesh Sieves				
	~~Grading SF~~	~~Grading ST~~	Grading SX	~~Grading S~~	~~Grading SG~~
37.5 mm (1½")					~~100~~
25.0 mm (1")				~~100~~	~~90 – 100~~
19.0 mm (¾")			100	~~90 – 100~~	
12.5 mm (½")		~~100~~	90 – 100	~~*~~	~~*~~
9.5 mm (⅜")	~~100~~	~~90 – 100~~	*	~~*~~	~~*~~
4.75 mm (#4)	~~90 – 100~~	~~*~~	*	~~*~~	~~*~~
2.36 mm (#8)	~~*~~	~~28 – 58~~	28 – 58	~~23 – 49~~	~~19 – 45~~
1.18 mm (#16)	~~30 – 54~~				
600 µm (#30)	~~*~~	~~*~~	*	~~*~~	~~*~~
300 µm (#50)					
150 µm (#100)					
75 µm (#200)	~~2 – 12~~	~~2 – 10~~	2 – 10	~~2 – 8~~	~~1 – 7~~
* These additional Specification Screens will initially be established using values from the As Used Gradation shown on the Design Mix.					

The aggregates for hot mix asphalt (HMA) shall meet the requirements of Table 703-6 when tested in accordance with CP-L 4211 Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus. The Contractor shall be assessed a price reduction of $1000 for each production sample of the combined aggregate with a value greater than 20 according to CP-L 4211.

Table 703-6

AGGREGATE DEGRADATION BY ABRASION IN THE MICRO-DEVAL CP-L 4211

	Not to exceed
Combined Aggregate (Mix Design)	18
Combined Aggregate (1/10,000 tons, or fraction thereof during production)	20

703.06 Aggregate for Cover Coat Material. Not Used.

703.07 Mineral Filler. Not Used.

703.08 Bed Course Material. Not Used.

703.09 Structure Backfill Material.

(a) Class I structure backfill shall meet the following gradation requirements:

Sieve Size	**Mass Percent Passing Square Mesh Sieves**
50 mm (2 inch)	100
4.75 mm (No. 4)	30-100
300 μm (No. 50)	10-60
75 μm (No. 200)	5-20

In addition this material shall have a liquid limit not exceeding 35 and a plasticity index of not over six when determined in conformity with AASHTO T 89 and T 90 respectively.

(b) Class 2 structure backfill shall be composed of suitable materials developed on the project. To be suitable for use under this classification, backfill shall be free of frozen lumps, wood, or other organic material. If the material contains rock fragments that, in the opinion of the Engineer, will be injurious to the structure, the native material shall not be used for backfilling and the Contractor shall furnish Class 1 structure backfill material at the contract unit price.

703.10 Filter Material. Not Used

703.11 Aggregate for Median Cover. Not Used.

END OF SECTION

SECTION 705 JOINT, WATERPROOFING, AND BEARING MATERIAL

705.01 Joint Fillers.

(a) Joint Sealant with Backer Rod. The joint sealant material shall be an approved ASTM D5893 silicone sealant or ASTM D6690 Type II hot applied sealant on CDOT's Approved Products List. The materials shall be stored and applied in accordance with manufacturer's recommendations, but they shall not be exposed to ambient temperatures in excess of 125 °F or stored in direct sunlight. The backer rod placed prior to joint sealant shall be an approved ASTM D5249 backer rod compatible with the joint sealant material chosen by the Contractor.

(b) Preformed Joint Fillers. Preformed fillers for joints shall conform to the requirements of AASHTO M 213 and shall be punched to admit the dowels where called for on the plans. The filler for each joint shall be furnished in a single piece for the full depth and thickness required for the joint unless otherwise authorized by the Engineer. When the use of more than one piece is authorized for a joint, the abutting ends shall be fastened securely, and held accurately to shape, by stapling or other positive fastening satisfactory to the Engineer.

705.02 Watertight Joint Systems. Watertight joint systems for plastic pipe shall conform to the requirements of ASTM D3212.

705.03 Gaskets. Rubber gasketed joints shall conform to the requirements of ASTM C443 and shall be flexible and able to withstand expansion, contraction, and settlement.

All rubber gaskets shall be stored in as cool a place as practicable, preferably at 70 °F or less. Rubber gaskets shall not be exposed to the direct rays of the sun for more than 72 hours.

Rubber gaskets, of the type requiring lubrication, shall be lubricated with the lubricant recommended and supplied by the manufacturer of the pipe.

705.04 Pipe Joint Sealing Compounds. Joint sealing compounds for concrete pipe shall conform to the requirements of AASHTO M 198.

Joint sealants for metal pipe shall conform to the pipe manufacturer's recommendations.

705.05 Compression Ring. Compression ring jointing connections for clay pipe, made of resilient material, shall conform to the requirements of ASTM C425.

705.06 Bearing Materials. Not Used

705.07 Protective Covering for Bridge Deck Waterproofing Membrane. Not Used

705.08 Prefabricated, Reinforced Membrane and Primer. Not Used

705.09 Single Component, Hot Applied, Elastomeric Membrane. The membrane shall be capable of being sprayed or spread to a uniform thickness at the application temperature recommended by the manufacturer. After cooling, it shall form a tough resilient membrane, well bonded to the concrete surface and shall conform to the requirement of ASTM D6690 Type 2, except that blocks for the bond test shall be prepared in accordance with CP-L 4101.

The sealant shall be listed in CDOT's Approved Products List prior to use.

705.10 Waterstop. Not Used.

END OF SECTION

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SECTION 706 CONCRETE PIPE

706.01 Nonreinforced Concrete Pipe. Not Used

706.02 Reinforced Concrete Pipe. This pipe shall conform to the requirements of AASHTO M 170 for the specified diameters and strength classes. Unless otherwise specified, pipe wall design and use of elliptical reinforcement in circular pipe are optional. Reinforced concrete pipe being jacked shall be Class V and shall be furnished with grouting nipples spaced not more than eight feet apart. Joints for this pipe shall come equipped with steel rings and rubber gaskets conforming to ASTM C361.

Precast reinforced concrete end sections shall have one of the following:

(1) At least one line of reinforcement conforming to the requirements of AASHTO M 170 equivalent to the square inches per linear foot for elliptical reinforcement in circular pipe, Class II, Wall B, or

(2) Macro fiber at 5.0 lbs/cy.

Pipe shall be obtained from a manufacturer that is a current plant quality certified member of the American Concrete Pipe Association (ACPA), meeting all current ACPA requirements for this certification.

A copy of the ACPA certification shall be submitted to the Engineer prior to delivery of the pipe.

706.03 Perforated Concrete Pipe. Not Used.

706.04 Drain Tile. Not Used.

706.05 Porous Concrete Pipe. Not Used.

706.06 Vitrified Clay Pipe. Not Used.

706.07 Coated Concrete Pipe. Not Used.

END OF SECTION

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SECTION 708 PAINTS

708.01 General. This specification covers ready-mixed paints and coatings. Paints and coatings shall be manufactured eight weeks or less prior to delivery to the project. Each paint container shall be labeled with the name and address of the manufacturer, trade name or trademark, type of paint, number of gallons, batch number, and date of manufacture.

Paints shall be free of foreign material that is capable of clogging screens, valves, pumps, and other parts of the application equipment. Paint shall not contain the following:

(1) Benzene.

(2) Chlorinated solvents.

(3) Ethylene glycol ethers.

(4) Ethylene glycol acetates.

(5) Lead.

(6) Mercury.

(7) Chromium.

(8) Cadmium.

(9) Petroleum products.

The Contractor shall obtain certification in writing from the manufacturer showing that the product is free of the materials described above and that it meets or exceeds the requirements of 29 CFR 1910.1200.

Paints shall not form a surface skin within 48 hours in three-quarter filled, tightly closed containers. Paint and coating pigments shall be lead free, and shall not thicken, become granular, or curdle in their containers.

Volatile Organic Compound (VOC) levels for paints and coatings shall comply with the most current EPA regulations. All product compositional proportions are specified by weight. Material Safety Data Sheets and manufacturer's recommended application instruction sheets representing each paint and coating shall be submitted to the Engineer for the project records prior to use.

708.02 List of Paints.

PAINTS	SPECIFICATION
Pavement Marking Paint Subsection	708.05

708.03 Structural Steel Bridge Paint. Not Used

708.04 Aluminum Paint. Not Used

708.03 Pavement Marking Materials. All pavement marking materials shall be selected from CDOT's Approved Products List (APL). Prior to start of work, a Certificate of Compliance (COC) for all pavement marking materials shall be submitted for review by the Engineer.

(a) Color. The pavement marking paint, without drop-on beads, shall meet the following requirements:

White – Federal Standard No. 595B-17925. The Yellowness Index (YI) of white shall not exceed 8.0 per ASTM E313 initially. The color after drying shall be a flat white, free from tint, and shall provide the maximum amount of opacity and visibility under both daylight and artificial light.

Yellow – Materials for pavement markings shall meet the initial daytime chromaticity that falls within the box created by the following corner points:

Initial Daytime Chromaticity Coordinates (Corner Points)

	1	2	3	4
x	0.530	0.510	0.455	0.472
y	0.456	0.485	0.444	0.400

(b) Low Temperature Acrylic Waterborne Paint. Low temperature acrylic waterborne paint binder (nonvolatile portion of vehicle) shall be 100 percent FASTRACK XSR acrylic polymer, by weight, as determined by infrared analysis or other chemical analysis available to the Engineer.

The paint shall meet the requirements of Table 708-1.

(c) High Build Acrylic Waterborne Paint. High build acrylic waterborne paint binder (nonvolatile portion of vehicle) shall be 100 percent FASTRACK HD 21A acrylic cross linking polymer, by weight, as determined by infrared analysis or other chemical analysis available to the Engineer.

The paint shall meet the requirements of Table 708-2.

(d) Performance Requirements. The Low Temperature Acrylic Waterborne Paint and High Build Acrylic Waterborne paint shall be water resistant and shall show no softening or blistering.

Table 708-1

LOW TEMPERATURE ACRYLIC WATERBORNE PAINT

Property	White	Yellow	Test Method
Nonvolatile portion of vehicle (white and yellow), %	41.0 (min)	41.0 (min)	ASTM D2205
Pigment Composition			
Percent by weight♦	58-62	58-62	ASTM D4451 ASTM D3723
Paint			
Titanium Dioxide Content, lb./gal	1.0 (min)		ASTM D5381
Properties of the Finished Paint			
Total Non-volatiles, (solids) % by weight	75.0 (min)	75.0 (min)	FTMS 141C - Method 4053.1, ASTM D2369, or ASTM D4758
Density, lbs./gal	13.3-13.9	13.1-14.0	ASTM D2205
Consistency (Viscosity) White and Yellow, Krebs-Stormer Units	75-85	75-85	ASTM D562
Freeze Thaw Stability	Shall complete 5 or more test cycles successfully		ASTM D2243
Fineness of Grind, Cleanliness Rating B, minimum	3	3	ASTM D1210
Scrub Resistance	800	800	ASTM D2486
Directional Reflectance: [15 mil Wet Film]	88 (min)	50 (min)	ASTM E1347
Dry Opacity (Contrast Ratio): [15 mil Wet Film]	0.98 (min)	0.98 (min)	ASTM D2805
♦Percent by weight shall include percent of organic yellow pigment.			

Table 708-2

HIGH BUILD ACRYLIC WATERBORNE PAINT

Property	White	Yellow	Test Method
Nonvolatile portion of vehicle (white and yellow), %	43.0 (min)	43.0 (min)	ASTM D2205
Pigment Composition			
Percent by weight♦	60-62	60-62	ASTM D4451 ASTM D3723
Paint			
Titanium Dioxide Content, lb./gal	1.0 (min)		ASTM D5381
Properties of the Finished Paint			
Total Non-volatiles, (solids) % by weight	77.0 (min)	77.0 (min)	FTMS 141C - Method 4053.1, ASTM D2369, or ASTM D4758
Density, lbs./gal	14.0-14.6	13.7-14.3	ASTM D2205
Consistency (Viscosity) White and Yellow, Krebs-Stormer Units	85-95	85-95	ASTM D562
Freeze Thaw Stability	Shall complete 5 or more test cycles successfully		ASTM D2243
Fineness of Grind, Cleanliness Rating B, minimum	3	3	ASTM D1210
Scrub Resistance	800	800	ASTM D2486
Directional Reflectance: [15 mil Wet Film]	88 (min)	50 (min)	ASTM E1347
Dry Opacity (Contrast Ratio): [15 mil Wet Film]	0.98 (min)	0.98 (min)	ASTM D2805
♦Percent by weight shall include percent of organic yellow pigment.			

708.06 Materials - Specifications

(a) Paint Pigment.

Chrominum Oxide, (Green)	ASTM D263
Magnesium Silicate	ASTM D605
Titanium Dioxide	ASTM D476, Class IV
Red Iron Oxide	ASTM D3721
Black Iron Oxide	ASTM D769

Yellow Iron Oxide	ASTM D768

708.07 Pavement Primers. Not Used.

708.08 Structural Concrete Coating. Not Used

708.09 Inspection and Testing. The manufacturer shall notify the Engineer well in advance of actual paint manufacture in order to arrange for sampling and testing of raw materials and inspection of paint production.

Test methods shall be according to ASTM or, if not covered therein, Federal Test Method Standard No. 141.

All paint shall have been approved before delivery.

END OF SECTION

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SECTION 709 REINFORCING STEEL AND WIRE ROPE

709.01 Reinforcing Steel. Reinforcing steel shall conform to the requirements of the following specifications:

Deformed and Plain Billet-Steel Bars for Concrete Reinforcement	ASTM A615
Axle-steel Deformed and Plain Bars for Concrete Reinforcement	ASTM A996
Steel Welded Wire Fabric, Plain for Concrete Reinforcement	AASHTO M 55

Unless otherwise designated, bars conforming to ASTM A615 and ASTM A996 shall be furnished in Grade 60.

In ASTM A184, bar material conforming to ASTM A616 will not be permitted.

In ASTM A955, bar material shall be furnished in Grade 75 unless otherwise designated.

In ASTM A1035, bar material of Type CL will not be permitted unless designated in the plans or otherwise approved by the Engineer.

709.02 Wire Rope. Not Used.

709.03 Dowel Bars and Tie Bars. Not Used.

END OF SECTION

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SECTION 712 MISCELLANEOUS

712.01 Water. Water used in mixing or curing concrete shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetation, or other substance injurious to the finished product. Concrete mixing water shall meet the requirements of ASTM C1602. The Contractor shall perform and submit tests to the Engineer at the frequencies listed in ASTM C1602. Potable water may be used without testing.

Where the source of water is relatively shallow, the intake shall be so enclosed as to exclude silt, mud, grass, and other foreign materials.

712.02 Calcium Chloride. Calcium chloride shall conform to the requirements of AASHTO M 144.

712.03 Hydrated Lime. The hydrated lime for hot mix asphalt (HMA) shall conform to the requirements of AASHTO M303, Type I. In addition, the particle size requirements shall conform to AASHTO M 303 when tested in accordance with CP-L 4209 Physical Testing of Quicklime, Hydrated Lime, and Limestone.

712.04 (Unused)

712.05 Precast Concrete Units. Not Used.

712.06 Frames, Grates, Covers, and Steps. Not Used.

712.07 Geosynthetics. Not Used.

712.08 Geotextiles. Geotextile rolls shall be furnished with suitable wrapping to protect against moisture and extended ultraviolet exposure prior to placement.

Each roll shall be labeled to provide product identification sufficient for inventory and process control purposes. Rolls shall be stored in a manner which protects them from the elements. If stored outdoors, they shall be elevated and protected with a waterproof cover. The Contractor shall submit a certified test report from the manufacturer including all data necessary to verify compliance with this specification.

Securing pins shall be made from galvanized steel wire or other approved wire material, 0.091 inch or larger in diameter. They shall be U-shaped, with legs 6 inches long and a 1 inch crown.

Physical requirements for all geotextiles shall conform to the requirements of AASHTO M-288. Materials shall be selected from the New York Sponsor of Transportation's Approved Products List of Geosynthetic materials that meet the National Transportation Product Evaluation Program (NTPEP) and AASHTO M288 testing requirements. The current list of products that meet these requirements is located at:

www.dot.ny.gov

https://www.dot.ny.gov/divisions/engineering/technical-services/technical-services-repository/alme/geo.html

Table 712-2

TYPICAL VALUES OF PERMEABILITY COEFFICIENTS[1]

Turbulent Flow	Particle Size Range Millimeters (inches)		Effective Size	Permeability Coefficient k cm/s
	D max	D min	D 20 mm (inches)	
Derrick STONE	3000 (120)	900 (36)	1200 (48)	100
One-man STONE	300 (12)	100 (4)	150 (6)	30
Clean, fine to coarse GRAVEL	80 (3)	10 (¼)	13 (½)	10
Fine, uniform GRAVEL	8 (⅜)	1.5 (1/16)	3 (⅛)	5
Very coarse, clean, uniform SAND	3 (⅛)	0.8 (1/32)	1.5 (1/16)	3
Laminar Flow				
Uniform, coarse SAND	2 (⅛)	0.5 (1/64)	0.6	0.4
Uniform, medium SAND	0.5	0.25	0.3	0.1
Clean, well-graded SAND & GRAVEL	10	0.05	0.1	0.01
Uniform, fine SAND	0.25	0.05	0.06	40×10^{-4}
Well-graded, silty SAND & GRAVEL	5	0.01	0.02	4×10^{-4}
Silty SAND	2	0.005	0.01	1.0×10^{-4}
Uniform SILT	0.05	0.005	0.006	0.5×10^{-4}
Sandy CLAY	1.0	0.001	0.002	0.05×10^{-4}
Silty CLAY	0.05	0.001	0.0015	0.01×10^{-4}
CLAY (30% to 50% clay sizes)	0.05	0.0005	0.0008	0.001×10^{-4}
Colloidal CLAY (-2 µm 50%)	0.01	10	40	10^{-9}

1. Basic Soils Engineering, R.K. Hough, 2nd Edition, Ronald Pess Co.; 1969, Page 76.

Note: Since the permeability coefficient of the soil will be unknown in most non-critical, non-severe applications for erosion control and drainage, the soil-permeability coefficients listed in Table 712-2 may be used as a guide for comparing the permeability coefficient of the fabric with that of the in-place soil.

END OF SECTION

SECTION 713 TRAFFIC CONTROL MATERIALS

713.01 Signs-General. Aluminum or steel used for traffic control shall conform to Table 713-1.

Table 713-1

Application	Aluminum		Steel
	ASTM Designation	Alloy No. Temper	ASTM Designation
Sign panels	B 209 B 449[1] B 921[1]	6061-T6 5052-H36 5052-H38	A 653[2]
Clip bolts	B 211	2024-T4	
Locknuts or steel nuts and bolts	B 211	2014-T4	A 307
Clips and backing angles	B 221	6061-T6	

1. In lieu of ASTM treatment, aluminum sign blanks shall receive a Class 2 anodized coating prior to the placement of retroreflective sheeting.

2. Steel sheets shall have a Z600 zinc coating in accordance with ASTM A 653 and a light phosphate coating. Phosphate coating of 3.5 oz./sq. ft. will be required for application with reflective sheeting. Nuts and bolts shall be galvanized or cadmium plated.

713.02 Aluminum Sign Panel Tolerances. Aluminum sign panel sheet dimensional tolerances shall conform to the applicable requirements of the American National Standards Institute Dimensional Tolerances for Aluminum Products, ANSI-H35.2(M), with the following exceptions:

The flatness tolerances shall be one-half the values listed in Table 3.12, and shall apply to all aluminum alloy grades permitted for sign panels.

Sign blanks are to be tensile leveled for sheet thickness less than 0.09 inch, and stretcher leveled for thickness equal to or greater than 0.09 inch.

The individual sign blank bow tolerance (deviation of a side edge from a straight line) shall not exceed $\frac{1}{32}$ inch, and the dimensions of the opposing sides shall be within $\frac{1}{16}$ inch.

Aluminum sign panel shall be subject to the requirements of the first paragraph of subsection 713.09.

713.03 (Unused)

713.04 Sign Message Materials. The legend, border, and overlay shall be used in accordance with the sheeting manufacturer's recommendation. Retroreflective sheeting background material shall be on CDOT's Approved Product List; and the retroreflective sheeting background material shall be the type specified on the plans. At a minimum, ASTM 4956 Type IV shall be used for ground mount signs. ASTM D4956 Type XI shall be used for Class III overhead signs.

All reflective sheeting shall be sealed at the seams and edges as recommended by the manufacturer.

713.05 Hardware. All hardware shall be compatible with sign material and shall not cause discoloration due to weather.

713.06 (Unused)

713.07 Reflectors. Reflectors shall consist of a clear and transparent acrylic plastic prismatic reflex lens

with a smooth front face, except for the legibly molded manufacturer's trademark, and a back hermetically sealed surface with prismatic configuration effecting total internal reflection of light. Firmly fused to the back surface shall be a backing material. The backing material shall be white opaque plastic of the same type as the lens and delineator reflectors may be backed with a plastic coated metallic foil. Delineator reflectors shall be housed in embossed aluminum and provided with a single grommetted mounting hole. The delineator unit shall withstand the combined corrosion test described in ASTM B117.

713.08 Glass Beads for Traffic Markings. Glass beads for pavement marking shall conform to AASHTO M 247, except for the following:

(1) Gradation:

U.S. Mesh	Microns	% Passing	
		~~Modified Epoxy and Methyl Methacrylate~~	Acrylic Waterborne: Low Temperature and High Build
16	1180	~~90-100~~	100
18	1000	~~65-80~~	97-100
20	850		85-100
30	600	~~30-50~~	50-70
40	425		10-35
50	300	~~0-5~~	0-10
80	180		0-5

(2) Roundness: All beads shall meet a minimum of 80 percent true spheres in accordance with the Office of Federal Lands Highways FLH T520 or a computerized optical testing method.

(3) Color / Clarity: Beads shall be colorless, clear, and free of carbon residues.

(4) Refractive Index: Minimum 1.51 by oil immersion method.

(5) Air Inclusions: Less than 5 percent by visual count.

(6) Coatings: According to the manufacturer’s recommendation for optimum adhesion and embedment.

(7) Chemical Resistance: Beads shall be resistant to hydrochloric acid, water, calcium chloride, and sodium sulfide as tested using the methods outlined in sections 4.3.6 to 4.3.9 of the TT-B Federal Spec.1325D.

(8) For modified epoxy pavement parking, a minimum of 50 percent of the total weight shall be manufactured using a molten kiln direct melt method. For acrylic waterborne paint, a minimum of 15 percent of the total weight shall be manufactured using a molten kiln direct melt method. All molten kiln direct melt glass beads shall be above the 600 μm (#30) sieve.

(9) Glass beads used for any type of pavement marking shall not contain more than 75 parts per million (ppm) arsenic, 75 ppm antimony and 100 ppm lead, as tested in accordance with EPA methods 3052 and 6010C, or other approved testing method

Glass beads shall be furnished in fully identified containers and shall be free of extraneous material or clumps.

713.09 Sampling and Inspection. The Engineer shall be notified well in advance of beginning of shop work so that adequate arrangements may be made for sampling and inspection. Shop inspection may be waived and complete inspection made when the fabricated sign panels are delivered to the site of the work.

The following samples shall be submitted to the Sponsor for approval:

(1) A 12 inch x12 inch sample of reflective sheeting representing each lot used on the project.

(2) Two reflectors for each 100, or part thereof, of each size and color, with a limit of 53 samples for any one size or color.

(3) 2 pounds of glass beads, representing each lot used on the project.

(4) 1 pint of paint of each color, representing each lot used on the project.

Quality Requirements of Reflective Materials. Reflective devices and reflective sheeting shall be materials which are on CDOT's Approved Products List.

(a) Reflective Devices.

1. Reflective Quality Requirements.

   A. Delineator and Median Barrier Reflectors. The specific intensity of each delineator and median barrier reflector shall be at least equal to the following minimum values when tested in accordance with AASHTO T257, with an observation angle of 0.1 degrees.

Entrance Angle Degrees	Specific Intensity Candlepower per Foot-Candle	
	Crystal	Yellow
0	115	70
20	45	25

2. Material and Component Requirements. Plastic for delineator shall be poly methyl methacrylate conforming to requirements of ASTM D788, Grade 8. The reflectors shall meet test requirements of CP L-2115, Section 3.2 and 3.3.

(b) Retroreflective Sheeting. Reflective sheeting for traffic control devices shall be listed on the CDOT Approved Products List, and conform to the requirements of ASTM D 4956.

1. Retroreflective Quality Requirements.

   Drums and Tubular Markers. Retroreflective sheeting shall conform to ASTM D4956 Type IV, with the following modifications:

   The Minimum Coefficient of Retroreflection (RA) shall conform to the following minimum values.

Observation Angle	Entrance Angle	Minimum Coefficient of Retroreflection (R_A) [cd/fc/ft^2 (cd/lx.m^2)]	
		White	Fluorescent Orange
0.2°	-4°	500	200
0.2°	30°	200	80
0.5°	-4°	225	90
0.5°	30°	85	34

2. Daytime Color.

   Drums and Tubular Markers. All fluorescent orange sheeting shall meet the color requirements of ASTM D4956, with the following modifications:

   The chromaticity coordinates and total luminance factor shall conform to the requirements as

described in 23 CFR Part 655 Appendix to Subpart F.

The Fluorescence Luminance Factor (YF) shall conform to the following minimum values.

Color	YF Initial Requirement	YF Minimum Requirement
Fluorescent Orange	20	15

713.11 Traffic Signals. Not Used

713.12 Thermoplastic Marking Material. Not Used

713.13 Preformed Plastic Material. Not Used

713.14 Preformed Thermoplastic Material. Not Used

713.15 Pavement Marking Tape. Not Used

713.16 Pavement Marking Tape (Removable). Not Used

713.17 Modified Epoxy Pavement Marking Material. Not Used.

713.18 Raised Pavement Marker. Not Used

713.19 Methyl Methacrylate Pavement Marking. Not Used

END OF SECTION