Section 8.0 Roadway Inspection and Testing Procedures

8.1 General

8.1.1

All EARTHWORK shall be performed per the Metropolitan Government Pavement Engineer's Council (MGPEC), MGPEC Pavement Design Standards and Construction Specification Manual, hereafter referred to as MGPEC Standards, some criteria modifications have been made in the following Douglas County Roadway Design and Construction Standards. In these standards, asphalt refers to Hot Bituminous Pavement, Existing Bituminous Pavement, and/or Asphalt Paving Material. In case of discrepancy, the most stringent criteria shall take precedence as determined by Douglas County.

8.1.2

Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, Sections 105.07, and 106.05, as amended, special provisions and revisions thereto and as amended by the MGPEC Standards and the Douglas County Roadway Design and Construction Standards shall apply to roadway testing and inspection requirements.

8.1.3

Prior to placement of any fill, the existing surface shall be scarified and reconditioned with moisture treatment in accordance with the MGPEC Item 3, Embankment Attachment to Chapter 5.

8.1.4

All tests and inspection results performed by the testing firm in the employment of the owners/developers/contractors shall be submitted directly from the testing agency to the Director of Public Works Engineering, Douglas County, or their field representative at the time of field tests, and within ten (10) working days after the testing or retesting date of laboratory tests. Failure to meet the above requirements may result in a Stop Work Order being issued along with penalties per Chapter 10, Section 10.7.

8.1.5

Any work performed inside Douglas County R.O.W., associated easements, and all storm water facilities shall be tested by approved materials testing firms. Materials testing firms and/or laboratories shall be approved AASHTO accredited and approved by the Engineering Inspections Division on an annual basis. They must employ a full time registered Colorado Licensed professional engineer who directly supervises work of the firm. The costs of testing, retests, and associated reporting will be paid by the Owner/Developer. All Material Testing Reports must be from an AASHTO accredited lab and must be certified by a Professional Engineer.

8.1.6

The testing of all materials and construction shall be in conformance with the appropriate AASHTO, ASTM, CDOT or MGPEC specifications.

8.1.7

Any work performed inside Douglas County R.O.W. and on all storm water facilities must have a valid Right-of-Way Use and/or Construction Permit. A Temporary Access Permit or a Permanent Access Permit may also be required. The Permit holder must call the Engineering Inspections Division (303-660-7487) at least 24 hours (one working day), but not more than 120 hours (5

working days), in advance of commencing work (Chapter 10, Section 10.1.1), or penalties of the "Stop Work" order may apply (Chapter 10, Section 10.7). If an inspection is scheduled with the Engineering Inspections Division and, for ANY reason, work is not performed as scheduled, the Permit holder must call and cancel the inspection as soon as possible. Failure to cancel the County inspection will result in a re-inspection fee levied. Repeated failure to notify the Engineering Inspections Division of a scheduled inspection cancellation may result in the revocation of the Permit holder's permit(s).

8.2 Ancillary Structure Testing

8.2.1 Utility Trenches, Inlets, Manholes and Junction Boxes Backfilling

8.2.1.1 Materials, Placement and Compaction

All utility trenches, within the R.O.W., associated easements and on all storm water facilities shall be placed and compacted in accordance with these standards.

8.2.1.2 Testing

Field moisture-density testing shall be performed during backfill operations including the bedding material up to the finished subgrade elevation. Minimum testing frequency shall be in accordance with MGPEC Table 3.7-1. As a minimum, one test shall be taken within 1 foot of every manhole, water valves or other obstacles after each 8-inch loose lift has been compacted. Locations of these tests shall be randomly selected however they shall not be placed within 45° either side of the previous test. A sufficient number of tests shall be taken at various depths to confirm backfill compaction and moisture content specifications are met. The results of field density tests shall be submitted to and reviewed by the Director of Public Works Engineering or their representative. Testing shall be done in accordance with this manual. Within the roadway area, trench compaction shall be in accordance with AASHTO T-99 or T-180. See Table 8.1/ MGPEC Table 3.4B-1.

8.2.2 Curb, Gutter, Sidewalk, Cross pans, and Minor Drainage Structures

8.2.2.1 Subgrade Preparation

8.2.2.1.1 Subgrade

Subgrade shall be thoroughly compacted in accordance with MGPEC Item 3, Embankment, included in the attachments to Chapter 5. The surface shall be smooth with no humps or depressions and to the final grade on which the concrete will be placed.

8.2.2.1.2 Testing

Testing frequency for the subgrade shall be in accordance with MGPEC Item 3, Embankment, Table 3.7-1. Once all testing is complete, the Subgrade shall be tested in accordance with 8.3.4 Final Proof Rolling. All costs associated with testing, retests, and associated reporting will be paid by the Owner/Developer. These test results shall be submitted to the field representative of the Director of Public Works Engineering or their representative for compliance review per Section 8.1.2.

8.2.2.2 Concrete

8.2.2.2.1 Materials

Concrete material shall conform with the requirements of MGPEC Item 30, Portland Cement Concrete Materials included in the Chapter 5 Attachments.

8.2.2.2.2 Curing

Curing methods shall conform to ACI 301 standard specifications.

8.2.2.2.3 Placement

Concrete placement and finishing shall include methods per ACI Craftsman Workbook Publication CP-10 (05) which will not reduce the strength or integrity of the final product.

8.2.2.2.4 Testing

Daily placement of concrete will require testing in accordance with MGPEC Item 31 included in the attachments to Chapter 5, plus unit weight on the first (3) consecutive passing truck loads. If placement is by means of a "pump truck", sampling will be from the point of placement (the end of the discharge hose). 1 set of 6 cylinders shall be made and used for compressive strength of the cylinders from one of the first three passing truck loads and every 100 subsequent cubic yards or portion thereof. In the event there will only be one or two truck load(s) placed then all of the above tests will be required to pass, and 1 set of cylinders made for compressive strength testing.

8.2.2.3 Cold Weather Concrete Protection

From November 1st through April 15th when the mean daily temperature is less than 40ºF OR when concrete is placed with ambient temperatures below 40ºF, cold weather protection shall be provided in accordance with MGPEC Item 31 and this Section.

All protection for the job must be on site and reviewed by the County Inspector prior to beginning the concrete placement. After the concrete has been placed, the Contractor shall provide sufficient protection such as cover, straw (as determined by R-factor per A.C.I. specifications), thermal blankets, canvas, framework, heating apparatus, etc., to enclose and protect the structure and maintain the temperature of the concrete at not less than 50ºF for a minimum of five (5) days or until at least sixty percent (60%) of the design strength has been attained. It shall be the Permittee's responsibility to provide proof of temperature compliance through the use of maturity meters or with surface temperature recording devices, as certified (by a P.E.) by a testing laboratory. The maximum frequency for recording temperatures shall be one (1) hour intervals. If surface temperature compliance data is not provided, the Permittee shall be required to provide the County with petrographic tests for every 50 C.Y. of concrete placed. Except as provided above, cold weather placement of concrete shall be in accordance with ACI-306. If in the opinion of the County Inspector, the protection provided is not in accordance with the above specifications, placement of concrete shall cease until conditions or procedures are satisfactory to the County Inspector.

NOTE: Dates for Mean Daily Temperature as determined over the last 25 years by the Colorado Climate Center, Department of Atmospheric Science by: (min. temp. + max. temp)/2 (which is accurate to within + or - 1 degree).

8.3 Roadway Subgrade Preparation

8.3.1 Swell Mitigation Procedure

If swell mitigation is required per the approved Pavement Design Report, the swelling material shall be mitigated per the approved measures (Refer to Section 5.4.3.1). Field density tests and a proof roll shall be performed and accepted per Sections 8.3.3 and 8.3.4.

8.3.2 Compaction

Subgrade shall be prepared in accordance with MGPEC Item 3, Embankment, as amended by Table 8.1 (Since most fills are done prior to R.O.W. dedication, certified compaction reports shall be required in accordance with this manual prior to initial acceptance by the County.)

To determine soil temperature, the subgrade will be checked at various depths below the surface as determined by the County Inspector. If there is the presence of ice crystals in the subgrade, or temperatures are recorded below 32ºF, as determined by the County Inspector, it shall be considered as frozen material.

8.3.3 Testing

Subgrade shall be tested in accordance with MGPEC Item 3, Embankment.

8.3.4 Final Proof Rolling

Subgrade shall be proof-rolled in accordance with MGPEC Item 3, Embankment. Subgrade which is pumping, or deforming as determined by the County Inspector, must be reworked, replaced or otherwise modified to form a smooth, stable, non-yielding base for subsequent paving courses. The proof roll shall be scheduled with the Engineering Inspections Division 24 hours in advance and the County Inspector shall be present at the time of the proof roll.

TABLE 8.1/
MGPEC TABLE 3.4B-1

SOIL TYPE	COMPACTION	MOISTURE
A-1, A-2-5, A-2-7, A-3, A-4, & A-5	95% Min. of AASHTO T 180	-2 to +2
A-2-4, A-2-6,	95% Min. of AASHTO T 99	-2 to +2
A-6, A-7	95% Min. Of AASHTO T 99	0 to +4

8.3.5 Acceptance

The results of field moisture/density tests shall be submitted and reviewed by the Director of Public Works Engineering or their representative. Provided all tests are acceptable and the proof roll is approved, placement of the first paving course may proceed. Should testing and proof rolling indicate unsatisfactory work, the necessary reworking, compaction, replacement, re-testing and new proof roll will be required prior to continuation of the paving process. The testing and proof rolling are valid for 24 hours. Changes in weather such as freezing, or precipitation will require re-testing and proof roll of the subgrade.

8.4 Lime and Cement Treated Subgrade

8.4.1 Materials

Construction of lime and cement treated subgrade shall not be allowed from October 1st through April 15th. Lime and cement treated subgrade shall be used only where a mix design has been previously submitted to and approved by the Douglas County Director of Public Works Engineering, or their representative.

8.4.2 Construction

Construction of lime and cement treated subgrade for swell mitigation shall be in accordance with MGPEC Item 5. Acceptable compressive strength test results shall be in a range from a minimum of 160 pounds per square inch to 500 pounds per square inch. If cement treatment subgrade is used under concrete pavement, a bond breaker shall be used.

Note: If lime or cement treated subgrade is used for swell mitigation per Section 5.4.3, the lime or cement treated subgrade cannot be used to improve the R-Value or the structural number.

8.4.3 Testing

Lime and cement treated subgrade shall be observed and tested on a full-time basis Minimum sampling and testing shall be in accordance with MGPEC Table 5.12-1. Compaction curves (AASHTO T 220) will be required for each soil type and field density shall be compared to the appropriate curve for percentage compaction determinations.

8.4.4 Acceptance

The results of the tests shall be submitted and reviewed by the Director of Public Works Engineering or their representative. Provided all tests, including a proof roll, are acceptable, the subgrade will be approved, and the next paving course can be placed.

8.5 Aggregate Base Course and Recycled Concrete Base Course

8.5.1 Materials

Aggregate Base Course materials must be from a currently approved source and conform to the requirements of MGPEC Item 13, included in Chapter 5 Attachments. Aggregate Base Course shall have a maximum LA Abrasion at 45% and a minimum specific gravity of 2.4. The owner/developer shall, upon request, provide verification of material properties.

8.5.2 Placement and Compaction

Materials shall be placed on an approved subgrade which has been tested and proof-rolled within the past 24 hours and found to be stable and non-yielding. Should weather conditions change, such as freezing, precipitation, etc., aggregate base materials shall not be placed until the subgrade is re-tested and proof rolled.

Aggregate base materials shall be placed, moisture treated and compacted as outlined in MGPEC Item 13 attached to Chapter 5. In addition, the material shall be compacted to 95% modified proctor, and moisture shall be within 2% of optimum.

8.5.3 Testing

Testing shall be done in accordance with MGPEC Item 13, included in Chapter 5 Attachments. Should these tests indicate the material does not meet specifications, the material shall be removed and replaced.

During placement and compaction, Compaction Curves will be required for each material used. Field moisture-density tests shall be taken of each lift of material at random locations at approximate intervals of 250 linear feet in each travel lane. At least 20 percent of the tests shall be taken within 1 foot of manholes, valves, and curbs.

8.5.4 Proof Rolling

After the base course has been compacted, tested and found to meet specifications in accordance with MGPEC Item 13, Base Course, which is pumping, or deforming must be reworked, replaced

or otherwise modified to form a smooth, stable, non-yielding base for subsequent paving courses. The proof roll shall be scheduled 24 hours in advance with the Engineering Inspections Division and the County Inspector shall be present at the time of the proof roll.

8.5.5 Acceptance

The results of field moisture/density tests and proof-rolling shall be submitted and reviewed by the Engineering Inspections Division. Provided all tests are acceptable and the proof roll is approved, placement of the first paving course may proceed. Should testing and proof rolling indicate unsatisfactory work, the necessary reworking, compaction, replacement, re-testing and new proof roll will be required prior to continuation of the paving process. The approval testing and proof rolling is are valid for 24 hours. Changes in weather such as freezing, or precipitation will require re-approval re-testing and proof roll of the base course.

8.6 Asphalt

8.6.1 Materials

All asphalt, aggregate, fillers and additives shall be combined to form a mix design in accordance with MGPEC Item 20, included in the Chapter 5 Attachments. The mix design must be submitted to and approved by the Engineering Inspections Division every two years. If any element of a mix design changes, a new mix design submittal is required.

8.6.2 Placement and Compaction

Materials shall be placed upon an approved subgrade, base course or previous paving course in accordance with MGPEC Item 20, Asphalt Pavement Materials, included in Chapter 5 Attachments.

If more than one theoretical maximum specific gravity test is taken in a day, the average of the theoretical maximum specific gravity results will be used to determine the percent compaction.

Self-propelled pavers shall be provided that are capable of spreading and finishing the Asphalt Paving Material in full lane widths applicable to the typical section and thicknesses as discussed at the pre-paving conference or shown in the Contract documents and shall be equipped with:

- Anti-segregation devices.
- A vibratory screed assembly capable of being heated.

Pavers used for shoulders, patching and similar construction, not requiring fine grade control, shall be capable of spreading and finishing courses of asphalt to the required widths and depths as shown in the Contract without segregation.

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

The paver shall be capable of operation at forward speeds consistent with uniform and continuous placement of the mixture. Stop and go operations of the paver shall be avoided. The screed or strike-off assembly shall produce the specified finished surface without tearing, shoving, segregating, or gouging the mixture. Self-propelled pavers shall be equipped with automatic screed controls with sensors capable of detecting grade provided by a source of reference line and maintaining the screed at the specified longitudinal grade and transverse slope. The sensors may be contact or non-contact type devices. 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 when they are required for the situation:

- Grade control device at least 30 feet in length.
- Joint matching device.
- Adequate length of control line and stakes, if no other type of geometric control is present.
- A straight edge at least 10 feet in length will be available to verify the crown on the screed, at the request of the County Inspector.

The controls shall be capable of maintaining the screed at the specified transverse slope within plus or minus 0.1 percent. Automatic mode should be used where possible. 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 thickness or surface tolerances, the paving operations shall be suspended until satisfactory corrections, repairs, or equipment replacements are made. Placement of Asphalt Paving Material on a waterproofed bridge deck shall be accomplished with equipment that will not damage the membrane or protective covering. Material placed that does not meet thickness requirements per Section 8.6.4 shall be removed and replaced. Material placed that does not meet smoothness requirements shall be removed and replaced or diamond ground so long as thickness requirements are still met after grinding.

Redistribution of the mixture using hand tools is only permitted when necessary around utilities and in areas inaccessible to equipment. Casting or raking will not be allowed.

Asphalt shall be placed only on properly prepared unfrozen surfaces which are free of water, snow, and ice. The asphalt shall be placed only when both the air and surface temperatures equal or exceed the temperatures specified in Table 8.2 and the County Inspector determines that the weather conditions permit the pavement to be properly placed and compacted.

TABLE 8.2
PLACEMENT TEMPERATURE LIMITATIONS IN ^{O}F

Compacted Layer Thickness in Inches	Minimum Surface and Air Temperature ^{o}F	
	Top Layer	Layers Below Top Layer
<1-1/2	60	50
1-1/2 to 3	50	40
> 3 *	45	35

Note: Air temperature is taken in the shade. Surface is defined as the approved subgrade, base course, or previous paving course on which the new pavement is to be placed.

* Requires Pre-approval from Douglas County Public Works Engineering Department.

The minimum temperature of the mixture when discharged from the mixer and when delivered for use shall be as shown in Table 8.3. Mix temperatures will be checked on each load behind the paver screed. Where the temperature does not meet specifications, the material shall be rejected.

TABLE 8.3
MIX TEMPERATURES

Asphalt Grade	Minimum Mix Discharge Temperature, °F[1]	Minimum Delivered Mix Temperature, °F[2]
PG 58-28	275	235
PG 64-22	290	235

[1] The maximum mix discharge temperature shall not exceed the minimum discharge temperature by more than 30°F
[2] Delivered mix temperature shall be measured behind the paver screed

8.6.3 Testing

Testing of Asphalt Pavement shall be performed in accordance with MGPEC Item 20, Asphalt Paving Materials, and this Section. The tests shall be performed under the general supervision of a Professional Engineer licensed in the State of Colorado. Laboratories shall be accredited by AASHTO for tests being performed to an AASHTO standard or an equivalent test method. Technicians taking samples and conducting compaction tests must have a LabCAT Level A certification. Technicians conducting tests of asphalt content and gradation must have a LabCAT Level B certification. Technicians performing volumetric testing must have a LabCAT Level C certification.

If any materials furnished or work performed, fails to fulfill the specification requirements, such deficiencies shall be reported to the Director of Public Works Engineering or their representative and/or County Project Manager and Contractor. Written field reports of all tests taken, and observation results shall be given to the Contractor, County Inspector and/or County Project Manager, and Developer within 3 business days after samples were obtained or density testing performed. Reports of in place density using Rice values from samples taken during construction or other test results that cannot be reported within 3 days of construction shall be provided to the County Inspector and/or County Project Manager no later than one week following the testing.

Nuclear density test results shall be corrected using Colorado Procedure 82 Field Correction of the In-Place Measurement of Density of Bituminous Pavement by the Nuclear Method. A new calibration should be developed for each change in mix design, pavement lift, or underlying surface. Results of nuclear density test results shall be reported to the inspector/project superintendent at the time the testing occurs. **Nuclear density test results are for information only and are not to be considered for acceptance.**

If the Contractor chooses to cover a lower asphalt lift before that material has been accepted, and it is determined that the lower lift is not within the tolerance variance (condition yellow) shown in Table 8.4, then both the lower lift and upper lift will be removed and replaced.

Mix temperatures will be checked on each load behind the paver screed. Where the temperature does not meet specifications, the material shall be rejected and removed immediately.

Upon completion of the paving the final pavement thickness and density shall be determined by taking cores. Core density shall be determined by coring after each lift of asphalt is placed. The cores shall be taken at random locations at intervals of approximately 500 feet in each travel lane

as determined and marked by the County Inspector. The County Inspector must be present during actual core drilling or cores will not be accepted. The core holes shall be repaired with Asphalt Paving Material or other approved products.

Profil-o-graph tests are required prior to initial acceptance on collector and arterial roadways. Profil-o-graphs shall be performed by a certified independent testing consultant with data supplied to the Engineering Inspections Division within five working days. Profil-o-graphs shall be performed per CDOT Section 105.07 and shall have an MRI <82.0. Corrective work will be required if the MRI >82.0 per CDOT Section 105.07 (c) *Corrective Work.*

TABLE 8.4
Job Mix Formula Production Tolerance Zones

	Reference Conditions		
ELEMENT	**WITHIN TOLERANCE** (GREEN)	**TOLERANCE VARIANCE** (YELLOW)	**OUT OF TOLERANCE** (RED)
Asphalt Content	±0.3%	+0.5/-0.4%	+0.51/-0.41%
Air Voids	±1.2%	±2.4%	±2.5%
[1] Voids in Mineral Aggregate (VMA)	±1.2%	±2.4%	±2.5%
Percent Relative Compaction - Mat	94 ±2%	N/A	N/A
Percent Relative Compaction – Joint	92 ±4%	N/A	N/A
Passing the 3/8" and Larger Sieves	±6%	±9%	±10%
Passing the No. 4 and No. 8 Sieves	±5%	±8%	±9%
Passing the No. 30 Sieve	±4%	±6%	±7%
Passing the No. 200 Sieve	±2%	±3%	±4%

Condition Green will exist when all Elements are within Tolerance. Condition Yellow will exist when any Element falls outside of the Within Tolerance Zone (Green) and has not exceeded the Tolerance Variance Zone (Yellow). If any of the Elements fall in the Tolerance Variance Zone (Yellow) the Contractor shall notify the Supplier and corrections shall be made. While Elements are in the Tolerance Variance Zone (Yellow) paving operations may continue while corrections are made provided in place densities meet the specifications. While Elements are in the Tolerance Variance Zone (Yellow) samples will be taken daily until the mix is back in the Within Tolerance Zone (Green). In the event the mix has not been brought back Within Tolerance (Green) by the end of the third day's paving operations or at any time the tests move into the Out of Tolerance Zone (Red) production/paving operations will be suspended until corrections are made and the mix verified per CDOT Standard Specification for Road and Bridge Construction, Section 106.05 (e).

8.6.4 Acceptance

To be used in addition to MGPEC Item 20.14, included in Chapter 5 Attachments.

The results of field density and laboratory tests shall be submitted to and reviewed by the Engineering Inspections Division. Provided all tests are acceptable, the asphalt concrete materials, placement and compaction will be approved. Acceptable results shall be in compliance with tolerances found in Table 8.4.

Should testing indicate unsatisfactory work, removal and replacement or overlay work will be required as determined by the Director of Public Works Engineering, Douglas County.

In addition to the requirements of MGPEC Section 20.13B:

a. One hundred percent (100%) of all mat cores must pass ninety-four percent (94%) +/- 2.0% of the theoretical maximum specific gravity (Rice Value);
b. One hundred percent (100%) of all longitudinal joint cores must pass ninety-two percent (92%) +/- 4.0% of the theoretical maximum specific gravity (Rice Value);
c. All Lottman (Tensile Strength Ratio, % Retained, CP-L 5109) shall be equal to or greater than 70%.

8.6.4.1 Hot Mix Asphalt Test Result Dispute Resolution

If the Contractor wishes to dispute the results of a failing test, then a split sample (in accordance with CDOT Field Materials Manual CP 55) shall be provided to a certified third-party laboratory within 10 working days after the testing date of the original laboratory test. The results of the retest shall replace those of the original test. The Contractor shall be responsible for paying for the retesting.

8.7 Portland Cement Concrete

8.7.1 Materials

All aggregate, Portland cement, fly ash, water, admixtures, curing materials and reinforcing steel shall meet the requirements of MGPEC Item 30, included in the Chapter 5 Attachments. All materials shall be combined in accordance with MGPEC Item 30 into a mix design, submitted to, and approved every two (2) years by the Engineering Inspections Division.

8.7.2 Construction Requirements

Materials shall be proportioned, handled, measured, batched, placed and cured in accordance with MGPEC Item 30, Portland Cement Concrete Materials, included in Chapter 5 Attachments.

8.7.2.1 Cold Weather Concrete Protection

From November 1st through April 15th when the mean daily temperature is less than 40ºF OR when concrete is placed with ambient temperatures below 40ºF, cold weather protection shall be provided in accordance with MGPEC Item 30 and this Section.

All protection for the job must be on site and reviewed by the County Inspector prior to beginning the concrete placement. After the concrete has been placed, the Contractor shall provide sufficient protection such as cover, straw (as determined by R-factor per A.C.I. specifications), thermal blankets, canvas, framework, heating apparatus, etc., to enclose and protect the structure and maintain the temperature of the concrete at not less than 50ºF for a minimum of five (5) days or until at least sixty percent (60%) of the design strength has been attained. It shall be the Permittee's responsibility to provide proof of temperature compliance through the use of maturity meters or with surface temperature recording devices, as certified (by a P.E.) by a testing laboratory. The maximum frequency for recording temperatures shall be one (1) hour intervals. If surface temperature compliance data is not provided, the Permittee shall be required to provide the County with petrographic tests for every 50 C.Y. of concrete placed. Except as provided above, cold weather placement of concrete shall be in accordance with ACI-306. If in the opinion of the County Inspector, the protection provided is not in accordance with the above specifications, placement of concrete shall cease until conditions or procedures are satisfactory to the County Inspector.

NOTE: Dates for Mean Daily Temperature as determined over the last 25 years by the Colorado Climate Center, Department of Atmospheric Science by: (min. temp. + max. temp)/2 (which is accurate to within + or - 1 degree).

8.7.3 Testing

8.7.3.1

Testing shall be in accordance with MGPEC Item 30 and this Section. During placement of Portland cement concrete pavement, observation and testing shall be on a full-time basis. For each day of production, change in source and/or supplier or every 400 cubic yards placed (or portion thereof), aggregate samples shall be obtained at the batch plant for gradation of both the coarse and fine aggregates.

8.7.3.2

Slump, air content, unit weight and mix temperature shall be tested every 100 cubic yards of pavement placed. Daily placement of concrete will require testing of slump, air content, unit weight, and mix temperature on the first (3) consecutive passing loads. Sampling will be from the point of placement. If any one test fails to meet the requirements, testing shall continue until loads meet requirements. Thereafter, slump, air content, unit weight, and mix temperature shall be tested at least every 100 subsequent cubic yard or portion thereof.

8.7.3.3

A minimum of six compressive strength cylinders shall be fabricated for each 100 cubic yards placed. Cylinders shall be tested as follows: 1 at 7 days, 3 at 28 days and 2 for backup, as required by the Engineering Inspections Division. Testing interval may be increased at the discretion of the County Inspector.

8.7.3.4

Portland cement and fly ash will be accepted on the basis of current certificates of compliance and pre-testing by CDOT. Reinforcing steel, dowels and tie bars will be accepted by certificate of compliance and mill reports. Water, if not potable, shall be sampled and tested before use. Only CDOT approved brands of air entraining agents, chemical admixtures and curing materials may be used and must be documented.

8.7.3.5

Surface smoothness shall be tested and corrected as necessary. Acceptance profiles shall be performed per CDOT Section 105.08 and shall have an MRI <82.0 unless otherwise noted in the plans. Corrective work will be required if the MRI >82.0 per CDOT Section 105.08 (c) Corrective Work. Hand placed concrete tested with a 10-foot straight edge shall have a deviation of no more than 3/16-inch in 10 feet. This requirement is for all concrete mainline pavement. Defective concrete pavement shall be corrected as necessary according to MGPEC Item 30.

Concrete thickness shall be verified by coring after construction at random locations at intervals of approximately 500 feet in each travel lane as determined and marked by the County Inspector. The County Inspector must be present during actual core drilling or cores will not be accepted. Core holes shall be repaired with an approved high strength epoxy grout or other approved material.

8.7.3.6

A final acceptance profile test shall be conducted after all corrections and repairs are made. Acceptance profiles shall be performed by a certified profiler with data supplied to Engineering Inspections Division within five working days following the test.

8.7.3.7

Curing methods shall conform to ACI 301 standard specifications.

8.7.4 Acceptance

All test results shall be submitted to and reviewed by the Director of Public Works Engineering or their representative. The pavement will be accepted once all tests are approved and applicable repairs/corrections have been made. Should testing indicate unsatisfactory work, removal and replacement or grinding will be required. All cores shall meet the same requirements as Section 8.6.4.

8.8 Other Materials

8.8.1 Asphalt Prime and Tack Coats

8.8.1.1 General

8.8.1.1.1

Prime coat is the application of a diluted, emulsified asphalt or cutback asphalt (as allowed by federal or state law) to previously prepared aggregate base course or granular soil subgrade prior to placing asphalt concrete. The prime penetrates into the base or subgrade, plugs the voids, binds the fine aggregate at the surface, waterproofs the surface until the asphalt concrete surfacing is placed and helps prevent shoving of the surfacing following construction.

8.8.1.1.2

Tack coat is a very light application of asphalt (usually diluted emulsified asphalt) to ensure a bond between the asphalt concrete being placed and underlying pavement or adjacent features such as gutter faces, valve boxes and manholes and rings. A tack coat prevents a slip plane in overlays and seals joints between the paving and other appurtenances. It must be applied uniformly and lightly. Too heavy a tack coat is worse than none at all. A tack coat is used when the surface to be overlaid is old, glazed, dried out or subjected to dust or traffic film. Tack coats are sometimes omitted between asphalt courses of new pavements if the succeeding course is placed within 24 hours. If the surface of the underlying course is contaminated by sand, dust or foreign material deposited by traffic or wind, merely brooming is not completely effective. A very light tack coat should be applied after brooming.

8.8.1.2 Materials

Emulsified asphalt shall meet the requirements of MGPEC Item 20 attached to Chapter 5.

8.8.1.3 Application

8.8.1.3.1

Prior to prime coat application, the surface should be allowed to dry to approximately 80% of optimum moisture. Application shall be made with a self-propelled pressure distributor capable of uniform distribution at the rate specified. The distributor should be calibrated and equipped hydraulically, or with tie downs, so the spray bar will maintain a uniform

height above the surface being primed. The asphalt material shall be applied in the range of 0.20 to 0.40 gallons/square yard. If the surface being primed is very tight textured and appears fairly non-absorbent, use the lower end of the range. If the surface is more open textured and appears more absorbent, use the higher end of the range. Apply as much material as the surface will absorb in a reasonable period of time. If an excess is applied, use a blotter material (sand or aggregate base material) to absorb the excess.

8.8.1.3.2

Tack coat is applied with a self-propelled pressure distributor that is in good condition, clean and has been calibrated with nozzles set properly for fan overlap and not plugged. The spray bar should be capable of being set hydraulically, or tied down, so the bar is maintained at a uniform height from the application surface. A 1:1 dilution should be applied at 0.10 gallon/square yard. Greater dilutions should be applied at heavier rates. A wand, or hand spray nozzle attached to the spray bar can be used for applying tack to gutter faces, valve boxes and manholes and rings. In lieu of the wand, a hand sprayer, or as a last resort a mop and bucket, may be used. Care must be taken with the wand, sprayer and especially a mop so that a very light coating is applied, and the emulsion is not sprayed on the surfaces where paving will not be used. Sloppy workmanship shall not be tolerated. The tack coat must be evenly distributed over the entire surface.

8.8.1.4 Curing

When applied, emulsified asphalt will be brown in color. When the emulsion breaks (dehydrates) it will separate into its two components, asphalt cement and water, and turn black in color. Following the break, the water must evaporate before placing asphalt concrete. The prime or tack coat will be sticky, or tacky, when cured. The length of time required for curing will depend on the surface temperature, air temperature, humidity and wind conditions. On a hot, dry, windy day, the prime or tack coat will cure in an hour or so. Cooler, more humid, cloudy and still conditions will extend this time period.

8.8.1.5 Acceptance

Prime or tack coat will be approved by the Engineering Inspections Division upon acceptance of mill certifications, visual approval and verification of application rate. Dust or contamination of prime or tack coats will require brooming and reapplication.

8.8.2 Joint/Crack Sealant

8.8.2.1 Hot Poured Joint and Crack Sealant

All materials shall conform to MGPEC Item 23, Crack Seal, attached to Chapter 5.

8.8.2.2 Concrete Joint Fillers

All materials shall conform to MGPEC Item 30, Portland Cement Concrete Materials included in Chapter 5 Attachments.

8.9 Road Cuts

8.9.1 Small Trench cut in an Existing Roadway

This section is generally reserved for small road cuts from utility locates, water line repairs, sewer line repairs, electrical line repairs, gas main, phone lines, fiber optic lines, cable lines, or service line repairs with damage to asphalt pavement areas less than 500 square feet. Unless pre-approved, all small trenches must be closed and temporarily resurfaced by the end of the workday. Trenches in existing roadways shall be backfilled with a pre-approved controlled low-strength material

(CLSM) backfill, and the surface restored to use by the end of the workday through the use of hot patch asphalt, cold-mix asphalt.

Final surface restoration shall be completed within 48 hours of temporary surface placement, excluding curing of concrete. For roadways where concrete in involved, high early strength concrete may be required. For damaged or disturbed concrete pavements, sidewalks, curbs, gutters, cross pans, fillets, curb ramps, etc., the entire panel must be removed and replaced.

If more than 500 square feet of existing roadway is disturbed (from single street cuts on arterial or collector streets to multiple street cuts on local streets) within a single block, the construction area shall be milled and overlaid by the end of the project. The mill and overlay shall encompass all of the disturbed asphalt areas in a rectangular shape. Standard trench patching shall be required immediately following the initial road cut(s).

8.9.2 Trenches Crossing a Roadway

Unless otherwise approved in writing by the Douglas County Public Works Engineering Director, all trenches crossing a roadway shall be perpendicular to the direction of travel. The sides of the trench shall be saw cut smooth a minimum of one-foot from the edge of the trench. The road surface shall be replaced in accordance with Standard Detail SP. 47a, matching the existing pavement grade and maintaining proper drainage. In concrete roads, the pavement thickness shall be the same as existing, but the panel must be doweled in the existing pavement as shown in the standard details. Unless otherwise approved, all trenches crossing in asphalt road surface that are less than five-years old shall be milled and overlaid with approved materials a minimum of ten-feet on both sides of the trench for local roadways and a minimum of 50-feet on both sides of the trench for collector and arterial roadways.

8.9.3 Longitudinal Trenches within a Roadway

8.9.3.1

Longitudinal trenches within a roadway shall be straight and will generally be a consistent distance from either the centerline of the road or flow line, as specified. Meandering will not be allowed. All pavements shall be saw cut a minimum of one-foot beyond the edge of the trench prior to patching. If the distance between the edge of the trench and the lip of gutter, cross pan or edge of pavement is less than six feet, all pavement to the lip of gutter, cross pan or edge of pavement shall be removed and replaced. At a minimum, removed asphalt pavements shall be in accordance with Standard Detail SP. 47a.

8.9.3.2

Pavements within arterials and collectors shall have the final repairs completed within 24 hours of the completion of the work requiring a road cut. All permanent repairs and temporary patches shall restore the pavements to existing or better conditions than existed prior to construction. Temporary patches in arterial and collector roadways shall be completed by the end of each working day.

8.9.3.3

Final repairs of pavement within local streets shall be completed within five (5) days of the completion of the work requiring a road cut. At no time will more than 800 feet of trench be allowed to be un-restored or temporarily patched. All patches shall restore the pavement to existing or better condition than existed prior to construction.

8.9.3.4

In collector and arterial roadways whose surface is more than five years old, a minimum 12-foot wide mill and overlay to a depth of two inches is required for the length of the trench before the end of construction. The edge of trench should not be in the wheel path. Where the trench straddles two or more traffic lanes, both lanes shall be milled and overlaid to a depth of two-inches for the length of the trench before the end of construction.

8.9.3.4.1

Local streets shall be patched in accordance with Standard Detail SP. 47a. Where multiple trench cuts occur in the street, the construction area shall be milled and overlaid by the end of the project. The mill and overlay shall encompass all of the disturbed asphalt areas in a rectangular shape.

8.9.3.5

In collector and arterial roadways whose surface is less than five years old, the half of the roadway disturbed by construction shall be milled and overlaid to a depth of two inches for the length of the trench before the end of construction. This restoration section shall extend from the centerline of the roadway to the lip of the gutter or pan. Should the road surface on both sides of the centerline be damaged as a result of construction activities, the entire surface of the roadway shall be milled and overlaid.

8.9.3.6

At no time will more than 800 feet of road be disturbed and unavailable for the public use, unless approved in writing by the Douglas County Public Works Engineering Director.

8.9.3.7

All final road restoration shall be completed within 24 hours of the temporary patch for arterials and 4-lane collectors, 48 hours for 2-lane collectors and 5 days for local roads unless otherwise approved by the Director of Public Works Engineering or their representative. Failure by the Contractor to perform the required restoration may result in the work being done though Douglas County with all costs charged to the Project Owner/Contractor. Failure to remit payment for all incurred costs within 30 days of written notice may incur additional finance charges, project acceptance delays, and collection fees.

8.9.4 Potholes for Locates or Subsurface Investigations in Asphalt Pavements

Potholes for utility locates shall be done by means of a 3 to 6 inch diameter core drill through the existing roadway surface. Potholes in asphalt roadways with a surface disturbance less than one-square foot shall be repaired using pre-approved pavement materials with an infrared surface treatment.

8.9.5 Potholes for Locates or Subsurface Investigations in Concrete Pavements

Potholes for utility locates shall be done by means of a 3 to 6 inch diameter core drill through the concrete surface. Potholes in concrete pavement shall be plugged using a pre-approved fast setting pavement concrete. More than two cores in a concrete pavement, including any previous core, or single disturbed area greater than one square foot, shall require the entire panel to be removed and replaced.

For potholes in sidewalks, curbs, gutters, fillets, curb ramps, cross pans, and other small concrete placements, the entire concrete section shall be removed and replaced.

8.9.6 Amount of Unpaved Roadway Trench

At no time shall more than 800-feet of a trench or trenches be without final restoration and useable by the public. Situations other than a temporary surface patch, approved by the Engineering Inspector, due to weather or the need to gain access for final tie in work must be approved in writing by the Public Works Engineering Director or his/her assignee prior to the road surface being cut. Before paving, the Contractor or the Project Owner shall provide passing compaction density tests and pass a proof roll.

8.9.7 Trenchless Technology – Bores and Missiles

Trenchless construction for dry utilities using missiles, rams, unguided bores, or any other type of limited control devices is not allowed in the right-of-way. Only machines with fully controlled boring head are permitted.

The individual Contractor shall warranty the work for a period of five years for heave or settlement. In areas where the exact depth and location of sewer mains or services is not known, the Contractor shall pothole to determine the depth or shall have a TV video survey done of the sewer line or service, prior to construction. The Contractor shall again video survey the sewer line or service after construction is complete to demonstrate the lines have not been damaged. A videotape of the before and after conditions shall be submitted to Douglas County Project Engineer within 30 days of completing boring operations.

8.5 QUICK REFERENCE
DOUGLAS COUNTY ENGINEERING MINIMUM TESTING REQUIREMENTS

SPECIFICATION	ITEM	TYPE OF TEST	MINIMUM FREQUENCY
8.2.1.2, MGPEC Item 3 MGPEC Table 3.7-1	DRY UTILITIES; GAS, ELECTRIC, PHONE & CABLE TV TRENCHES (BACKFILL)	MOISTURE/DENSITY	1 PER 200 LF EVERY 8" ELEVATION & 1' FROM ALL STRUCTURES
8.2.1.2, MGPEC Item 3 MGPEC Table 3.7-1	WET UTILITIES: SANITARY & STORM SEWER, WATER LINE TRENCHES, SERVICES (BACKFILL) (FULL TIME TESTER)	MOISTURE/DENSITY	1 PER 200 LF EVERY 8" ELEVATION & 1' FROM ALL STRUCTURES, MANHOLES, VALVES, AND OTHER OBSTACLES
8.2.2.2.4, MGPEC Item 30 MGPEC Table 30.3 D-1	INLETS (CONCRETE)	AIR, SLUMP, UNIT WEIGHT, TEMPERATURE	FIRST 3 CONSECUTIVE PASSING LOADS, EVERY 100 CY THEREAFTER
		CYLINDERS	1 SET PER 100 CY
		STEEL	VISUAL DOCUMENTATION
8.2.1.2, MGPEC Item 3 MGPEC Table 3.7-1	INLETS (BACKFILL)	DENSITY	8" IN ELEVATION AROUND STRUCTURE

8.2.2.1.2, MGPEC Item 3 MGPEC Table 3.7-1	SIDEWALK, CURB & GUTTER (SUBGRADE)	MOISTURE/DENSITY	1 PER 200 LF EVERY 8" ELEVATION
SECTION 8.3.4		PROOF-ROLL	ALL SUBGRADE
8.2.2.2.4, MGPEC Item 30 MGPEC Table 30.3 D-1	SIDEWALK, CURB & GUTTER (CONCRETE)	AIR, SLUMP, UNIT WEIGHT, TEMPERATURE	FIRST 3 CONSECUTIVE PASSING LOADS, EVERY 100 CY THEREAFTER
		CYLINDERS	1 SET PER 100 CY
8.3.3 MGPEC Item 3 MGPEC Table 3.7-1	ROADWAY (SUBGRADE)	MOISTURE/DENSITY	1 PER 200 LF EVERY 8" ELEVATION & 1' FROM ALL STRUCTURES
SECTION 8.3.4		PROOF-ROLL	ALL SUBGRADE
8.5.3 MGPEC Item 13	ROADWAY (BASE COURSE)	GRADATION & ATTERBERG LIMITS	1 PER 2,000 TONS
		MOISTURE/DENSITY	1 PER 250 LF
Section 8.5.4		PROOF-ROLL	ALL BASE COURSE
8.7.3 MGPEC Item 30 MGPEC Table 30.3D-1, Minimum Frequency (General Use) Column	ROADWAY (CONCRETE) (FULL TIME TESTER)	AIR, SLUMP, UNIT WEIGHT, TEMPERATURE	FIRST 3 CONSECUTIVE PASSING LOADS, EVERY 100 CY THEREAFTER
		CYLINDERS	1 SET PER 100 CY
8.6.3 MGPEC Item 20 MGPEC Table 20.14-1	ROADWAY (ASPHALT) (FULL TIME TESTER)	DENSITY BY NUCLEAR GAUGE	1 PER 500 LANE FEET
		ASPHALT CONTENT, GRADATION, AIR VOIDS, VMA	1 PER 1,000 TONS OR MINIMUM 1 PER EACH DAYS PRODUCTION SAMPLED AT PAVER
		LOTTMAN STRIPING TSR & DRY DENSITY	ONE PER PROJECT PER MIX USED
8.6.3 & 8.7.3	ROADWAY (ASPHALT & CONCRETE)	CORES (THICKNESS & DENSITY VERIFICATION)	1 PER 500 LANE FEET
8.6.3 & 8.7.3.5	ROADWAY	SMOOTHNESS PROFILE	ALL ROADWAYS
ALL ITEMS ABOVE ARE GENERALIZATIONS. PLEASE REFERENCE DOUGLAS COUNTY ROADWAY DESIGN AND CONSTRUCTION STANDARDS, MGPEC ATTACHMENTS, AND COLORADO DEPARTMENT OF TRANSPORTATION SPECIFICATIONS FOR ADDITIONAL STANDARDS.			

Note: For subdivision work, a project shall be defined as a Filing or a Phase, unless otherwise approved by the Director of Public Works Engineering or their representative in advance of the start of work.