# CHAPTER 9

# ROADWAY INSPECTION AND TESTING PROCEDURES AND CONSTRUCTION GUIDELINES

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# CHAPTER 9
# ROADWAY INSPECTION AND TESTING PROCEDURES

## INDEX

# CHAPTER 9 - ROADWAY INSPECTION AND TESTING PROCEDURES

## 9.1 GENERAL

9.1.1 CDOT Standard Specifications for Road and Bridge Construction, as amended, special provisions and revisions thereto and as amended by the Roadway Standards shall apply to roadway testing and inspection requirements.

9.1.2 All tests and inspection results performed by the testing firm in the employment of the applicants shall be submitted directly from the testing agency to the County Engineer or his field representative at the time of field tests, and within ten (10) working days after the testing or retesting date of laboratory tests.

9.1.3 Any work performed inside Teller County R.O.W. or approved developments shall be tested by an approved materials testing firm. Materials testing firms shall be approved by the County Engineer and must employ a full time registered professional engineer who directly supervises work of the firm. The costs of testing and associated reporting will be paid by the Applicant. All material testing reports must be from an approved lab and must be certified by a professional engineer.

9.1.4 The testing of all materials and construction shall be in conformance with the appropriate AASHTO, ASTM, A.C.I., or CDOT specifications. A partial list of approved testing methods includes:

| TEST PROCEDURES | AASHTO | ASTM |
|---|---|---|
| Asphalt Core Densities | T 166 - 78 | |
| Atterberg Limits(LL & PL) | T 89 & T 90 | D 4318 |
| Gradation Analysis (except hydrometer) | T 27 | D 422 |
| CBR (as modified in Section 5.2.4.1) | 193 | — |
| R-value (subgrade & base) | T 190 | D 2844 |
| Marshall Stability | T 245 | D 1559 |
| $R_t$ Value | T 246 | D 1560 |
| Compaction Curve (standard) | T 99 | D 698 |
| Compaction Curve (modified) | T 180 | D 1557 |
| Compaction Curve (CTAB) | T 134 | --- |
| Field Density Test (Sand Cone) | T 191 | D 1556 |
| Field Density Test (Nuclear) | T 238/T 239 | D 2922/D 3017 |
| Field Density Test (Balloon) | T 205 | D 2167 |
| Concrete Slump | T 119 | C 143 |
| Concrete Air Content | T 152 | C 231 |
| Concrete Compressive Strength | T 22 | C 39 |
| Concrete Sampling | T 141 | C 172 |
| Strength of Soil-Lime Mixtures | T 220 | --- |
| Asphalt Flow | T 245 | D 1559 |
| Air Voids | T 245 | D 1559 |
| Profil-o-graph | Colo. Procedure 64-85 | |
| Denver/Colorado/Swell Consolidation Test | | |

#### 9.1.5 General

Any work performed inside Teller County R.O.W. must have a valid Right-of-Way Use Permit and/or an Access Permit. The permit holder must call the Road and Bridge Department (719-687-8812) at least 24 hours (one work day), but not more than 120 hours, in advance of commencing work, or penalties of the "Stop Work" order may apply. (See Section 10.7.) If an inspection is scheduled with the Road and Bridge Department 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 penalty fee levied. Repeated failure to notify the Road and Bridge Department of a scheduled inspection cancellation may result in the recommendation for revocation of the permit holder's license.

## 9.2 ANCILLARY STRUCTURE TESTING

### 9.2.1 Utility Trenches, Inlets, Manholes and Junction Boxes Backfilling

#### 9.2.1.1 Materials, Placement and Compaction

All utility trenches within the R.O.W. shall be placed and compacted in accordance with Chapter 11 of these Roadway Standards.

#### 9.2.1.2 Testing

Field moisture-density testing shall be performed during backfill operations beginning 1 foot above the top of the pipe and extending to the finished subgrade elevation. A sufficient number of tests shall be taken at various depths to confirm backfill compaction and moisture content specifications are met. As a minimum, one test shall be taken within 1 foot of manholes, water valves or other obstacles. Testing shall be done in accordance with Chapter 9 of these Roadway Standards. Within the roadway area, trench compaction shall be in accordance with AASHTO T-99 or T-180. (See Table 9.2.)

#### 9.2.1.3 Acceptance

The results of field density tests shall be submitted to and reviewed by the Road and Bridge Department. Provided all tests are acceptable, the two-year probationary period may begin. If no failures of the trenches are evident after two (2) years, the County will assume maintenance obligations, if within Teller County R.O.W. Any failures must be corrected in accordance with the provisions of Chapter 11.

### 9.2.2 Curb, Gutter, Sidewalk, Crosspans, and Minor Drainage Structures

#### 9.2.2.1 Subgrade Preparation

a. Subgrade shall be thoroughly compacted to the moisture and density specifications required for the material tested. The surface shall be smooth with no humps or depressions and to the final grade on which the concrete will be placed.

b. Testing frequency for the subgrade shall be a minimum of each six inch lift on replacement materials with one test for every 250 feet of structure with more tests taken if necessary for control, and must meet requirements in Section 9.3.3 of these Roadway Standards.

c. These test results shall be submitted to the field representative of the County Engineer for compliance review.

9.2.2.2 **Concrete**

a. Air entrained Class A, B, or D shall be used. (Table 8.2)

b. Curing methods shall conform to CDOT standard specifications.

c. Concrete placement shall include methods which will not reduce the strength or integrity of the final product.

d. The slump, air content and unit weight tests shall be carried out on the first three (3) trucks of concrete for the daily placement and all tests shall be taken at the end of the concrete chute, or, if a "pump truck" is used, at the end of the pump, and thereafter in conformance with the following table:

**TABLE 9.1**
**TESTING FREQUENCY**

| ITEM | TESTING FREQUENCY |
|---|---|
| Sidewalks, Crosspans, Curb Returns | 1 set of 6 cylinders for every 100 cubic yards or fraction thereof of concrete placed. |
| Curbing and Combination Curb, Gutter, and Walk | 1 set of 6 cylinders for every 100 cubic yards or fraction thereof of concrete placed. |

NOTE: The testing to include the slump (T 119), air entrainment (T 152), temperature of concrete at placement, yield and compressive strength of the cylinders (T 22). The first three (3) concrete trucks shall be tested (see CDOT Field Materials Manual).

All work done by hand (non-extrusion) shall require a minimum of two (2) sets of tests per day.

e. These test results shall be submitted to the field representative of the County Engineer for compliance review.

9.2.2.3 **Inspection and Testing at Acceptance**
At the discretion of the field representative of the County Engineer, the contractor will provide core test results of concrete at random intervals, not averaging less than one test in 500 feet, to verify that specified thickness of concrete was installed. Testing costs shall be paid for by the Applicant. The contractor will provide core tests at the discretion of the field representative of the County Engineer if the field representative of the County Engineer has not been given the opportunity to inspect the sub-grade and/or concrete forms prior to placement of concrete.

9.2.2.4 **Cold Weather Concrete Protection**
From November 3rd to April 9th when the mean daily temperature is less than 40°F, in accordance with A.C.I. Specifications, OR when

concrete is placed with ambient temperatures below 40°F, the contractor shall provide satisfactory methods and means to protect the mix from injury by freezing. Placing of concrete may be started in the morning if the contractor desires, but shall be discontinued at 3 p.m. of the same day if freezing weather threatens. The concrete or aggregates shall be protected during transit, mixing, and before and after placing, as directed by the field representative for the County Engineer, to retain all heat possible in the concrete mix. All protection for the job must be on site and approved by the field representative for the County Engineer 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. specs), canvas, framework, heating apparatus, etc., to enclose and protect the structure and maintain the temperature of the concrete at not less than 50°F 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 with surface temperature recording devices as certified (by a Professional Engineer) by a testing lab. If surface temperature recording devices are 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 concreting shall be in accordance with ACI-306. If, in the opinion of the field representative for the County Engineer, the protection provided is not in accordance with the above specifications, concreting shall cease until conditions or procedures are satisfactory to the field representative for the County Engineer.

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

## 9.3 ROADWAY SUBGRADE PREPARATION

### 9.3.1 Compaction

The subgrade shall be free of organic material and shall be deep plowed to a minimum depth of 12 inches, moisture treated to within 2 percent (optimum to +4% for A-6 or A-7-6) of optimum moisture content, disked or sheep-foot rolled, and replaced and compacted in 6 inch lifts. On all arterials and collectors, in areas of fill, compaction shall be required in accordance with this section, and tested for every 12 inches of fill placed (since most fills are done prior to R.O.W. dedication, certified compaction reports shall be required in accordance with these Roadway Standards prior to initial acceptance by the County). Table 9.2 shall be used to determine the compaction. (See Section 7.2.4.1.b).

### 9.3.2 Testing

Field moisture-density tests using acceptable methods will be required at random locations at the rate of one for each 500 lineal feet (or as specified by the County Engineer) of paving for each travel lane.

### 9.3.3 Final Proof-Rolling

After the subgrade has been compacted, tested and found to meet specifications, the entire subgrade shall be proof-rolled with a heavily loaded vehicle to ensure uniformity of the subgrade. The vehicle must have a loaded GVW of 50,000 pounds with a loaded single axle weight of at least 18,000 pounds and a tire pressure of 90 psi. The County Engineer shall be notified at least 24 hours before final proof-rolling.

**TABLE 9.2***
**MOISTURE-DENSITY CONTROL**

| Soil Classification (AASHTO M 145) | AASHTO T 99 Minimum Relative Compaction (Percent Standard) | AASHTO T 180 Minimum Relative Compaction (Percent Modified) |
|---|---|---|
| A-1 | 100 | 95 |
| A-3 | 100 | 95 |
| A-2-4 | 100 | 95 |
| A-2-5 | 100 | 95 |
| All Other | 95 | 90 |

*Chart taken from CDOT Standard Specifications

### 9.3.4 Acceptance

The results of field density tests and proof-rolling shall be submitted and reviewed by the County Engineer. Provided all tests are acceptable, compaction will be approved for the placement of the next paving course. Subgrade which is pumping or deforming must be reworked, replaced or otherwise modified to form a smooth, stable, non-yielding base for subsequent paving courses. Should testing indicate unsatisfactory work, the necessary reworking, compaction or replacement will be required prior to continuation of the paving process. The approval is valid for 24 hours. Changes in weather such as freezing or precipitation will require reapproval of the subgrade.

## 9.4 LIME TREATED SUBGRADE

### 9.4.1 Materials

Lime treated subgrade shall be used only where a mix design has been previously submitted and approved by the County Engineer. The requirements of Section 7.5.5.5 shall apply.

### 9.4.2 Construction

Construction of lime treated subgrade shall be in accordance with the requirements of Section 307 of the CDOT Standard Specifications, except that the curing period shall be a minimum of 24 hours.

### 9.4.3 Testing

Lime treated subgrade shall be observed and tested on a full-time basis and paid for by the Applicant. Field moisture-density tests shall be taken at the rate of one for each 500 lineal feet (or as specified by the County Engineer) of travel lane for each lift. 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. Field compacted 7-day strength and lime content (AASHTO T 232) determinations shall be required for each 500 tons of subgrade treated, with a minimum of one per project.

### 9.4.4 Acceptance

The results of field density, lime content and strength tests shall be submitted and reviewed by the County Engineer. Provided all tests are acceptable, the subgrade will be approved and the next course can be placed. Should these tests fail to meet project specifications, the strength reduction will be used to calculate increased pavement layer or overlay thicknesses required for the design section.

## 9.5 AGGREGATE BASE COURSE

### 9.5.1 Materials

Aggregate base course materials must be from a currently approved source and conform to the requirements of Section 7.5.5.3. The Applicant shall, upon request, provide verification of material properties.

### 9.5.2 Placement and Compaction

Materials shall be placed on an approved subgrade which has been 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 reapproved.

Aggregate base materials shall be placed, moisture treated and compacted as outlined in Section 304 of the CDOT Standard Specifications. In addition, the material shall be compacted to 95% standard proctor, and moisture shall be within 2% of optimum.

### 9.5.3 Testing

At least one sample of aggregate base course for each 1000 tons of materials (or as specified by the County Engineer) placed shall be tested to determine gradation and Atterberg Limits. 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 500 feet in each travel lane. At least 20 percent of the tests shall be taken within 1 foot of manholes, valves, and curbs.

### 9.5.4 Acceptance

The results of field density tests shall be submitted to and reviewed by the County Engineer. Provided all tests are acceptable, the aggregate base course materials, placement and compaction will be approved and the next paving course can be placed. Should testing indicate unsatisfactory work, the necessary reworking, compaction or replacement will be required prior to continuation of the paving process. All base course shall meet the proof rolling requirements of Section 9.3.3.

## 9.6 CEMENT TREATED AGGREGATE BASE COURSE

### 9.6.1 Materials

Aggregate and cement materials must be from a currently approved source and the mix design shall conform to the requirements of Section 7.5.5.4. The Applicant shall provide verification of material properties and an approved mix design.

### 9.6.2 Placement and Compaction

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

Cement treated aggregate base shall be prepared per the mix design, placed, moisture treated and compacted as outlined in Section 308 of the CDOT Standard Specifications.

### 9.6.3 Testing

At least one sample of cement treated aggregate base course for each 1000 tons (or as specified by the County Engineer) of material placed shall be tested to determine cement content, gradation and Atterberg Limits. Six field prepared proctor mold samples shall be taken for each 500 tons placed and tested at 7 and 28 days to determine unconfined compressive strength.

During placement and compaction, compaction curves will be required for each material used in accordance with AASHTO T 134. Field moisture-density test shall be taken of each lift of material at random locations at approximate intervals of 500 feet in each travel lane. At least 20 percent of the tests shall be taken within 1 foot of manholes, valves and curbs.

### 9.6.4 Acceptance

The results of laboratory tests and field density tests shall be submitted to and reviewed by the County Engineer. Provided all tests are acceptable, the cement treated aggregate base course materials, placement and compaction will be approved and the next paving course can be placed. Should testing indicate unsatisfactory work, necessary adjustments will be made to the pavement section to comply with original design strength requirements.

## 9.7 PLANT MIX HOT BITUMINOUS PAVEMENT (HBP)

### 9.7.1 Materials

All asphalt, aggregate, fillers and additives shall be combined to form a mix design in accordance with Section 7.5.5.1. The mix design must be submitted to and approved by the County Engineer.

### 9.7.2 Placement and Compaction

Materials shall be placed upon an approved subgrade base course or previous paving course in accordance with Section 400 of the CDOT Standard Specifications. Prime or tack coats shall be applied in accordance with Section 9.9.1.

When more than one lift of pavement is required, where possible, the joints or seams between lifts shall be staggered so that joints are separated by at least 2 feet in the horizontal direction.

The bituminous paving mix shall be compacted to at least 95 percent of the mix determined Marshall density to achieve design strength.

A thirty foot (30') ski type device shall be required on all bituminous pavers (except on local roads where the field representative of the County Engineer may substitute an alternate device per CDOT).

Regardless of job-mix temperatures, the mixture shall not be delivered for use on the roadway at a temperature less than 235 degrees F, or 260 degrees F for rubberized asphalt (per CDOT). In no case shall asphalt be placed with air or surface temperatures less than 45 degrees F, otherwise reference Table 401-3 CDOT.

**9.7.3 Testing**

During placement and compaction of plant mix bituminous pavement, observation and testing shall be on a full-time basis. For each 1000 tons of material placed or at least one for each day of production, a field sample shall be taken and subjected to Marshall extraction and gradation analysis. Also, determination of the VMA for the mix is required, bulk specific gravity testing performed on aggregate obtained from stockpiles at the plant.

Mix temperatures will be checked on each truck and where the temperature does not meet specifications, the load shall not be placed.

During compaction the density of the pavement will be checked randomly, for information only, at the rate of one test for each 500 lineal feet of travel for each lift.

Either during or after completion of the paving the final pavement thickness and density shall be determined for the plant mix bituminous pavement using coring, rings or other acceptable methods. Thickness determinations shall be made at random locations at intervals of approximately 500 feet in each travel lane as determined and marked by the field representative of the County Engineer. The field representative of the County Engineer must be present during actual core drilling or cores will not be accepted.

**9.7.4** Profil-o-graph tests shall be submitted to, and accepted by, the County Engineer prior to the beginning of the applicable warranty period. This requirement is for collectors and arterials.

**9.7.5 Acceptance**

The results of field density and laboratory tests shall be submitted to and reviewed by the County Engineer. Provided all tests are acceptable, the asphalt concrete materials, placement and compaction will be approved. Acceptable results shall be in compliance with tolerances for gradation and extraction found in Tables 7.11 and 7.12. Marshall stability test results shall average 1,500 lbs. or more. Should testing indicate unsatisfactory work, removal and replacement or overlay work will be required as determined by the County Engineer.

Criteria used to determine satisfactory work shall be all for the following:

a. Ninety percent (90%) of core tests must meet or exceed design HBP thickness;

b. Average of all core tests must meet or exceed design HBP thickness;

c. All core test thicknesses must exceed design HBP thickness minus 1/4".

d. One hundred percent (100%) of all cores must pass ninety-five percent (95%) minimum Marshall value.

If all these criteria are not met, additional core tests or approved non-destructive testing at the expense of the Applicant may be required to further delineate the area(s) of unsatisfactory work which will require correction prior to acceptance.

## 9.8 PORTLAND CEMENT CONCRETE

**9.8.1 Materials**

All aggregate, Portland cement, fly ash, water, admixtures, curing materials and reinforcing steel shall meet the requirements of Section 7.5.5. All materials shall be combined in accordance with Section 7.5.5 into a mix design and submitted to, and approved by the County Engineer.

**9.8.2 Construction Requirements**

Materials shall be proportioned, handled, measured, batched, placed and cured in accordance with Section 412 of the CDOT Standard Specifications.

9.8.2.1 **Cold Weather Concrete Protection**

From November 3rd to April 9th, when the mean daily temperature* is less than 40 degrees F, in accordance with A.C.I. Specifications, OR when concrete is placed with ambient temperatures below 40 degrees F, the contractor shall provide satisfactory methods and means to protect the mix from injury by freezing. Placing of concrete may be started in the morning if the contractor desires, but shall be discontinued at 3 P.M. of the same day if freezing weather threatens. The concrete or aggregates shall be protected during transit, mixing, and before and after placing, as directed by the field representative of the County Engineer, to retain all heat possible in the concrete mix. All protection for the job must be on-site and approved by the field representative of the County Engineer 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. specs), canvas, framework, heating apparatus, etc., to enclose and protect the structure and maintain the temperature of the concrete at not less than 50 degrees F 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 with surface temperature recording devices as certified (by a Professional Engineer) by a testing lab. If surface temperature recording devices are 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 concreting shall be in accordance with ACI-306. If, in the opinion of the field representative of the County Engineer, the protection provided is not in accordance with the above specifications, concreting shall cease until conditions or procedures are satisfactory to the field representative of the County Engineer.

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).

**9.8.3 Testing**

9.8.3.1 During placement of Portland cement concrete pavement, observation and testing shall be on a full-time basis. For each day of production or every 400 cubic yards placed (or portion thereof), aggregate samples shall be obtained for gradation of both the coarse and fine aggregates.

9.8.3.2 Slump, air content, unit weight and mix temperature shall be tested every 100 cubic yards (or as specified by the County Engineer) of pavement placed. The first three loads shall be tested for slump and air content. If any one test fails to meet requirements, slump and air content tests shall continue until three consecutive loads meet requirements. Thereafter, slump and air shall be tested at least every fifth load.

9.8.3.3 Six compressive strength cylinders shall be fabricated for each 100 cubic yards placed. Cylinders shall be tested as follows: 2 at 7 days, 2 at 28 days and 2 for backup, as required by the County Engineer. Testing interval may be increased to approximately 1/3 of the daily volume to be placed at the discretion of the County Engineer.

9.8.3.4 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.

9.8.3.5 Thickness of concrete shall be verified by coring as specified by the County Engineer in each traffic lane. Any noted deficiency areas shall be corrected at that time. Surface smoothness shall be tested and corrected as necessary according to Section 412.17 CDOT. The profil-o-graph index shall be not more than 14 inches per mile with a deviation of not more than 0.5 inches in 25 feet. 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. Surface smoothness shall be tested and corrected as necessary according to CDOT Section 412.16.

Concrete thickness shall be verified by coring after construction at random locations in each travel lane as determined and marked by the field

representative of the County Engineer. The field representative of the County Engineer must be present during actual core drilling or cores will not be accepted. Surface smoothness shall be tested and corrected as necessary according to CDOT Section 412.16.

9.8.3.6 Profil-o-graph tests shall be submitted to, and accepted by, the County Engineer prior to beginning of the applicable warranty period. This requirement is for all concrete paving.

9.8.3.7 All on-site air tests shall be taken at the point of placement: at the end of the concrete chute, or, if a "pump truck" is used, at the end of the pump, etc.

**9.8.4 Acceptance**

All test results shall be submitted and reviewed by the County Engineer. Provided all tests are acceptable, the pavement will be accepted. Should testing indicate unsatisfactory work, removal and replacement or grinding will be required. All cores shall meet the same requirements as Section 9.7.5.

## 9.9 OTHER MATERIALS

### 9.9.1 Asphalt Prime and Tack Coats

#### 9.9.1.1 General

a. 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.

b. 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 first 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.

#### 9.9.1.2 Materials

Emulsified asphalt of any of the following grades may be used: SS-1, SS-1h, CSS-1 or CSS-1h. All of these should be diluted 1:1 with water. A certificate of compliance must be provided by the supplier. Where allowed by federal and state regulations, cutback asphalt may be used upon written permission by the County Engineer.

#### 9.9.1.3 Application

a. 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.

b. 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. A pneumatic tired roller is an effective piece of equipment used to spread the tack material uniformly.

#### 9.9.1.4 Curing

When applied, emulsified asphalt will be brown in color. When the emulsion breaks 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 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.

#### 9.9.1.5 Acceptance

Prime or tack coat will be approved by the County Engineer 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.

### 9.9.2 Asphalt Chip Seal

#### 9.9.2.1 General

This section is for the application of a polymerized emulsified asphalt and a cover coat of aggregate and fog seal to those roads directed by the County Engineer.

#### 9.9.2.2 Materials

a. Liquid Asphalt Material (Polymerized): Polymerized asphalts shall consist of a rapid setting cationic emulsified asphalt (CRS-2P, or its equivalent) and a rubberizing material, nonfoaming when heated to 180° F and capable of being fluxed with a suitable solvent. The contractor, or the supplier as his agent, shall deliver to the County Engineer, a certification signed by an authorized representative of the supplier to cover the quality and quantity of material and the condition of container for each shipment. The asphaltic material shall meet the following specification:

1. The test requirement for settlement may be waived when the emulsified asphalt is used in less than five days time; or the purchase may require that the settlement test be run from the time the sample is received until it is used, if the elapsed time is less than five days.

2. The 24 hour (1 day) storage stability test may be used instead of the five day settlement test.

3. The demulsibility test shall be made within 30 days from date of shipment.

4. Distillation shall be determined by AASHTO test T 59, oven evaporation method.

5. The asphalt cement shall be rubberized (polymerized) prior to emulsification.

b. Cover Aggregate The chip or cover aggregate shall be washed, hard, sound, 100 percent granite crushed or broken, free from dirt, organic matter, clay balls, adherent films of clay, dust, or other objectional matter. The aggregate shall contain at least 90% by weight of crushed pieces having two or more surfaces, or faces produced by fracture.

When tested in accordance with AASHTO T-182-70, the aggregate shall have a retained bituminous film above 95%. Aggregates which do not meet this requirement may be used for surface treatments and seal coats provided a satisfactory chemical additive or wetting agent is used to render a water resistant film.

The cover aggregate when tested by the standard method of test for abrasion (AASHTO Method T96-70) shall show a loss of not more than 20%.

The moisture content of the cover aggregate at the time of application shall not exceed 3% of the weight of dry aggregate, but not less than 0.5%.

The cover aggregate shall conform to the following gradation:

| Sieve Size | Percentage by Weight Passing Square Mesh Sieves |
|---|---|
| ½" | 100 |
| 3/8" | 90-100 |
| 1/4" | 0-50 |
| No. 8 | 0-3 |
| No. 200 | 0-2 (By Wash Test) |

C. Fog Seal - CRS-2P The fog seal shall meet the requirements of section 9.9.2.2.a and its subparagraphs except that the material shall be a polymerized asphalt consisting of a rapid setting cationic emulsified asphalt (CRS-2P, or its equivalent) and a rubberizing material, nonfoaming when heated to 180° F and capable of being fluxed with a suitable solvent.

**9.9.2.3 Construction Requirements**

a. Quantities of Materials Per Square Yard: The polymerized asphaltic and aggregate cover material and fog seal shall be applied at the following rates:

1. **Polymerized Asphalt shall be applied at a rate of 0.35 to 0.38** net gallon per square yard or as specified by the County Engineer.

2. **Cover aggregate** will be hand distributed over a measured square yard until coverage appears to be slightly over or right at a layer one rock thick. The aggregate will then be collected and weighted. This procedure will be repeated six times. Optimum coverage will then be the average weight of the six samples thus prepared.

3. **A fog seal** shall be applied at a minimum of 0.1 gallons per square yard of CRS-2P.

b. Weather Limitation: Bituminous material shall not be applied on a wet surface as determined by the County Engineer or his authorized representative; or when the pavement temperature is below 70°F and the ambient air temperature is 70°F and falling or as otherwise directed by the Engineer. All temperature readings on pavement are to be taken in the shade. When precipitation appears imminent all application operations shall stop.

c. Equipment The following equipment or its equivalent shall be required:

1. Bituminous distributor and equipment for heating bituminous material shall be so designed, equipped, maintained and operated that bituminous material can be heated and an even temperature maintained; also, the distributor must be able to apply the material uniformly 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. 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.

2. A rotary power broom or other approved sweeping or blowing equipment meeting applicable U.S. Environmental Protection Agency Standards.

3. Pick-up Broom.

4. A minimum of one rubber-tired roller and one steel wheel roller shall be on the project for the chip seal operation. The pneumatic-tired rollers shall be self-propelled and the gross load adjustable to apply 200 to 350 pounds per inch of rolling width as directed. Tire pressures or contact pressures may be specified for the pneumatic tire rollers. Tire pressures on each roller shall not vary more than plus or minus 2.0 p.s.i.

5. One self-propelled aggregate spreader of approved design supported by at least four wheels equipped with pneumatic tires on two axles. The aggregate spreader shall be equipped with a means of applying the larger cover coat material and with computerized controls so that the required amount of material will be deposited uniformly over the full width of the bituminous material. Other types of aggregate spreaders may be used provided they accomplish equivalent results and are approved. The aggregate spreader shall follow immediately behind the spray distributor.

6. One water truck.

**9.9.2.4. Preparation of Existing Road Surface**

No application of the chip seal on any road will be permitted to be placed until any patching required has been completed unless approved by the County Engineer. An EPA approved weed killer will be applied to the roads to be sealed, and any vegetation shall be removed from the road surface before applying the chip seal.

Immediately prior to the application of the seal coat, remove all loose and objectionable material, mud, and silt, by sweeping, blowing or other means. The application of the seal coat shall not be started until the surface has been approved by the County Engineer or his authorized representative.

**9.9.2.5 Soil Sterilization (Weed Killing)**

The contractor will furnish and apply a soil sterilization chemical agent to prevent all weed growth on the roads to be chip sealed. Requirements of CDOT Standard Specifications, Section 217, shall govern, except as otherwise provided herein. An EPA approved weed killer will be applied to the roads to be sealed, and any vegetation shall be removed from the road surface before applying the chip seal. Soil sterilant shall be applied wherever weeds are protruding through the existing pavement surface. Dead weeds shall be removed by approved methods prior to chip seal application.

**9.9.2.6 Application of Chip Seal Material**

a. Bituminous Material: Bituminous material shall be applied by means of a pressure distributor in a uniform, continuous spread over the section to be treated and within the temperature range of 150° F for the CRS-2P or approved equivalent. The distributor shall be moving forward at proper application speed at the time the spray bar is opened. Any skipped areas or deficiencies shall be corrected. Junctions of spreads shall be carefully made to assure a smooth riding surface. The length of spread of bituminous material shall not be in excess of that which trucks loaded with cover coat material can immediately cover. The spread of bituminous material shall not be more than six inches wider than the width covered with aggregate from the spreading device and shall spread no more than 2 inches onto concrete gutter pans. Under no circumstances shall operations proceed in such a manner that bituminous material will be allowed to chill, set, dry or otherwise impair retention of the cover coat.

b. Cover Coat Material: Immediately following the application of bituminous material, cover coat material shall be spread in quantities as designated above. Spreading shall be accomplished in such a manner that the tires of the trucks or aggregate spreader at no time contact the uncovered and newly applied bituminous material.

If directed by the County Engineer, the cover coat material shall be moistened with water to eliminate or reduce the dust coating of the aggregate; however, excess dust will be cause for rejection of the aggregate. Immediately after the cover coat material is spread, any deficient areas shall be covered by additional material. Rolling shall proceed in a longitudinal direction, beginning at the outside and working toward the center. Each pass shall overlap the previous pass by approximately one-half the width of the front wheel or roll.

There will be a minimum of three passes with the rubber-tired roller over the entire surface. One pass will be considered the number of trips (as described above) to cover the entire surface from one side of the street to the other and for the length being worked. The first rolling of the aggregate shall be completed before the emulsion "breaks". The second phase rolling will follow the first phase rolling as soon as possible with a steel wheel roller. Rolling will proceed in the same manner as described for the rubber tired roller and will make a minimum of three passes, followed by the steel wheel roller last making a minimum of two complete passes.

Third phase rolling will be done by a pneumatic tired roller and will make a minimum of two passes. This roller will pay special attention to areas that are not in the main travel areas (shoulder, parking areas, etc.). Additional rolling in these areas may be required by the County Engineer or his authorized representative. All rolling will be done using low gear and shall not exceed 2.5 m.p.h.

After the application of the cover coat material the surface, where specified, shall be lightly broomed or otherwise maintained as directed by the County Engineer, for a period of 3 to 4 days. Maintenance of the surface shall include the distribution of cover coat material over the surface to absorb any free bituminous material and cover any area deficient in cover coat material. In those areas requiring additional cover coat

material, the surface should be rolled with a rubber-tired roller to embed the aggregate in the bituminous material. The maintenance shall be conducted so as not to displace imbedded material. At the proper time, as determined by the County Engineer, the Contractor will remove the excess material.

Manholes and valves on roads to be chip sealed shall be clean when the work is completed. They shall be covered with paper or other suitable material prior to sealing. The covering shall be removed immediately after the road is chip sealed.

### 9.9.3 Dust Control

#### 9.9.3.1 General

Dust control on unpaved Teller County roads shall be accomplished by use of the material specified in this section and in accordance with the following procedures.

#### 9.9.3.2 Subgrade Preparation

Prior to application of dust suppressant, the road surface shall be prepared in the following manner:

a. The road surface shall be graded to a smooth, uniform surface profile with a minimum of 2% and a maximum of 6% cross slope. All depressions and washboarding shall be completely removed and regraded level with the cross section of the road. All soft or yielding areas of the road surface shall be removed to firm subgrade and replaced with CDOT Class 5 or 6 road base.

b. The entire road surface shall be compacted to 95% standard proctor, and moisture shall be within 2% of optimum. After the subgrade has been compacted, tested and found to meet specifications, the entire subgrade shall be proof-rolled with a heavily loaded vehicle to ensure uniformity of the subgrade. The vehicle must have a loaded GVW of 50,000 pounds with a loaded single axle weight of at least 18,000 pounds and a tire pressure of 90 psi. Subgrade which is pumping or deforming must be reworked, replaced or otherwise modified to form a smooth, stable, non-yielding surface. The County Engineer or his designated representative shall be notified at least 24 hours before final proof-rolling and shall witness all proof rolling.

#### 9.9.3.3 Material

Liquid dust suppressant material shall be a magnesium chloride product conforming to the following requirements, at the time of application, when subjected to laboratory analysis in accordance with ASTM E499 test procedure.

a. The brine shall be a solution of water and magnesium chloride commercially produced for use as a dust suppressant. The chemical composition, as a percentage of the brine weight shall be as follows.

| | |
|---|---|
| Chloride Composition (sum of magnesium chloride and calcium chloride) | 30.0% minimum |

| | |
|---|---|
| Sulfate | 3.5%maximum |
| Nitrate | 1.0% maximum |
| pH | 4.5 - 10.0 |

The brine may contain small amounts of non-detrimental ions not to exceed the quantities by weight shown below.

| | |
|---|---|
| Magnesium (Mg) | 9.2% |
| Chloride ($Cl_2$) | 27.0% |
| Sulfate ($SO_4$) | 3.5% |
| Sodium (Na) | 1.0% |
| Potassium (K) | 0.8% |

Other non-detrimental elements such as Li, Br and Fe may be present in trace quantities. The presence of any potentially detrimental foreign material is prohibited.

b. Specific gravity of the brine shall be a minimum of 1.29 at 60 degrees Fahrenheit, with a unit weight of approximately 11 pounds per gallon. Dissolved solids shall comprise a minimum of 30% of the solution by weight.

c. A manufacturer's certificate of compliance with the above requirements, along with the manufacturer's printed procedure for application of the dust suppressant, shall be delivered to the County Engineer or his authorized representative prior to the application of any dust suppressant material.

**9.9.3.4 Application**

Dust suppressant material shall be applied by appropriate self-propelled spray distribution equipment in accordance with the manufacturer's recommendations.

**9.9.3.5 Application Rate**

a. For initial application, or when the previous application was more than three years prior, or when the road surface, in the sole opinion of the Road and Bridge Director, has been significantly disturbed since the prior application, the application rate shall be a minimum of 0.5 gallons per square yard.

b. For subsequent applications which do not meet the restrictions stated for initial application above, the application rate shall be 0.3 gallons per square yard.

## 9.10 QUICK REFERENCE

**QUICK REFERENCE**
**TELLER COUNTY ROAD AND BRIDGE DEPARTMENT**
**MINIMUM TESTING REQUIREMENTS**

| SPEC # | ITEM | TYPE OF TEST | MINIMUM FREQUENCY | MIN. # | ACT. # |
|---|---|---|---|---|---|
| 9.2.1.2 | UTILITIES; GAS, ELECTRIC, PHONE & CABLE TV TRENCHES | MOISTURE/DENSITY | 1 PER 250 L.F. EVERY 1' ELEV. & 1' FROM ALL STRUCTURES. | | |
| 9.2.1.2 | SANITARY SEWER TRENCH | MOISTURE/DENSITY | 1 PER 250 L.F. EVERY 1' ELEV. & 1' FROM ALL STRUCTURES. | | |
| 9.2.1.2 | WATER LINE TRENCH | MOISTURE/DENSITY | 1 PER 250 L.F. EVERY 1' ELEV. & 1' FROM ALL STRUCTURES. | | |
| 9.2.1.2 | STORM SEWER TRENCH | MOISTURE/DENSITY | 1 PER 250 L.F. EVERY 1' ELEV. & 1' FROM ALL STRUCTURES. | | |
| 8.5.7.2 | INLETS CONCRETE TESTING | AIR SLUMP | FIRST 3 LOADS, EVERY 5 LOADS THEREAFTER. | | |
| | | CYLINDERS | 1 SET PER 100 C.Y. | | |
| | | STEEL | VISUAL - DOCUMENTATION | | |
| 8.5 | INLETS BACKFILL | DENSITY | 1 FOOT IN ELEVATION AROUND STRUCTURE. | | |
| 9.2.2.1B. | SIDEWALK, CURB & GUTTER | MOISTURE/DENSITY | 1 PER 250 L.F. EVERY .5' OF FILL. | | |
| 9.2.2.1A | SIDEWALK, CURB & GUTTER | PROOF-ROLL | ALL SUBGRADE. | | |

## QUICK REFERENCE
## TELLER COUNTY ROAD AND BRIDGE DEPARTMENT
## MINIMUM TESTING REQUIREMENTS

| SPEC # | ITEM | TYPE OF TEST | MINIMUM FREQUENCY | MIN. # | ACT. # |
|---|---|---|---|---|---|
| 9.2.2.2 | SIDEWALK, CURB & GUTTER | SLUMP<br>AIR<br>CYLINDERS | MACHINE - FIRST 3 BATCHES + 1 PER 1,000 L.F.<br>HAND - FIRST 3 BATCHES + 1 PER 1,000 L.F. | | |
| 9.3.2 | ROADWAY (SUBGRADE) | MOISTURE/DENSITY | 1 PER 500 LANE FEET | | |
| 9.3.3 | ROADWAY (SUBGRADE) | PROOF-ROLL | ALL SUBGRADE. | | |
| 9.8.3.2,.3 | ROADWAY (CONCRETE) (TESTER FULL TIME) | SLUMP<br>AIR<br>CYLINDERS | FIRST 3 BATCHES, IF PASS EVERY 100 CU. YDS. THEREAFTER - CYLINDERS CAST EVERY 100 CU. YDS. | | |
| 9.5.3. | ROADWAY (BASE COURSE) | MOISTURE/DENSITY | 1 PER 500 LANE FEET WITH 20% WITHIN 1' OF STRUCTURES. | | |
| 9.5.3 | ROADWAY (BASE COURSE) | GRADATION & ATTERBERG LIMITS | 1 PER 1,000 TONS. | | |
| 9.7.3 | ROADWAYS (ASPHALT) (TESTER, FULL TIME) | DENSITY | 1 PER 500 LANE FEET | | |
| 9.7.3 | ROADWAYS (ASPHALT) | EXTRACTION, GRADATION, MARSHALL | 1 PER 1,000 TONS, INTERVAL MAY BE INCREASED TO 1 PER ½ DAY PRODUCTION. | | |

## QUICK REFERENCE
## TELLER COUNTY ROAD AND BRIDGE DEPARTMENT
## MINIMUM TESTING REQUIREMENTS

| SPEC # | ITEM | TYPE OF TEST | MINIMUM FREQUENCY | MIN. # | ACT. # |
|---|---|---|---|---|---|
| 9.7.3 & 9.8.3 | ROADWAYS (ASPHALT & CONCRETE) | CORES (DENSITY & THICKNESS VERIFICATION) | 1 PER 500 LANE FEET | | |
| 9.7.4. | ROADWAYS (CONCRETE) | PROFIL-O-GRAPH | ALL ROADWAY. | | |

***ALL ITEMS ABOVE ARE GENERALIZATIONS, PLEASE REFERENCE TELLER COUNTY ROADWAY DESIGN AND CONSTRUCTION STANDARDS, AND COLORADO DEPARTMENT OF TRANSPORTATION SPECIFICATIONS FOR ADDITIONAL INFORMATION.***