

CHAPTER 12

ROADWAY INSPECTION AND TESTING PROCEDURES

AND CONSTRUCTION GUIDELINES

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INDEX

Section	Topic	Page
12.1	General	12-1
12.2	Ancillary Structure Testing	12-2
12.3	Roadway Subgrade Preparation	12-3
12.4	Aggregate Base Course	12-4
12.5	Plant Mix Hot Bituminous Pavement	12-5
12.6	Portland Cement Concrete	12-6
12.7	Other Materials	12-7

**CHAPTER 12
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AND CONSTRUCTION GUIDELINES**

12.1 GENERAL

- 12.1.1 *Colorado Department of Transportation Standard Specifications for Road and Bridge Construction*, dated 1999 or most recent edition, special provisions and revisions thereto and as amended by the *Town of Winter Park Design and Construction Standards* shall apply to roadway testing and inspection requirements.
- 12.1.2 All test and inspection results performed by the testing firm in the employment of the owners/developers shall be submitted to the Town or its field representative at the time of testing or within two weeks after the testing or retesting date.
- 12.1.3 Any work performed inside Town right-of-way and associated easements shall be tested by an approved materials testing firm. A concrete technician must be qualified as a Level 1 Field Concrete Technician by ACI standards or an equivalent program. The costs of testing and associated reporting are paid by the owner/developer.
- 12.1.4 The testing of all materials and construction shall be in conformance with the appropriate AASHTO or ASTM specifications. A partial list of approved testing methods includes:

TEST PROCEDURE	AASHTO	ASTM
Atterberg Limits (LL and PL)	T 89 & T 90	D 4318
Gradation Analysis (except hydrometer)	T 27	D 422
CBR (as modified in Section 5.2.4.1)	T 193	---
R-value (subgrade and 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 180	D 1557
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
Making and curing concrete test specimens in the field	T 23	C 31

12.2 ANCILLARY STRUCTURE TESTING

12.2.1 Utility Trenches, Inlets, Manholes, and Junction Boxes

12.2.1.1 Materials, Placement, and Compaction. All utility trenches within the right-of-way shall be placed and compacted in accordance with Chapter 9, Trench Backfill Compaction of this specification.

12.2.1.2 Testing. Field moisture-density testing shall be performed during backfill operations beginning one 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 that backfill compaction and moisture content specifications are met. As a minimum, one test shall be taken for each 500 cubic yards of backfill or per street cut. At least 20 percent of the tests shall be taken within one foot of manholes, water valves or other obstacles.

12.2.1.3 Acceptance. The results of field density tests shall be submitted to and reviewed by the Town. Provided all tests are acceptable, the two-year probationary period will begin. If no failures of the trench patch are evident after two years, the Town will assume maintenance obligations. Any failures must be corrected in accordance with the provisions of Chapter 9, Trench Backfill Compaction

12.2.2 Curb, Gutter, Sidewalk, Crosspans, Etc.

12.2.2.1 Subgrade Preparation

12.2.2.1.1 Surface 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.

12.2.2.1.2 Testing frequency for the subgrade shall be a minimum of each six-inch lift on replacement materials with one test for every 100 feet of structure with more tests taken if necessary for control.

12.2.2.1.3 These test results shall be submitted to the field representative of the Town for compliance review.

12.2.2.2 Concrete

12.2.2.2.1 Air entrained Class D shall be used.

12.2.2.2.2 Curing methods shall conform to CDOT standard specifications

12.2.2.2.3 Testing and inspection of concrete. The slump, air content, and unit weight tests shall be carried out on the first truck of concrete for the daily placement and thereafter in conformance with the following table:

**TABLE 12.1
TESTING FREQUENCY**

<u>Item</u>	<u>Testing Frequency</u>
Sidewalks, crosspans, radius returns, curbing, and combination curb, gutter, and walk	One set of four cylinders for every 100 sq yards or fraction thereof of concrete placed; One set of four cylinders for every 100 linear feet or fraction thereof of curb and gutter placed.

NOTE: The testing is to include the slump (T 119), air entrainment (T 152), temperature of concrete at placement, unit weight, and compressive strength of the cylinders (T 22 and T 23).

12.2.2.2.4 These test results shall be submitted to the field representative of the Town for compliance review.

12.2.3 Inspection and Testing at Acceptance. At the discretion of the Town Inspector, the contractor will provide core test results of concrete at random intervals, averaging not less than one test in 500 feet, to verify that specified thickness of concrete was installed. Testing costs shall be paid for by the owner/developer.

12.3 ROADWAY SUBGRADE PREPARATION

12.3.1 Compaction

The subgrade shall be free of organic material and shall be scarified to a depth of six inches, moisture treated to within two percent of optimum moisture content, and compacted. Table 12.2 shall be used to determine the compaction.

**TABLE 12.2
MOISTURE--DENSITY CONTROL**

<u>Soil Classification (AASHTO M 145)</u>	<u>AASHTO T 99 Minimum Relative Compaction (Percent)</u>	<u>AASHTO T 180 Minimum Relative Compaction (Percent)</u>
A-1	95	100
A-3	95	100
A-2-4	95	100
A-2-5	95	100
All other	95	90

Chart taken from CDOT Specifications Section 203.07

12.3.2 Testing Intervals

Field moisture-density tests using acceptable methods will be required at random locations at the rate of one for each 500 linear feet of paving for each travel lane.

12.3.3 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. 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 base for subsequent paving courses. Town shall be notified at least 48 hours before final proof-rolling.

12.3.4 Acceptance

The results of field density tests and proof-rolling shall be submitted and reviewed by the Town Engineer. The approval is valid for 24 hours. Changes in weather such as freezing or precipitation will require reapproval of the subgrade.

12.4 AGGREGATE BASE COURSE

12.4.1 Materials

Aggregate Base Course materials must be from a currently approved source and conform to the requirements of Chapter 5, The Pavement Designed Technical Criteria. The owner/developer shall, upon request, provide verification of material properties.

12.4.2 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 Colorado Department of Transportation Standard Specifications.

12.4.3 Testing

At least one sample of aggregate base course for each 1000 tons of materials placed shall be tested to determine gradation and Atterberg limits. Should these tests indicate that 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 one foot of manholes, valves, and curbs.

12.4.4 Acceptance

The results of field density tests shall be submitted to and reviewed by the Town. 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.

12.5 PLANT MIX HOT BITUMINOUS PAVEMENT (HBP)

12.5.1 Materials

All asphalt, aggregate, fillers, and additives shall be combined to form a mix design in accordance with Chapter 5, Pavement Design and Technical Criteria. The mix design must be submitted to and approved by the Town.

12.5.2 Placement and Compaction

Materials shall be placed upon an approved subgrade base course or previous paving course in accordance with Section 400 of the Colorado Department of Transportation Standard Specifications. Prime or tack coats shall be applied in accordance with Section 12.9.1.

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

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

12.5.3 Testing

During placement and compaction of plant mix bituminous pavement, observation and testing shall be on a full-time basis. For each 1,000 tons of material placed or at least one for each day of production, a field sample shall be taken and subjected to Marshall or Hveem testing, extraction, and gradation analysis. The results will be used to control compaction in the field and to form a basis for acceptance of the pavement.

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 at the rate of one test for each 500 linear feet of travel for each lift. Nuclear test methods are suggested.

Either during or after completion of the paving, the final pavement thickness 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.

12.5.4 Acceptance

The results of field density and laboratory tests shall be submitted to and reviewed by the Town 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 5.11 and 5.12. 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.

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

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

*The average of all core tests must meet or exceed design HBP thickness.

*All core test thicknesses must exceed design HBP thickness minus ½ inch.

If all three criteria are not met, additional core tests or approved nondestructive testing at the expense of the owner/developer may be required to further delineate the area(s) of unsatisfactory work which will require correction prior to acceptance.

12.6 PORTLAND CEMENT CONCRETE

12.6.1 Materials

All aggregate, Portland cement, fly ash, water, admixtures, curing materials, and reinforcing steel shall meet the requirements of Chapter 5, Pavement Design and Technical Criteria. All materials shall be combined in accordance with Chapter 5, Pavement Design and Technical Criteria into a mix design and submitted to and approved by the Town Engineer.

12.6.2 Construction Requirements

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

12.6.3 Testing

12.6.3.1 During placement of Portland cement concrete pavement, observation and testing shall be done on a full-time basis. For each day of production or 1,000 square yards placed, aggregate samples shall be obtained for gradation of both the coarse and fine aggregates.

12.6.3.2 Slump, air content, unit weight, and mix temperature shall be tested every 1,000 square yards 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 content tests shall continue until three consecutive loads meet requirements. Thereafter, slump and air shall be tested at least every fifth load.

12.6.3.3 Six compressive strength cylinders shall be fabricated for each 2,000 square yards placed. Cylinders shall be tested as follows: two at 7 days, two at 28 days, and two at a later date, if necessary, as required by the Town.

12.6.3.4 Portland cement and fly ash will be accepted on the basis of certificates of compliance and pretesting by Colorado Department of Transportation. 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 Colorado Department of Transportation approved brands of air entraining agents, chemical admixtures, and curing materials may be used and must be documented.

12.6.3.5 Thickness of fresh concrete must be checked every 500 linear feet in each traffic lane. Any noted deficiency areas shall be corrected at that time. Surface deficiency areas shall be corrected at that time. Surface smoothness shall be tested and corrected as necessary according to Colorado Department of Transportation Section 412.16.

12.6.4 **Acceptance**

All test results shall be submitted to and reviewed by the Town. Provided all tests are acceptable, the pavement will be accepted. Should testing indicate unsatisfactory work, removal and replacement or grinding will be required.

12.7 **OTHER MATERIALS**

12.7.1 **Asphalt Prime and Tack Coats**

12.7.1.1 **General**

12.7.1.1.1 Prime coat is the application of a diluted, emulsified asphalt 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.

12.7.1.1.2 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 seal 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 two or three days. 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.

12.7.1.2 **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. If dilutions greater than 1:1 are used (2:1, 3:1, etc.) the distributor truck speed can be reduced and a heavier application rate used. A certificate of compliance must be provided by the supplier.

12.7.1.3 **Application**

12.7.1.3.1 Prior to prime coat application, the surface should be allowed to dry to approximately 80 percent 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 nonabsorbent, 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.

12.7.1.3.2 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 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.

12.7.1.4 **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.

12.7.1.5 Acceptance

Prime or tack coat will be approved by the Town 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.