

## **APPENDIX J ROADWAY INSPECTIONS AND TESTING**

### **J.1 PURPOSE**

This appendix presents general requirements for testing and inspecting roadways and ancillary facilities constructed within the County. This appendix presents the minimal standards the ECM Administrator will follow for project inspections and ultimately acceptance of completed improvements.

### **J.2 GENERAL TESTING AND INSPECTION PROCEDURES**

#### **J.2.1 Roadway Testing and Inspection Standards**

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

#### **J.2.2 Submission of Tests**

All tests and inspection results performed by the testing firm in the employment of the permit holder shall be submitted directly from the testing agency to ECM Administrator, at the time of field tests, and within 10 working days after the testing or retesting date of laboratory tests.

#### **J.2.3 Testing Required**

Any work performed inside the County's RIGHT-OF-WAY or associated easements shall be tested by an approved materials testing firm who 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 permit holder. All Material Testing Reports must be from an ECM Administrator-approved lab and must be certified by a Professional Engineer.

#### **J.2.4 Approved Testing Methods**

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 is provided in Table J-1.

**Table J-1. Approved Testing Methods**

Test Procedures	AASHTO	ASTM
Asphalt Core Densities	T 155 – 78	
Atterberg Limits (LL & PL)	T 89 & T 90	D 4318
Gradation Analysis (except hydrometer)	T 27	D 422
CBR	193	
R-value (subgrade & base)	T 190	D 2844
Marshall Stability	T 245	D 1559
Rt 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	
Swell Potential Evaluation		D 4546-96

**J.2.5 Scheduling Inspections and Penalties**

Any work performed in the County right-of-way must have a valid permit issued by the ECM Administrator. The permit holder must call the ECM Administrator at least 48 hours in advance of commencing work and schedule inspections. If 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 ECM Administrator inspection will result in a penalty fee. The privilege to work in the County's right-of-way may be revoked by the ECM Administrator for non-conformance with any permit or ECM condition or standard.

**J.3 ANCILLARY FACILITIES TESTING AND INSPECTION**

**J.3.1 Utility Trenches Backfill Testing and Inspection**

**A. Field Moisture Density Testing**

Field moisture-density testing shall be performed during backfill operations beginning 12 inches 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 12 inches of manholes, water valves, or

other obstacles. Testing shall be done in accordance with Appendix K. Within the roadway area, trench compaction shall be in accordance with AASHTO T-99 or T-180.

**J.3.2 Curb, Gutter, Sidewalk, and Minor Drainage Structures Testing and Inspection**

**A. Testing Frequency**

Testing frequency for the subgrade shall be a minimum of each 6-inch lift on replacement materials with one test for every 250 feet of structure with more tests taken if necessary for control.

**B. Slump, Air Content and Unit Weight Tests**

The slump, air content, and unit weight tests for the delivered product 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 Table J-2.

**Table J-2. Testing Frequency**

Item	Testing Frequency <sup>1</sup>
Sidewalks, Crosspans, Curb Returns	1 set of per class of concrete per project for every 100 cubic yard or fraction thereof of concrete placed
Curbing and Combination Curb, Gutter, and Walk	1 set of per class of concrete per project for every 100 cubic yard or fraction thereof of concrete placed
Note: Testing shall include the slump (T 119), air entrainment (T 152), temperature of concrete at placement, yield and compressive strength of the cylinders (T 22).	
<sup>1</sup> All work done by hand (non-extrusion) shall require a minimum of two (2) sets of tests per day.	

**C. Core Tests**

At the discretion of the ECM Administrator, the contractor or permit holder 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. If the ECM Administrator has not been give the opportunity to inspect the subgrade or concrete forms prior to placement of the concrete, the contractor or permit holder shall provide core tests.

**D. Temperature Data and Tests**

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, it shall be the contractor or permit holder’s responsibility to provide testing lab certified proof that the temperature of the concrete has been maintain 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 of temperature compliance with surface temperature recording devices as certified by a. If surface temperature recording devices are not provided, the permit holder shall be required to provide the ECM Administrator with petrographic tests for every 50 C.Y. of concrete placed.

## **J.4 ROADWAY TESTING AND INSPECTION**

### **J.4.1 Roadway Subgrade Testing and Inspection**

#### **A. Field Moisture Density Tests**

Field moisture-density tests using acceptance methods will be required at random locations at the rate of one for each 500 lineal feet, or portion thereof, of paving for each travel lane.

#### **B. Final Proof Rolling Inspection Notification**

The ECM Administrator shall be notified at least 24 hours before final proof-rolling.

#### **C. Review and Approval of Tests**

The results of field density tests and proof-rolling shall be submitted to and reviewed by the ECM Administrator. If testing indicates unsatisfactory work, the necessary reworking, compaction, or replacement will be required prior to continuation of the paving process. If all tests are acceptable, compaction will be approved for the placement of the paving course. The approval is valid for 24 hours. Changes in weather, such as freezing or precipitation, will require reapproval of the subgrade.

### **J.4.2 Lime Treated Subgrade Testing and Inspection**

#### **A. Field Moisture Density Tests**

Lime treated subgrade shall be observed and tested on a full-time basis. Field moisture-density tests shall be taken at the rate of one for each 500 lineal feet of travel lane for each lift. Field density shall be compared to the compaction curves (AASHTO T 220) each soil type 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.

#### **B. Review and Approval of Tests**

The results of field density, lime content, and strength tests shall be submitted and reviewed by the ECM Administrator. Should these tests fail to meet project specifications, the strength reduction will be used to calculate increased pavement layer or overlay thickness required for the design section. If all tests are acceptable, compaction will be approved for the placement of the paving course.

### **J.4.3 Aggregate Base Course Testing and Inspection**

#### **A. Verification of Materials Properties**

The contractor or permit holder shall, upon request by the ECM Administrator, provide verification of material properties.

**B. Gradation and Atterberg Limits Materials Sample Tests**

At least one sample of aggregate base course for each 1,000 tons of materials 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.

**C. Field Moisture Density Tests**

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 12 inches of manholes, valves, and curbs.

**D. Review and Approval of Tests**

The results of field density tests shall be submitted to and reviewed by the ECM Administrator. Should testing indicate unsatisfactory work, the necessary reworking, compaction, or replacement will be required prior to continuation of the paving process. If all tests are acceptable, compaction will be approved for the placement of the paving course.

**J.4.4 Cement Treated Aggregate Base Course Testing and Inspection**

**A. Verification of Materials Properties**

The contractor or permit holder shall provide verification of material properties of the approved mix design.

**B. Approval of Subgrade**

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

**C. Cement Content, Gradation, and Atterberg Limits Material Test**

At least one sample of cement treated aggregate base course for each 1,000 tons 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 determined unconfined compressive strength.

**D. Field Moisture Density Tests**

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 12 inches of manholes, valves, and curbs.

**E. Review and Approval of Tests**

The results of laboratory tests and field density tests shall be submitted to and reviewed by the ECM Administrator. Should testing indicate unsatisfactory work, necessary adjustments will be made to the pavement section to comply with original design strength requirements. If all tests are acceptable, compaction will be approved for the placement of the paving course.

**J.4.5 Hot Mix Asphalt (HMA) Testing and Inspection**

**A. Marshall Extraction and Gradation Test of Material**

During placement and compaction of HMA, 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 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.

**B. Mix Temperature Test**

Mix temperatures shall be checked on each truck.

**C. Pavement Density Test**

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

**D. Final Pavement Thickness and Density Test**

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, or portion thereof, in each travel lane as determined and marked by the ECM Administrator. The ECM Administrator must be present during actual core drilling or cores will not be accepted.

**E. Profil-O-Graph Tests**

Profil-o-graph tests for collectors and higher functional classification roadways shall be submitted to, and accepted by, the ECM Administrator prior to the beginning of the 2-year warranty period.

**F. Review and Approval of Tests**

The results of field density and laboratory tests shall be submitted to, and reviewed by, the ECM Administrator. Should testing indicate unsatisfactory work, removal and replacement or overlay work will be required as determined by the ECM Administrator. If all tests are acceptable, the pavement will be accepted and the 2-year warranty period will begin.

**G. Testing Criteria**

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

- Ninety percent (90%) of core tests must meet or exceed design HMA thickness;
- Average of all core tests must meet or exceed design HMA thickness;
- All core test thicknesses must exceed design HMA thickness minus ¼”;
- 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 may be required to further delineate the area(s) of unsatisfactory work, which will require correction prior to acceptance.

#### **J.4.6 Portland Cement Concrete Testing and Inspection**

##### **A. Portland Cement Concrete Requirements**

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, it shall be the contractor or permit holder's responsibility to provide testing lab certified proof that the temperature of the concrete has been maintain 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 of temperature compliance with surface temperature recording devices as certified by a. If surface temperature recording devices are not provided, the permit holder shall be required to provide the ECM Administrator with petrographic tests for every 50 C.Y. of concrete placed.

##### **B. Aggregate Samples**

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.

##### **C. Slump, Air Content, Unit Weight, and Mix Temperature Testing**

Slump, air content, unit weight, and mix temperature shall be tested every 100 cubic 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 shall be tested every fifth load.

##### **D. Compressive Strength Cylinder Testing**

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 ECM Administrator. Testing interval may be increased to approximately 1/3 of the daily volume at the discretion of the ECM Administrator.

**E. Certificates of Compliance and Pre-Testing**

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.

**F. Surface Smoothness Tests**

Surface smoothness shall be tested and corrected as necessary according to Section 412.17 CDOT. The profil-o-graph index shall not be 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 pavements. Surface smoothness shall be tested and corrected as necessary according to CDOT Section 412.16.

**G. Concrete Thickness Tests**

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 ECM Administrator. The ECM Administrator 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.

**H. Profil-O-Graph Tests Submitted**

Profil-o-graph tests shall be submitted to, and accepted by, the ECM Administrator prior to beginning the 2-year warranty period.

**I. Onsite Test Location**

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.

**J. Review and Approval of Tests**

All test results shall be submitted to, and reviewed by, the ECM Administrator. Should testing indicate unsatisfactory work, removal and replacement or grinding will be required. If all tests are acceptable, the pavement will be accepted and the 2-year warranty period will begin.

**J.4.7 Asphalt Prime and Tack Coats Testing and Inspection**

**A. Certificate of Compliance**

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 ECM Administrator.

**B. Inspection and Approval of Tack Coat**

Prime or tack coat will be approved by the ECM Administrator upon acceptance of certificate of compliance, visual approval and verification of application rate. Dust or contamination of prime or tack coats will require brooming and reapplication.

**J.5 TESTING SUMMARY**

Table J-3 summarize the testing requirements outlined in Appendix J.

**Table J-3. Summary Minimum Testing Requirements**

No.	Item	Type Of Test	Minimum Frequency	Min. #	Act. #
1	Utilities: Water, Sewer, Gas, Electric, Phone and Cable Trenches	Moisture/Density	1 per every 250 L.F. or fraction thereof, every 2' elevation. Each structure (manhole, valve, etc.) every 2' elevations. This requirement also applies to every third service.		
2	Storm Sewer Trench	Moisture/Density	Same as above. Each structure (manhole, inlet, etc.) every 2' elevations.		
3	Inlets Concrete Testing	Air Slump	First load or until compliance. Minimum 1 per day.		
		Cylinders	1 set (4) per project for every 100 C.Y. or fraction thereof.		
		Steel	Visual and Documentation		
4	Curb and Gutter	Moisture/Density	1 per every 500 L.F. or fraction thereof.		
		Proof-Roll	All final subgrade.		
		Air/Slump	First load or until compliance. Minimum 1 per every 2,000 L.F. or fraction thereof.		
		Cylinders	1 set (4) per project every 2,000 L.F. or fraction thereof.		

**Table J-3. Summary of Minimum Testing Requirements Continued**

No.	Item	Type of Test	Minimum Frequency	Min. #	Act. #
5	Sidewalk	Moisture/Density	1 per every 500 L.F. or fraction thereof.		
		Air/Slump	First load or until compliance. Minimum 1 per every 1,000 S.Y. or fraction thereof.		
		Cylinders	1 set (4) per project 1,000 S.Y. or fraction thereof.		
6	Roadway Subgrade: Fills and Cuts	Moisture/Density	1 per every 500 Lane Ft. or fraction thereof, every 2' elevation. Cuts to be scarified to a depth of 1', recondition as needed and recompact.		
			All final subgrade.		
7	Roadway (Concrete)	Air/Slump	First 3 loads or until compliance, then every 1,250 C.Y. or fraction thereof.		
		Cylinders	1 set (4) per project for every 1,250 C.Y. or fraction thereof.		

**Table J-3. Summary of Minimum Testing Requirements Continued**

No.	Item	Type of Test	Minimum Frequency	Min. #	Act. #
8	Roadways (Base Coarse)	Moisture/Density	1 per 500 Lane Ft. or fraction thereof.		
		Gradation & Atterberg Limits	1 per 2,000 Tons or fraction thereof.		
		Proof-Roll	Subgrade prior to Base Coarse placement. Base Coarse prior to placement of asphalt.		
9	Roadways (Asphalt)	Density	1 per 500 Lane Ft. or fraction thereof, per lift.		
		Extraction/Gradation	1 per 2,000 Tons or fraction thereof.		
		Marshall	1 per Design Mix per project or as needed.		
10	Roadways (Asphalt & Concrete)	Cores	1 per 1,000 Lane Ft. or fraction thereof.		
		Profil-O-Graph	Minor Arterial classification and above.		

Appendix J Roadway Inspections and Testing  
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