

SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by Contractor.

1.2 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - T027-11.....Sieve Analysis of Fine and Coarse Aggregates
 - T096-02 (R2006).....Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - T099-10.....The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
 - T104-99 (R2007).....Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
 - T180-10.....Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
 - T191-02 (R2006).....Density of Soil In-Place by the Sand-Cone Method
- C. American Concrete Institute (ACI):
 - 506.4R-94 (R2004).....Guide for the Evaluation of Shotcrete
- D. American Society for Testing and Materials (ASTM):
 - A325-10.....Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - A370-10.....Definitions for Mechanical Testing of Steel Products
 - A416/A416M-10.....Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
 - A490-10.....Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
 - C31/C31M-10.....Making and Curing Concrete Test Specimens in the Field
 - C33-11.....Concrete Aggregates
 - C39/C39M-12.....Compressive Strength of Cylindrical Concrete Specimens
 - C109/C109M-11.....Compressive Strength of Hydraulic Cement Mortars

C138-10.....Unit Weight, Yield, and Air Content
(Gravimetric) of Concrete

C140-10.....Sampling and Testing Concrete Masonry Units and
Related Units

C143/C143M-10.....Slump of Hydraulic Cement Concrete

C172-10.....Sampling Freshly Mixed Concrete

C173-10.....Air Content of freshly Mixed Concrete by the
Volumetric Method

C330-09.....Lightweight Aggregates for Structural Concrete

C567-11.....Density Structural Lightweight Concrete

C780-10.....Pre-construction and Construction Evaluation of
Mortars for Plain and Reinforced Unit Masonry

C1019-11.....Sampling and Testing Grout

C1060-11.....Thermographic Inspection of Insulation
Installations in Envelope Cavities of Frame
Buildings

C1064/C1064M-05.....Freshly Mixed Portland Cement Concrete

C1077-06.....Laboratories Testing Concrete and Concrete
Aggregates for Use in Construction and Criteria
for Laboratory Evaluation

C1153-10.....Location of Wet Insulation in Roofing Systems
Using Infrared Imaging

C1314-11.....Compressive Strength of Masonry Prisms

D698-07.....Laboratory Compaction Characteristics of Soil
Using Standard Effort

D1143-07.....Piles Under Static Axial Compressive Load

D1188-07.....Bulk Specific Gravity and Density of Compacted
Bituminous Mixtures Using Paraffin-Coated
Specimens

D1556-07.....Density and Unit Weight of Soil in Place by the
Sand-Cone Method

D1557-09.....Laboratory Compaction Characteristics of Soil
Using Modified Effort

D2166-06.....Unconfined Compressive Strength of Cohesive Soil

D2167-08.....Density and Unit Weight of Soil in Place by the
Rubber Balloon Method

D2216-10.....Laboratory Determination of Water (Moisture)
Content of Soil and Rock by Mass

D2922-05.....Density of soil and Soil-Aggregate in Place by
Nuclear Methods (Shallow Depth)

- D2974-07.....Moisture, Ash, and Organic Matter of Peat and
Other Organic Soils
- D3666-09.....Minimum Requirements for Agencies Testing and
Inspection Bituminous Paving Materials
- D3740-10.....Minimum Requirements for Agencies Engaged in the
Testing and Inspecting Road and Paving Material
- E94-10 (2004).....Radiographic Testing
- E164-08.....Ultrasonic Contact Examination of Weldments
- E329-10.....Agencies Engaged in Construction Inspection
and/or Testing
- E543-09.....Agencies Performing Non-Destructive Testing
- E605-93 (R2006).....Thickness and Density of Sprayed Fire-Resistive
Material (SFRM) Applied to Structural Members
- E709-08.....Guide for Magnetic Particle Examination
- E779-10.....Determining Air Leakage Rate by Fan
Pressurization
- E1155-96 (R2008).....Determining FF Floor Flatness and FL Floor
Levelness Numbers
- E1827-11.....Determining Air tightness of Buildings Using an
Orifice Blower Door
- E. American Welding Society (AWS):
 - D1.1-10.....Structural Welding Code-Steel
- F. International Standards Organization (ISO):
 - 6781-83.....Thermal insulation - Qualitative detection of
thermal irregularities in building envelopes -
Infrared method

1.3 REQUIREMENTS:

- A. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e.; E 329, C 1077, D 3666, D3740, A 880, E 543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."
- 1. Building Air Tightness Testing Agency Qualifications: The testing firm shall have minimum 2 years experience in air tightness testing and analysis, and a minimum of 3 successful projects of similar type

and scope in the previous 3 years, using the specified testing standard, and employing qualified test technicians.

- a. Building Air Tightness Test Technician Qualifications: The testing technician shall have 2 years experience in air tightness testing using the specified testing standard and equipment.
- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by the Contracting Officer's Representative (COR). When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of COR to such failure.
- C. Written Reports: Testing laboratory shall submit test reports to COR, Contractor, unless other arrangements are agreed to in writing by the COR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to COR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK:

- A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:
 1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the COR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
 2. Provide full time observation of fill placement and compaction and field density testing in building areas and provide full time observation of fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.
- B. Testing Compaction:
 1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with ASTM D698 and ASTM D1557.

2. Make field density tests in accordance with the primary testing method following ASTM D2922 wherever possible. Field density tests utilizing ASTM D1556, or ASTM D2167 shall be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the COR before the tests are conducted.

- a. Pavement Subgrade: One test for each 335 m² (400 square yards), but in no case fewer than two tests.
- b. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
- c. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.

C. Testing Materials: Test suitability of on-site and off-site borrow as directed by COR.

3.2 LANDSCAPING:

- A. Test topsoil for organic materials, pH, phosphate, potash content, and gradation of particles.
 - 1. Test for organic material by using ASTM D2974.
 - 2. Determine percent of silt, sand, clay, and foreign materials such as rock, roots, and vegetation.
- B. Submit laboratory test report of topsoil to COR.

3.3 ASPHALT CONCRETE PAVING:

- A. Aggregate Base Course:
 - 1. Determine maximum density and optimum moisture content for aggregate base material in accordance with ASTM D1557, Method D.
 - 2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with ASTM D1556.
 - 3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the applicable state highway standards and specifications.
- B. Asphalt Concrete:
 - 1. Aggregate: Sample and test aggregates in stock pile and hot-bins as necessary to insure compliance with specification requirements for gradation (AASHTO T27), wear (AASHTO T96), and soundness (AASHTO T104).
 - 2. Temperature: Check temperature of each load of asphalt concrete at mixing plant and at site of paving operation.

3. Density: Make a minimum of two field density tests in accordance with ASTM D1188 of asphalt base and surface course for each day's paving operation.

3.4 SITE WORK CONCRETE:

Test site work concrete including materials for concrete as required in Article CONCRETE of this section.

3.5 CONCRETE:

A. Batch Plant Inspection and Materials Testing:

1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of COR with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by COR.
2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to COR.
3. Sample and test mix ingredients as necessary to insure compliance with specifications.
4. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.
5. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.

B. Field Inspection and Materials Testing:

1. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
2. After good concrete quality control has been established and maintained as determined by COR make three cylinders for each 80 m³ (100 cubic yards) or less of each concrete type. Label each cylinder with an identification number. COR may require additional cylinders to be molded and cured under job conditions.

4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m³ (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m³ (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
9. Verify that specified mixing has been accomplished.
10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
 - a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
 - b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
11. Observe preparations for placement of concrete:
 - a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
 - b. Inspect preparation of construction, expansion, and isolation joints.
12. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
13. Observe concrete mixing:
 - a. Monitor and record amount of water added at project site.
 - b. Observe minimum and maximum mixing times.

14. Measure concrete flatwork for levelness and flatness as follows:
 - a. Perform Floor Tolerance Measurements F_F and F_L in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.
 - b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
 - c. Provide the Contractor and the COR with the results of all profile tests, including a running tabulation of the overall F_F and F_L values for all slabs installed to date, within 72 hours after each slab installation.
15. Other inspections:
 - a. Grouting under base plates.
 - b. Grouting anchor bolts and reinforcing steel in hardened concrete.
- C. Laboratory Tests of Field Samples:
 1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by COR. Compile laboratory test reports as follows:
Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
 2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
 3. Furnish certified compression test reports (duplicate) to COR. In test report, indicate the following information:
 - a. Cylinder identification number and date cast.
 - b. Specific location at which test samples were taken.
 - c. Type of concrete, slump, and percent air.
 - d. Compressive strength of concrete in MPa (psi).
 - e. Weight of lightweight structural concrete in kg/m^3 (pounds per cubic feet).
 - f. Weather conditions during placing.
 - g. Temperature of concrete in each test cylinder when test cylinder was molded.
 - h. Maximum and minimum ambient temperature during placing.
 - i. Ambient temperature when concrete sample in test cylinder was taken.
 - j. Date delivered to laboratory and date tested.

3.6 STEEL DECKING:

- A. Provide field inspection of welds of metal deck to the supporting steel, and testing services to insure steel decking has been installed in accordance with contract documents and manufacturer's requirements.
- B. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with "Welder Qualification" procedures of AWS D1.1. Refer to the "Plug Weld Qualification Procedure" in Part 3 "Field Quality Control."
- C. Submit inspection reports, certification, and instances of noncompliance to COR.

3.7 TYPE OF TEST:

Approximate
Number of
Tests
Required

A. Earthwork:

Laboratory Compaction Test, Soils:

Field Density, Soils (AASHTO T191, T205, or T238)	<u> 2 </u>
Penetration Test, Soils	<u> 1 </u>
	<u> </u>

B. Landscaping:

Topsoil Test	<u> 1 </u>
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C. Aggregate Base:

Laboratory Compaction,	<u> 0 </u>
Field Density	<u> 2 </u>
Aggregate, Base Course	
Gradation)	<u> 0 </u>
Wear	<u> 0 </u>
Soundness	<u> 0 </u>

D. Asphalt Concrete:

Field Density,	<u> 1 </u>
Aggregate, Asphalt Concrete	
Gradation	<u> 1 </u>
Wear	<u> 1 </u>
Soundness	<u> 1 </u>

E. Concrete:

Making and Curing Concrete Test Cylinders (ASTM C31)	<u> 2 </u>
Compressive Strength, Test Cylinders (ASTM C39)	<u> 1 </u>
Concrete Slump Test (ASTM C143)	<u> 2 </u>
Concrete Air Content Test (ASTM C173)	<u> 1 </u>
Unit Weight, Lightweight Concrete (ASTM C567)	<u> 1 </u>
Aggregate, Normal Weight:	
Gradation (ASTM C33)	<u> 0 </u>
Deleterious Substances (ASTM C33)	<u> 0 </u>
Soundness (ASTM C33)	<u> 0 </u>
Abrasion (ASTM C33)	<u> 0 </u>
Aggregate, Lightweight	

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529-13-103

Gradation (ASTM C330)	<u>0</u>
Deleterious Substances (ASTM C330)	<u>0</u>
Unit Weight (ASTM C330)	<u>0</u>
Flatness and Levelness Readings (ASTM E1155) (number of days)	<u>1</u>

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