

SECTION 01 45 29

TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. 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. Refer to Section 01 00 00, GENERAL REQUIREMENTS, for additional information.

1.2 RELATED DOCUMENTS

- A. Section 01 00 00, GENERAL REQUIREMENTS.

1.3 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this Specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified. Use latest edition or revision.
- B. American Association of State Highway and Transportation Officials (AASHTO):
- | | |
|------------|--|
| T27 | Sieve Analysis of Fine and Coarse Aggregates |
| T96 | Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| T99 | The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop |
| T104 | Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate |
| T180 | Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop |
| T191 | Density of Soil In-Place by the Sand-Cone Method |
| T205 | Standard Test Method for Density of Soil In-Place by the Rubber-Balloon Method. |
| T238 | Standard Test Method for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods. |
- C. American Society for Testing and Materials (ASTM):
- | | |
|------------|---|
| A370 | Definitions for Mechanical Testing of Steel Products |
| A880 | Standard Practice for Criteria for Use in Evaluation of Testing Laboratories and Organizations for Examination and Inspection of Steel, Stainless Steel |
| C31 | Making and Curing Concrete Test Specimens in the Field |
| C33 | Concrete Aggregates |
| C39 | Compressive Strength of Cylindrical Concrete Specimens |
| C109 | Compressive Strength of Hydraulic Cement Mortars |

C138.....	Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
C143.....	Slump of Hydraulic Cement Concrete
C172.....	Sampling Freshly Mixed Concrete
C173.....	Air Content of freshly Mixed Concrete by the Volumetric Method
C780.....	Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C1019.....	Sampling and Testing Grout
C1064.....	Freshly Mixed Hydraulic Cement Concrete
C1077.....	Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
C1364.....	Architectural Cast Stone
D698.....	Laboratory Compaction Characteristics of Soil Using Standard Effort
D1188.....	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
D1556.....	Density and Unit Weight of Soil in Place by the Sand-Cone Method
D1557.....	Laboratory Compaction Characteristics of Soil Using Modified Effort
D2166.....	Unconfined Compressive Strength of Cohesive Soil
D2167.....	Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2216.....	Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D2922.....	Standard Test Method for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods.
D2974.....	Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
D3666.....	Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials
D3740.....	Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock
E329.....	Agencies Engaged in Construction Inspection, Testing, or Special Inspection
E543.....	Agencies Performing Nondestructive Testing
E1155.....	Determining FF Floor Flatness and FL Floor Levelness Numbers

1.4 REQUIREMENTS

- A. Accreditation Requirements: Testing Laboratory retained and paid for by Contractor must be accredited by one or more of the National Voluntary Laboratory Accreditation Program (NVLAP) programs acceptable in the geographic region for the Project. Furnish to the CO and COR a copy of the Certificate of Accreditation and Scope of Accreditation. For testing laboratories that have not yet obtained accreditation by a NVLAP program, submit an acknowledgement letter from one of the laboratory accreditation authorities indicating that the application for accreditation has been received and the accreditation process has started, and submit to the CO and COR for approval,

ertified statements, signed by an official of the testing laboratory attesting that the proposed laboratory, meets or conforms to the ASTM standards listed below as appropriate to the testing field.

1. Laboratories engaged in testing of construction materials must meet the requirements of ASTM E329.
2. Laboratories engaged in testing of concrete and concrete aggregates must meet the requirements of ASTM C1077.
3. Laboratories engaged in testing of bituminous paving materials must meet the requirements of ASTM D3666.
4. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, must meet the requirements of ASTM D3740.
5. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A880.
6. Laboratories engaged in non-destructive testing (NDT) must meet the requirements of ASTM E543.
7. Laboratories engaged in Hazardous Materials Testing must meet the requirements of OSHA and EPA.

B. Inspection and Testing: Testing laboratory to inspect materials and workmanship and perform tests described herein and additional tests requested by COR. When it appears materials furnished or Work performed by Contractor fail to meet construction Contract requirements, Testing Laboratory must direct attention of COR to such failure.

1. Testing Lab shall submit a certification, signed by a Principal of the testing laboratory, stating that the testing and reporting requirements of this specification have been read by and are understood by the testing laboratory personnel.

C. Written Reports: Testing laboratory to submit test reports to COR and Contractor within 24 hours after each test is completed 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, or otherwise indicated for electronic submissions.

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 is to provide qualified personnel, materials, equipment, and transportation as required to perform the services identified and/or required herein, within the agreed to schedule and/or time frame. The Work to be performed is as identified herein including, 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.

- a. 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 subgrade preparation, proof-rolling, fill placement and compaction and field density testing in crypt areas and provide full time observation of subgrade preparation, proof-rolling, fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with Contract Documents.
 3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill and for subgrade preparation at preplaced crypts.
- 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 D1557.
 2. Make field density tests in accordance with the primary testing method following ASTM D2922 wherever possible. Field density tests utilizing ASTM D1556 to 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 must provide satisfactory explanation to the COR before the tests are conducted.
 - a. Crypt and Pad Subgrade: At least one test of subgrade for every 2,000 square feet of crypt or pad subgrade, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 2,000 square feet of overlaying crypt or pad subgrade, but in no case fewer than three tests.
 - b. Pavement Subgrade: One test for each 400 square yards, but in no case fewer than two tests.
 - c. Curb, Gutter, and Sidewalk: One test for each 300 feet, but in no case fewer than two tests.
 - d. Trenches: One test at maximum 100 foot intervals and per 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.
- C. Submit recommendations for soil amendments, from a regional soil conservation service or cooperative extension, to bring soil into compliance with minimum parameters in these Specifications.

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

- A. 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 CO 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 Work 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. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. 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.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 50 cubic yards or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. After good concrete quality control has been established and maintained as determined by COR make three cylinders for each 100 cubic yards or less of each concrete type, and at least three cylinders from any one day's pour for 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 25 cubic yards thereafter each day. For concrete not required to be air-entrained, test every 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. 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 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 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. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
12. Observe conveying, placement, and consolidation of concrete for conformance to Specifications.
13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
14. Observe curing procedures for conformance with Specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
15. 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.
16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
17. Observe concrete mixing:
 - a. Monitor and record amount of water added at project site.
 - b. Observe minimum and maximum mixing times.
18. Measure concrete flatwork for levelness and flatness as follows:
 - a. Perform Floor Tolerance Measurements FF and FL 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 FF and FL values for all slabs installed to date, within 72 hours after each slab installation.
19. 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 to be the result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it must be discarded and strength of spare cylinder to be used.
2. 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 psi.
 - e. Weight of concrete in 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. Aggregates: Per ASTM C33.

3.6 REINFORCEMENT

- A. Review mill test reports furnished by Contractor.
- B. Perform sampling at fabricating plant. Take two samples from each 25 tons or fraction thereof of each size of reinforcing steel No. 3 through No. 18.
- C. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.
- D. Written report must include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.

3.7 ARCHITECTURAL CAST STONE

- A. Perform testing according to ASTM C1364 or verify compliance by reviewing previous test results of same product.
- B. Inspect the plant to verify that specification requirements for curing and finishes have been met.

3.8 MASONRY

- A. Mortar Tests:
 - 1. Laboratory compressive strength test:
 - a. Comply with ASTM C109 and ASTM C780.
 - b. Obtain samples during or immediately after discharge from batch mixer.
 - c. Furnish molds with 2 inch, 3 compartment gang cube.
 - d. Test one sample at 7 days and 2 samples at 28 days.
 - 2. Two tests during first week of operation; one test per week after initial test until masonry completion.
- B. Grout Tests:
 - 1. Laboratory compressive strength test:
 - a. Comply with ASTM C1019.
 - b. Test one sample at 7 days and 2 samples at 28 days.
 - c. Perform test for each 2500 square feet of masonry.
- C. Field Inspection and Materials Testing:
 - 1. Verify the following prior to grouting:
 - a. Grout space is clean.

- b. Type, spacing, and placement of reinforcement, connectors, and anchors comply with the Contract requirements.

3.9 TYPE OF TEST

Type of Test	Approximate Minimum Number of Tests Required
A. Earthwork:	
Laboratory Compaction Test, Soils:	
ASTM D1557	4
Field Density, Soils (ASTM D1556, ASTM D2922)	127
B. Landscaping:	
Topsoil Test	1
C. Aggregate Base:	
Laboratory Compaction, ASTM D1557	1
Field Density, ASTM D1556	12
Aggregate, Base Course	
Gradation (AASHTO T27)	1
Wear (AASHTO T96)	1
Soundness (AASHTO T104)	1
D. Asphalt Concrete:	
Field Density, ASTM D1188	4
Aggregate, Asphalt Concrete	
Gradation (AASHTO T27)	1
Wear (AASHTO T96)	1
Soundness (AASHTO T104)	1
E. Concrete:	
Making and Curing Concrete Test Cylinders (ASTM C31)	6
Compressive Strength, Test Cylinders (ASTM C39)	2
Concrete Slump Test (ASTM C143)	2
Concrete Air Content Test (ASTM C173)	6
Unit Weight, Concrete (ASTM C138)	2
Aggregate, Normal Weight:	
Gradation (ASTM C33)	1
Deleterious Substances (ASTM C33)	1
Soundness (ASTM C33)	1
Abrasion (ASTM C33)	1
Flatness and Levelness Readings (ASTM E1155)	1
F. Reinforcing Steel:	
Tensile Test (ASTM A370)	1
Bend Test (ASTM A370)	1
G. Masonry:	
Making and Curing Test Cubes (ASTM C109)	3

Compressive Strength, Test Cubes (ASTM C109)	3
Sampling and Testing Mortar, Comp. Strength (ASTM C780)	3
Sampling and Testing Grout, Comp. Strength (ASTM C1019)	1

- H. Approximate Minimum Number of Tests Required reflects requirements for Base Bid scope of work only. Add additional tests of each type at the rate specified herein if the Add Alternate work is awarded.

END OF SECTION