

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.

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. Referenced standards shall be the current version as of the date of advertisement of the project.
- B. American Association of State Highway and Transportation Officials (AASHTO):
- T99.....Standard Method of Test for Moisture-Density Relations of Soils Using a 5.5 lb. Rammer and a 12 inch Drop
- T180.....Standard Method of Test for Moisture-Density Relations of Soils using a 10 lb. Rammer and an 18 inch Drop
- T191.....Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method
- C. American Concrete Institute (ACI):
- D. ASTM International (ASTM):
- A325.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- A370.....Standard Test Methods and Definitions for Mechanical Testing of Steel Products
- A416/A416M.....Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
- C31/C31M.....Standard Practice for Making and Curing Concrete Test Specimens in the Field
- C39/C39M.....Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C138.....Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
- C140.....Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
- C143/C143M.....Standard Test Method for Slump of Hydraulic Cement Concrete
- C172.....Standard Practice for Sampling Freshly Mixed Concrete
- C173.....Standard Test method for Air Content of freshly Mixed Concrete by the Volumetric Method
- C567.....Standard Test Method for Determining Density of Structural Lightweight Concrete
- C780.....Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
- C1019.....Standard Test Method for Sampling and Testing Grout
- C1064/C1064M.....Standard Test Method for Freshly Mixed Portland Cement Concrete

- C1077.....Standard Practice for Laboratories Testing
Concrete and Concrete Aggregates for Use in
Construction and Criteria for Laboratory
Evaluation
- C1314.....Standard Test Method for Compressive Strength of
Masonry Prisms
- D698.....Standard Test Methods for Laboratory Compaction
Characteristics of Soil Using Standard Effort
- D1188.....Standard Test Method for Bulk Specific Gravity
and Density of Compacted Bituminous Mixtures
Using Coated Specimens
- D1556.....Standard Test Method for Density and Unit Weight
of Soil in Place by the Sand-Cone Method
- D2937.....Standard Test Method for Density of Soil in
Place by the Drive-Cylinder Method
- D2974.....Standard Test Methods for Moisture, Ash, and
Organic Matter of Peat and Other Organic Soils
- D3666.....Standard Specification for Minimum Requirements
for Agencies Testing and Inspecting Road and
Paving Materials
- D3740.....Standard Practice for Minimum Requirements for
Agencies Engaged in Testing and/or Inspection of
Soil and Rock Used in Engineering Design and
Construction
- D6938.....Standard Test Method for In-Place Density and
Water Content of Soil and Soil-Aggregate by
Nuclear Methods (Shallow Depth)
- E94.....Standard Guide for Radiographic Examination
- E164.....Standard Practice for Contact Ultrasonic Testing
of Weldments
- E329.....Standard Specification for Agencies Engaged in
Construction Inspection, Special Inspection, or
Testing Materials Used in Construction
- E543.....Standard Specification for Agencies Performing
Nondestructive Testing
- E605.....Standard Test Method for Thickness and Density
of Sprayed Fire-Resistive Material (SFRM)
Applied to Structural Members
- E709.....Standard Guide for Magnetic Particle Examination
- E1155.....Standard Test Methods for Determining F_F Floor
Flatness and F_L Floor Levelness Numbers
- E. American Welding Society (AWS):
- D1.1-07.....Structural Welding Code-Steel
- F. Texas Department of Transportation (TxDOT):
- 2004 Standard Specifications for Construction and Maintenance of
Highways, Streets and Bridge (TxDOT Standard
Specifications)

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.; E329, C1077, D3666, D3740, E543) 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."
- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by the COTR. When it appears materials furnished, or work

performed by Contractor, fail to meet construction contract requirements, Testing Laboratory shall direct attention of the COTR to such failure.

- C. Written Reports: Testing laboratory shall submit test reports to the COTR, Engineer, and Contractor, unless other arrangements are agreed to in writing by the COTR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to the COTR 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 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 COTR regarding suitability or unsuitability of graded areas. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to the COTR the 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 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.
- B. Testing Compaction:
 - 1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with the standards referenced in individual specification sections.
 - 2. Make field density tests in accordance with the primary testing method following ASTM D6938 wherever possible. Field density tests utilizing ASTM D1556 or ASTM D2937 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 COTR before the tests are conducted.
 - a. Building Slab Subgrade: At least one test of subgrade for every 1000 square feet of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 1000 square feet of soil overlaying building slab, but in no case fewer than three tests.
 - b. Foundation Wall Backfill: One test per 100 feet of each layer of compacted fill but in no case fewer than two tests per wall.
 - c. Pavement Subgrade: One test for each 3000 square feet, and a minimum of one test per 200 linear feet along roadway alignment.
 - d. Curb, Gutter, and Sidewalk: One test for each 100 feet) along alignment of the construction.
 - e. Trenches: One test at maximum 100-foot intervals per two feet of vertical lift and at changes in required density, but in no case fewer than two tests.

- f. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. In each compacted fill layer below wall footings, perform one field density test for every 50 feet of wall but in no case no less than one test per any wall exceeding 25 feet in length. Verify subgrade is level, all loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.
- C. Testing for Footing Bearing Capacity: Evaluate to determine if suitable bearing capacity material is encountered in footing subgrade.
- D. Testing Materials: Test suitability of on-site and off-site borrow as directed by the COTR.

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 the COTR.

3.3 ASPHALT CONCRETE PAVING

- A. Aggregate Base Course:
 - 1. Determine maximum density and optimum moisture content for aggregate base material in accordance with AASHTO T99, Method A.
 - 2. Make a minimum of three field density tests on each day's final compaction on aggregate base course in accordance with AASHTO T191.
 - 3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the referenced Texas DOT Standard Specifications.
- B. Asphalt Concrete:
 - 1. Aggregate: Sample and test aggregates in stockpiles and hot-bins as necessary to insure compliance with specification requirements for gradation (AASHTO T27), wear (AASHTO T96), and soundness (AASHTO T103 or T104), unless otherwise required in the referenced Texas DOT Standard Specifications.
 - 2. Temperature: Check temperature of each load of asphalt concrete at mixing plant and at site of paving operation.
 - 3. Density: Perform field density testing of asphalt base and surface course for each day's paving operation as specified in the referenced VDOT Standard Specifications.

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 the COTR with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by the COTR.
 - 2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to the COTR.
 - 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. 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 the COTR 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. COTR 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 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 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 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 COTR 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.
 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 the COTR. 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 the COTR. 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 lightweight structural 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.

3.6 REINFORCEMENT

- A. Review mill test reports furnished by Contractor.

3.7 ARCHITECTURAL PRECAST CONCRETE

- A. Inspection at Plant: Forms, placement of reinforcing steel, concrete cover, and placement and finishing of concrete.
- B. Concrete Testing: Test concrete including materials for concrete as required in Article CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.
- C. Inspect members to insure specification requirements for curing and finishes have been met.

3.8 MASONRY

- A. Mortar Tests:
 - 1. Laboratory compressive strength test:
 - a. Comply with 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. Masonry Unit Tests:
 - 1. Laboratory Compressive Strength Test:
 - a. Comply with ASTM C140.
 - b. Test 3 samples for each 5000 square feet of wall area.
- D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 5000 square feet of wall area. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.

3.9 STRUCTURAL STEEL

- A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Welding shall conform to AWS D1.1 Structural Welding Code.
- B. Prefabrication Inspection:
 - 1. Review design and shop detail drawings for size, length, type and location of all welds to be made.
 - 2. Approve welding procedure qualifications either by pre-qualification or by witnessing qualifications tests.
 - 3. Approve welder qualifications by certification or retesting.
 - 4. Approve procedure for control of distortion and shrinkage stresses.
 - 5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.
- C. Fabrication and Erection:
 - 1. Weld Inspection:
 - a. Inspect welding equipment for capacity, maintenance and working condition.
 - b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
 - c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
 - d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
 - e. Measure 25 percent of fillet welds.

- f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
 - 1) 20 percent of all shear plate fillet welds at random, final pass only.
 - 2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
 - 3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
 - 4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
 - 5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
- g. Verify that correction of rejected welds are made in accordance with AWS D1.1.
- h. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
- 2. Bolt Inspection:
 - a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 Bolts.
 - b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 Bolts. Inspect all bolts in connection when one or more are rejected.
 - c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 Bolts. Inspect all bolts in connection when one or more are rejected.
 - d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.
 - e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
 - f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.
- D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to the COTR.

3.10 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 the COTR.

3.11 SHEAR CONNECTOR STUDS

- A. Provide field inspection and testing services required by AWS D.1 to insure shear connector studs have been installed in accordance with contract documents.
- B. Tests: Test 20 percent of headed studs for fastening strength in accordance with AWS D1.1.

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- C. Submit inspection reports, certification, and instances of noncompliance to the COTR.

3.12 SPRAYED-ON FIREPROOFING

- A. Provide field inspection and testing services to certify sprayed-on fireproofing has been applied in accordance with contract documents.
- B. Obtain a copy of approved submittals from the COTR.
- C. Use approved installation in test areas as criteria for inspection of work.
- D. Test sprayed-on fireproofing for thickness and density in accordance with ASTM E605.
 - 1. Thickness gauge specified in ASTM E605 may be modified for pole extension so that overhead sprayed material can be reached from floor.
- E. Location of test areas for field tests as follows:
 - 1. Thickness: Select one bay per floor, or one bay for each 10,000 square feet of floor area, whichever provides for greater number of tests. Take thickness determinations from each of following locations: Metal deck, beam, and column.
 - 2. Density: Take density determinations from each floor, or one test from each 10,000 square feet of floor area, whichever provides for greater number of tests, from each of the following areas: Underside of metal deck, beam flanges, and beam web.
- F. Submit inspection reports, certification, and instances of noncompliance to the COTR.

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