

**SECTION 01 45 29  
TESTING LABORATORY SERVICES**

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between // -- // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.

**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.

SPEC WRITER NOTES:

1. Remove reference citations that do not remain in Part 2 or Part 3 of edited specification.
2. Verify and make dates indicated for remaining citations the most current at date of submittal; determine changes from date indicated on the TIL download of the section and modify requirements impacted by the changes.

B. American Association of State Highway and Transportation Officials (AASHTO):

T27-11(18)	Sieve Analysis of Fine and Coarse Aggregates
T96-02(R2006)	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
T99-10	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 Society for Testing and Materials (ASTM):	
A325-13	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
A370-22	Definitions for Mechanical Testing of Steel Products
A490-14	Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
C31/C31M-22	Making and Curing Concrete Test Specimens in the Field
C33/C33M-18	Concrete Aggregates
C39/C39M-21	Compressive Strength of Cylindrical Concrete Specimens
C109/C109M-21	Compressive Strength of Hydraulic Cement Mortars
C138/C138M-17a	Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
C140-22C	Sampling and Testing Concrete Masonry Units and Related Units
C143/C143M-20	Slump of Hydraulic Cement Concrete
C172/C172M-17	Sampling Freshly Mixed Concrete
C173/C173M-16	Air Content of freshly Mixed Concrete by the Volumetric Method
C330/C330M-09	Lightweight Aggregates for Structural Concrete
C567/C567M-19	Density Structural Lightweight Concrete
C780-20	Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C1019-20	Sampling and Testing Grout
C1064/C1064M-17	Freshly Mixed Hydraulic Cement Concrete
C1077-17	Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

C1314-23	Compressive Strength of Masonry Prisms
C1364-23	Architectural Cast Stone
D698-R21	Laboratory Compaction Characteristics of Soil Using Standard Effort
D1143/D1143M-20	Deep Foundations Under Static Axial Compressive Load
D1188-15	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
D1556-15E01	Density and Unit Weight of Soil in Place by the Sand-Cone Method
D1557-12R21	Laboratory Compaction Characteristics of Soil Using Modified Effort
D2166M-16	Unconfined Compressive Strength of Cohesive Soil
D2167-15	Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2216-19	Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D2974-20E01	Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
D3666-16	Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials
D3740-19	Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock
E94M-22	Radiographic Examination
E164-19	Contact Ultrasonic Testing of Weldments
E329-21	Agencies Engaged in Construction Inspection, Testing, or Special Inspection
E543-21	Agencies Performing Nondestructive Testing
E709-21	Guide for Magnetic Particle Testing
E1155-20	Determining FF Floor Flatness and FL Floor Levelness Numbers

D. American Welding Society (AWS):

D1.1-07	Structural Welding Code-Steel
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**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 // Contracting Officer // RE/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 // Contracting Officer // RE/COR // for approval, certified 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 RE/COR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory must direct attention of RE/COR to such failure.
- C. Written Reports: Testing laboratory to submit test reports to RE/COR, Contractor//, and Local Building Authority// within 24 hours after each test is completed unless other arrangements are agreed to in writing by the RE/COR. Submit reports of tests that fail to meet construction contract requirements on colored paper.

- D. Verbal Reports: Give verbal notification to RE/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/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 RE/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 RE/COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.

SPEC WRITER NOTES:

1. Adjust the following requirements to include applicable conditions for specific project. Weigh the requirement for full time observation and costs.
  2. Provide // full time // part time // observation of fill placement and compaction and field density testing in building areas and provide // full time // part 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.
  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 // AASHTO // T99/T180 // Method A // // ASTM // D698 // D1557 // Method A // ASTM D698 and/or ASTM D1557.
  2. Make field density tests in accordance with the primary testing method following ASTM D2922 // AASHTO T238 // wherever possible. Field density tests utilizing ASTM D1556 // AASHTO T191 //, or //

ASTM D2167 // 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 RE/COR before the tests are conducted.

SPEC WRITER NOTES:

1. Include only applicable types of construction. Rates are for typical project; adjust for individual project.
- a. Building Slab Subgrade: At least one test of subgrade for every 185 m<sup>2</sup> (2000 square feet) of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 185 m<sup>2</sup> (2000 square feet) of overlaying building slab, but in no case fewer than three tests.
  - b. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.
  - c. Pavement Subgrade: One test for each 335 m<sup>2</sup> (400 square yards), but in no case fewer than two tests.
  - d. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
  - e. 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.
  - f. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested subgrade when acceptable to RE/COR. In each compacted fill layer below wall footings, perform one field density test for every 30 m (100 feet) of wall. 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 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 RE/COR.

**3.2 FOUNDATION PILES**

## SPEC WRITER NOTES:

1. Verify that test piles are required, and location is shown.

- A. Witness load test procedure for conformance with ASTM D1143 and interpret test data to verify geotechnical recommendations for pile capacity. Submit load test report in accordance with ASTM D1143.
- B. Review Contractor's equipment, methods, and procedures prior to starting any work on site. Provide continuous inspection of pile installation. Maintain a record of all pertinent phases of operation for submittal to RE/COR.
- //C. Auger-Placed Piles: Take and test samples of grout in accordance with ASTM C109 for conformance with specified strength requirements. Make no less than six cubes for each day of casting. Test three cubes at 7 days and three at 28 days. //
- //D. Cast-in-Place Concrete Piles: 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. //
- //E. Prestressed Concrete Piles:
  1. Inspection at Plant: Inspect forms, placement of reinforcing steel and strands, placement and finishing of concrete, and tensioning of strands.
  2. 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.
  3. Test strand for conformance with ASTM A416/A416M and furnish report to RE/COR.
  4. Inspect piles to insure specification requirements for curing and finishes have been met. //

## SPEC WRITER NOTES:

1. Verify need for topsoil testing with Landscape Architect. Additional soil testing for pesticides, fertilizers, and other chemicals should be incorporated based upon discussion with the Landscape Architect.
2. Soils from borrow pits will generally require testing for toxic materials; verify criteria with governing jurisdiction.

**3.3 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.
  - //3. Test for moisture absorption capacity.//
- B. Submit laboratory test report of topsoil to RE/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.//

SPEC WRITER NOTES:

- 1. Edit this section to refer to local state highway standards for materials and specifications, whenever possible. Insure these specifications agree with applicable state highway specifications and allow the construction to occur utilizing locally available materials accepted for the intended use that are approved in the state highway standards and specifications.
- 2. When editing following section, specific project location may have differing standards to reference.

**3.4 ASPHALT CONCRETE PAVING**

- A. Aggregate Base Course:
  - 1. Determine maximum density and optimum moisture content for aggregate base material in accordance with // AASHTO T180, Method D // 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 // AASHTO T191 // 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.

SPEC WRITER NOTES:

- 1. Substitute applicable lab method or delete lab method if theoretical density is specified. Modify AASHTO standards indicated herein below to reflect the local equivalent test utilized by the State Highway

Department (SHD) standards and specifications. Contact local asphalt plant laboratories, or refer to SHD standards, for approved SHD products and associated tests that are the equivalent to the indicated AASHTO standards. Utilize SHD standard materials and testing procedures wherever possible and edit the following paragraphs accordingly.

B. Asphalt Concrete:

1. Aggregate: Sample and test aggregates in stockpile 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.

**3.5 SITE WORK CONCRETE**

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

**3.6 CONCRETE**

A. Batch Plant Inspection and Materials Testing:

1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of RE/COR with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by RE/COR.
2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to RE/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.

SPEC WRITER NOTES:

1. Include only tests applicable to the project. For a project with a large volume of concrete consider changing the rate of making concrete cylinders during the progress of the job.

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 40 m<sup>3</sup> (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 RE/COR make three cylinders for each 80 m<sup>3</sup> (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. RE/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 m<sup>3</sup> (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m<sup>3</sup> (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. 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 RE/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.
  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 RE/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. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
  3. Furnish certified compression test reports (duplicate) to RE/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<sup>3</sup> (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.

SPEC WRITER NOTES:

- 1. Testing of reinforcement bars is required for all major projects in the State of California. Check with structural engineer for testing in other locations.

### 3.7 REINFORCEMENT

- //A. Review mill test reports furnished by Contractor.//
- //A. Perform sampling at fabricating plant. Take two samples from each 23 t (25 tons) or fraction thereof of each size of reinforcing steel No. 10 thru No. 57 (No. 3 thru No. 18). //
- B. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.
- C. Written report must include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.
- D. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

### 3.8 PRESTRESSED CONCRETE

- A. Inspection at Plant: Forms, placement and concrete cover of reinforcing steel and tendons, placement and finishing of concrete, and tensioning of tendons.
- B. Concrete Testing: Test concrete including materials for concrete required in Article, CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.
- C. Test tendons for conformance with ASTM A416 and furnish report to RE/COR.
- D. Inspect members to insure that specification requirements for curing and finishes have been met.

**3.9 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.

**3.10 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 50 mm (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 230 m<sup>2</sup> (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 460 m<sup>2</sup> (5000 square feet) of wall area.
- D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 460 m<sup>2</sup> (5000 square feet) of wall area. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.
- E. 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.

## SPEC WRITER NOTES:

- 1. Verify need for and extent of Structural Steel Inspection and testing services with Structural Engineer.

### 3.11 STRUCTURAL STEEL

- A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Conform to AWS D1.1 Structural Welding Code for welding.
- 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 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. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS D1.1 for 100 percent of all full penetration welds, braced and moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.

SPEC WRITER NOTES:

- 1. Specify radiographic testing only for very large jobs or those with complicated full penetration welds.
- h. Welding Radiographic Testing: Test in accordance with ASTM E94, and AWS D1.1 for 5 percent of all full penetration welds at random.
  - i. Verify that rejected welds corrections are made in accordance with AWS D1.1.
  - j. 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 or A490 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 or A490 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 or A490 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 RE/COR.

SPEC WRITER NOTES:

- 1. Verify need for and extent of Steel Decking Inspection and testing services with Structural Engineer.

**3.12 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 RE/COR.

**3.13 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.
- C. Submit inspection reports, certification, and instances of noncompliance to RE/COR.

SPEC WRITER NOTES:

- 1. Use rates specified and estimated quantities to determine approximate number of tests and man-days of inspection required.

**3.15 TYPE OF TEST**

Approximate  
Number of  
Tests  
Required

A. Earthwork:

Laboratory Compaction Test, Soils:

// (AASHTO T180) // (AASHTO T99) // (ASTM D1557) // (ASTM D698) //

Field Density, Soils (AASHTO T191, T205, or T238) \_\_\_\_\_

Penetration Test, Soils \_\_\_\_\_

- B. Landscaping:
  - Topsoil Test \_\_\_\_\_
- C. Aggregate Base:
  - Laboratory Compaction, // (AASHTO T180)// //(ASTM D1557)// \_\_\_\_\_
  - Field Density, //(AASHTO T191)// //(ASTM D1556)// \_\_\_\_\_
  - Aggregate, Base Course
  - Gradation (AASHTO T27) \_\_\_\_\_
  - Wear (AASHTO T96) \_\_\_\_\_
  - Soundness (AASHTO T104) \_\_\_\_\_
- D. Asphalt Concrete:
  - Field Density, (AASHTO T230)//ASTM D1188// \_\_\_\_\_
  - Aggregate, Asphalt Concrete
  - Gradation (AASHTO T27) \_\_\_\_\_
  - Wear (AASHTO T96) \_\_\_\_\_
  - Soundness (AASHTO T104) \_\_\_\_\_
- E. Concrete:
  - Making and Curing Concrete Test Cylinders (ASTM C31) \_\_\_\_\_
  - Compressive Strength, Test Cylinders (ASTM C39) \_\_\_\_\_
  - Concrete Slump Test (ASTM C143) \_\_\_\_\_
  - Concrete Air Content Test (ASTM C173) \_\_\_\_\_
  - Unit Weight, Lightweight Concrete (ASTM C567) \_\_\_\_\_
  - Aggregate, Normal Weight:
  - Gradation (ASTM C33) \_\_\_\_\_
  - Deleterious Substances (ASTM C33) \_\_\_\_\_
  - Soundness (ASTM C33) \_\_\_\_\_
  - Abrasion (ASTM C33) \_\_\_\_\_
  - Aggregate, Lightweight
  - Gradation (ASTM C330) \_\_\_\_\_
  - Deleterious Substances (ASTM C330) \_\_\_\_\_
  - Unit Weight (ASTM C330) \_\_\_\_\_
  - Flatness and Levelness Readings (ASTM E1155) (number of days) \_\_\_\_\_
- F. Reinforcing Steel:
  - Tensile Test (ASTM A370) \_\_\_\_\_
  - Bend Test (ASTM A370) \_\_\_\_\_
  - Mechanical Splice (ASTM A370) \_\_\_\_\_
  - Welded Splice Test (ASTM A370) \_\_\_\_\_
- G. Prestressed Concrete:

Testing Strands (ASTM A416) \_\_\_\_\_

H. Masonry:

Making and Curing Test Cubes (ASTM C109) \_\_\_\_\_

Compressive Strength, Test Cubes (ASTM C109) \_\_\_\_\_

Sampling and Testing Mortar, Comp. Strength (ASTM C780) \_\_\_\_\_

Sampling and Testing Grout, Comp. Strength (ASTM C1019) \_\_\_\_\_

Masonry Unit, Compressive Strength (ASTM C140) \_\_\_\_\_

Prism Tests (ASTM C1314) \_\_\_\_\_

I. Structural Steel:

Ultrasonic Testing of Welds (ASTM E164) \_\_\_\_\_

Magnetic Particle Testing of Welds (ASTM E709) \_\_\_\_\_

Radiographic Testing of Welds (ASTM E94) \_\_\_\_\_

J. Sprayed-On Fireproofing:

Thickness and Density Tests (ASTM E605) \_\_\_\_\_

SPEC WRITER NOTES:

- 1. Use man-days on small projects where the inspection will be paid separate from field tests.

//K. Inspection:

Technical Personnel (Man-days) \_\_\_\_\_//

SPEC WRITER NOTES:

- 1. Use the following for large projects where field testing is part of technician's service.

//L. Technical Personnel: (Minimum \_\_\_\_\_ months)

- 1. Technicians to perform tests and inspection listed above. Laboratory will be equipped with concrete cylinder storage facilities, compression machine, cube molds, proctor molds, balances, scales, moisture ovens, slump cones, air meter, and all necessary equipment for compaction control. //

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