

SECTION 01 45 29 – TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for:
 - 1. Contractor provided quality assurance testing laboratory services (Concrete mix designs, required material certification testing, material certification tests, and similar specified testing). Testing, inspection, and certifications paid for by the Contractor shall be performed by agencies approved by the Owner.
 - 2. Owner provided quality control testing laboratory and field inspection services.
 - 3. Testing laboratory qualifications, procedures, limits of authority and testing laboratory submittal requirements.

1.3 RELATED WORK

- A. Related Work of Other Sections:
 - 1. Division 03 Section – Cast-In-Place Concrete.
 - 2. Division 04 Section – Unit Masonry.
 - 3. Division 05 Section – Structural Steel Framing.
 - 4. Division 05 Section – Steel Joist Framing.
 - 5. Division 05 Section – Steel Decking.
 - 6. Division 05 Section – Metal Fabrications.
 - 7. Division 31 Section – Earth Moving.

1.4 GENERAL REQUIREMENTS FOR OWNERS QUALITY CONTROL TESTING

- A. The Owner will employ a testing laboratory service to perform quality control tests and inspection services and to transmit copies of the test and inspection reports to Contractor. Sampling and testing that the Owner may require is specified in this Section and in the various technical Sections requiring quality control testing. Cooperate with Owner's testing laboratory personnel, provide access to the Work, to manufacturer and fabricator's operations, furnish incidental labor and facilities, and samples for test and inspections, as specified.
 - 1. Employment of testing laboratory to perform quality control tests and field inspections is for benefit of Owner in confirming that performance and quality of the Work is in conformance with the Contract Documents.
 - 2. Employment of a testing and inspection laboratory by Owner in no way relieves Contractor's obligation to perform work in accordance with Contract Documents.
 - 3. Owner's testing laboratory shall not be the same as Contractor's testing laboratory used for design and certification testing unless otherwise acceptable to the Architect/Engineer and Owner.
 - 4. Where the terms "Inspector" and "Laboratory" are used, they mean and refer to an officially designated and accredited inspector of the testing laboratory engaged by the Owner.

5. The inspecting agency shall make all inspections and perform all tests in accordance with the rules and regulations of the building code, local authorities, the Specifications of the ASTM and these Contract Documents.
 6. Commercial Testing Laboratories: In general, a commercial testing laboratory selected and paid for by the Owner will perform all quality control testing. Retesting will also be paid by the Owner, but will be re-invoiced at cost to the Contractor. The number of copies of test reports will in general will include:
 - a. Two copies for the General Contractor;
 - b. One copy for the Architect/Engineer;
 - c. One copy for the Owner's Representative; and
 - d. One copy for the Project Manager.
- B. Owner's quality control testing and sampling will include the following and other services and testing to ensure Contract performance.
1. Division 31 Section – Earth Moving: Perform field density tests.
 2. Division 31 Section – Drilled Concrete Piers: Perform tests and inspections to verify the design-bearing capacities.

1.5 GENERAL REQUIREMENTS FOR CONTRACTOR'S LABORATORY SERVICES

- A. Contractor's Design and Certification Testing: Provides services of an independent testing laboratory or facility acceptable to the Architect/Engineer and Owner to perform design and certification testing services.
1. Submit written description of testing laboratory giving qualifications of personnel, laboratory facilities and equipment, and other information as may be requested by Architect/Engineer.
 2. Contractor's testing laboratory shall not be the same as Owner's testing laboratory used for quality control testing unless otherwise acceptable to the Architect/Engineer and Owner.
- B. Contractor's design testing and certification testing includes:
1. Earthwork: Identify suitable soil material at borrow material location, sampling soil material, and testing of soil material samples.
 2. Performing compressive strength tests on grouted reinforced masonry prisms.
 3. Performing certified welding procedure qualification and requalification testing specified in Division 5 Sections Structural Steel, Architecturally Exposed Structural Steel, Steel Joists, and Steel Deck.
 4. Testing of above materials when mill certificates are unavailable.
 5. Testing when source of material is changed after initial tests have been performed.
 6. Samples of concrete aggregates and delivery to the Testing Laboratory providing services for the Contractor.
 7. Certification of reinforcing steel.
 8. Certification of Portland cement, lime, fly ash.
 9. Other testing required by other Sections of the Specifications.

1.6 QUALITY ASSURANCE

- A. Laboratory Qualifications and Procedures:

1. Meet "Recommended Requirements for Independent Laboratory Qualification," latest edition published by American Council of Independent Laboratories. Testing agencies shall meet the requirements of ASTM E 329, "Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction" and ASTM E 543, "Determining the Qualification of Nondestructive Testing Agencies."
 2. Testing agencies shall each be insured against errors and omissions by a professional liability insurance policy having a limit of liability not less than \$500,000.00.
 3. The inspection and testing services of the testing agency shall be under the direction of a Registered Engineer licensed in the State of Texas, charged with engineering managerial responsibility, and having at least five years engineering experience in inspection and testing of construction materials.
 4. Inspecting personnel monitoring concrete work shall be ACI certified inspectors.
 5. Submit copy of report of inspection of facilities made by Materials Reference Laboratory of National Bureau of Standards during most recent tour of inspection. Include memorandum of remedies of deficiencies reported by this inspection.
 6. Testing Equipment: Calibrated at reasonable intervals by devices of accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.
 7. Tests and inspections shall be conducted in accordance with specified requirements and if not specified, in accordance with applicable standards of the American Society for Testing and Materials and other recognized authorities as approved.
 8. Primary inspectors performing structural steel welding inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, "Standard and Guide for Qualification and Certification of Welding Inspectors." The inspector may be supported by assistant inspectors who may perform specific inspection functions under the supervision of the inspector. Assistant inspectors shall be currently certified ASW Certified Associate Welding Inspectors (CAWI). The work of assistant inspectors shall be regularly monitored by the inspector, generally on a daily basis.
- B. Laboratory Duties: Cooperate with Architect/Engineer and Contractor. Upon notice, provide qualified personnel to perform required tests and inspections. In performing tests and inspections, Laboratory shall:
1. Comply with specified standards. Comply with building code requirements for "Special Inspection" whether or not such inspections are specified herein.
 2. Ascertain compliance of materials with requirements of Contract Documents. If the material furnished and/or work performed fails to meet requirements of contract documents, laboratory inspector shall promptly notify both the Contractor and the Architect/Engineer of such failure.
 3. Promptly notify Owner's Representative, Contractor and Architect/Engineer of observed irregularities or deficiencies in the Work.
 4. A representative of the Owner's testing laboratory, who has reviewed and is familiar with the project and specifications, shall participate in all preconstruction conferences. It shall coordinate material testing and inspection requirements with the Contractor and its subcontractors consistent with the planned construction schedule. The laboratory representative shall attend, throughout the course of the project, such conferences as may be required or requested to address quality control issues.

5. Laboratory personnel shall inspect and/or test materials, assemblies, specimens, and work performed, including the design mixes, methods and techniques and regularly report to the Architect/Engineer the progress thereof.
- C. Limits of Testing Laboratory Authority: Laboratory is not authorized to:
1. Approve or reject any portion of the Work.
 2. Perform any duties of the Contractor and subcontractors.
 3. Laboratory technicians do not act as foremen, or perform other duties for Contractor. Work will be checked as it progresses, but failure to detect any defective work or materials shall not, in any way, prevent later rejection when such defect is discovered.
 4. The laboratory inspector is not authorized to revoke, alter, relax, enlarge, or release any requirement of the Contract Documents or to approve or accept any portion of the work, except where such approval is specifically called for in the Specifications.
- D. Contractor's Responsibilities:
1. Cooperate with laboratory personnel; provide access to Work; provide access to manufacturer and fabricator's operations wherever work is in preparation or progress.
 2. Secure and deliver to the laboratory without cost to Owner adequate quantities of representative samples of materials proposed to be used and which require testing.
 3. Furnish Incidental Labor and Facilities:
 - a. To provide access to Work to be tested.
 - b. To obtain and handle samples at the Project Site or at the source of the product to be tested.
 - c. To facilitate inspections and tests. Furnish such labor as is required to assist laboratory personnel in obtaining and handling samples at the site.
 - d. For safe storage and curing of concrete test cylinders at project site and other test samples as required for field curing by ASTM C31.
 4. Costs of tests, samples, and mock-ups of substitute material, where the Contractor requests the substitution and the tests are necessary in the opinion of the Architect/Engineer to establish equality with specified items, shall be borne by the Contractor.
 5. Costs of tests, samples, and mock-ups performed solely for the benefit or convenience of the Contractor will be borne solely by the Contractor.
 6. Notify laboratory sufficiently in advance of construction operations to allow laboratory to complete required checks or tests and to make assignment of personnel and scheduling of tests.
 7. Owner's testing laboratory will conduct additional tests at Contractor's expense when initial quality control testing indicates work is defective or does not conform to requirements. Materials and workmanship not meeting the required standards or performance obligations are to be removed and replaced. Replacement and subsequent testing shall be at the expense of the Contractor.
 8. Furnish concrete mix designs, in accordance with ACI 301, Section 3.9, made by an independent testing laboratory or qualified concrete supplier. Where mix designs by an independent testing laboratory are required, the laboratory shall be selected by the Contractor, approved by the Architect/Engineer, and paid by the Contractor.

9. Obtain required inspections or approvals of the building official when required. All inspection requests and notifications required by the building code, are the responsibility of the Contractor.
10. Provide current welder certifications for each welder to be employed.
11. Furnish fabrication/erection inspection and testing of all welds in accordance with AWS D1.1, Chapter 6.
12. Prequalification of all welding procedures to be used in executing the work.

1.7 SUBMITTALS

- A. General: Testing laboratory shall promptly submit written report of each and every test and inspection; 1 copy each to Architect, Engineer, Project Manager and and 2 copies each to the Contractor and to the Owner. Reports shall be submitted in portable document file (.pdf) format posted to Architect provided FTP website. Each report shall include:
 1. Date issued.
 2. Project title and number.
 3. Testing laboratory name, address, and telephone number.
 4. Name and signature of laboratory inspector.
 5. Date and time of sampling or inspection.
 6. Record of temperature and weather conditions.
 7. Date of test.
 8. Identification of product and Specification Section.
 9. Location of sample or test in the Project.
 10. Type of inspection or test.
 11. Results of tests and observation regarding compliance with Contract Documents.
 12. Interpretation of test results, when requested by the Architect/Engineer.
- B. State in report all details of each inspection and test. Indicate compliance or noncompliance with requirements of the Contract Documents. Also state in report any and all unsatisfactory conditions.
- C. In addition to furnishing a written report, promptly notify the Architect/Engineer and the Contractor verbally of any uncorrected conditions or failures to comply with the requirements of the Contract Documents.
- D. At completion of each trade or branch of work requiring inspecting and testing, submit a final certificate attesting to satisfactory completion of work and full compliance with requirements of Contract Documents.
- E. Upon completion of building, testing laboratory shall furnish, to Owner and Architect/Engineer, statement (certified by Notary Public) that all required tests and inspections were made in accordance with requirements of Contract Documents.

1.8 REFERENCED STANDARDS

- A. The latest adopted edition of all standards references in this section shall apply, unless noted otherwise. In case of conflict between these Contract Documents and a referenced standard, the Contract Documents shall govern. In case of conflict between these Contract Documents and the Building Code, the more stringent shall govern.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.1 TESTING LABORATORY PROCEDURES, GENERAL

- A. Provide inspection, sampling, testing, and reporting services as specified.

3.2 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

- A. Inspect all concrete reinforcing steel prior to placing of concrete for compliance with Contract Documents and approved shop drawings. All instances of noncompliance with Contract Documents and approved shop drawings shall be immediately brought to the attention of the Contractor for correction and then, if uncorrected, reported to the Architect/Engineer immediately.
- B. Observe and Report on the Following:
 - 1. Number and size of bars.
 - 2. Bending and lengths of bars.
 - 3. Splicing.
 - 4. Clearance to forms including chair heights.
 - 5. Clearance between bars or spacing.
 - 6. Rust, form oil, and other contamination.
 - 7. Grade of steel.
 - 8. Securing, tying, and chairing of bars.
 - 9. Excessive congestion or reinforcing steel.
 - 10. Installation of anchor rods and placement of concrete around such rods.
 - 11. Fabrication of embedded metal assemblies, including visual inspection of all welds.
 - 12. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents. Check number, spacing and weld quality. If after welding visual inspection reveals that a sound weld or a full 360 degree fillet has not been obtained for a particular bar, strike such bar with a hammer and bend 15 degrees off perpendicular and then bend back into position. Replace anchors failing this test.
- C. Arrange for Independent Testing Laboratory to provide an experienced technician to inspect reinforcing steel.

3.3 CONCRETE INSPECTION AND TESTING

- A. Receive and evaluate all proposed concrete mix designs submitted by the Contractor. If the mix designs comply with the Drawings and Specifications, the laboratory shall submit a letter to the Architect/Engineer certifying compliance. Mix designs not complying with the Drawings and Specifications shall be returned by the laboratory as unacceptable.
- B. Sample fresh concrete in accordance with ASTM C172, except modify for slump requirements of ASTM C 94.

1. Perform 1 slump test (ASTM C 243 and ASTM C 172) for each load of concrete at point of discharge and 1 test for each set of compressive strength cylinders. Make additional slump tests whenever the consistency of concrete appears to vary. Do not permit placement of concrete having a measured slump outside the limits given on the Drawings, except when approved by the Architect/Engineer. Slump tests corresponding to samples from which strength tests are made shall be reported with the strength test results.
 2. Perform 1 air content test (ASTM C 231) for each set of compressive strength cylinders.
 3. Determine temperature of concrete sample for each strength test.
- C. Mold and cure cylinders from each day's pour of 50 cu. yd., or fraction thereof, of building concrete and for each 150 cu. yds. of paving concrete of 4,000 psi and less compressive strength concrete required in accordance with ASTM C 31. Supervise the curing and protection provided (by others) for test specimens in the field, and the transportation from the field to the laboratory. Store test cylinders in the field 24 hours and then be carefully transported to the laboratory and cure in accordance with ASTM C 31. Test specimens in accordance with ASTM C 39 as follows.
1. Test 1 cylinder at 7 days for information;
 2. Test 2 cylinders at 28 days; and
 3. Retain 1 cylinder for testing at 56 days, if directed by Architect/Engineer.
 4. Report test results within 24 hours of test, to Architect/Engineer and Contractor. Indicate the slump test result taken at time of sampling, air content, air temperature, and concrete strength class used and the placing location at the Project Site in each test report.
- D. The testing agency shall furnish and maintain a competent inspector at the mixing plant at the start of each day's mixing. The inspector shall examine concrete materials for compliance with Specifications and approved mix design, weighing and measuring devices, proportioning and mixing of materials, the water and cement content of each batch, the general operation of the plant and the transportation of concrete to the jobsite. The inspector shall verify that the amount of free surface moisture contained in the fine and coarse aggregate has been properly accounted for in the concrete mixing to achieve the required consistency and water cement ratio.
- E. The testing laboratory shall monitor the addition of water to the concrete at the jobsite and the length of time the concrete is allowed to remain in the truck before placement. The inspector shall compare the mixture with the criteria on the approved mix design and report any significant deviation to the Architect/Engineer, Contractor and concrete supplier. Do not permit the addition of water which will exceed the maximum water/cement ratio for the mix as given on the approved mix design.
- F. Observe the placing of all structural concrete and concrete paving, including concrete toppings, walks, housekeeping pads, and similar non-structural concrete work. Observe and report on placing method, consolidation, cold joints, length of drop, and displacement of reinforcement. Report deficiencies to the Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when the laboratory has deemed all procedures satisfactory.
- G. The testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or poured), amount of water added and the time at which the cement and aggregate was dispensed into the truck, and the time at which the concrete was discharged from the truck.

H. Evaluation and Acceptance:

1. If the measured slump or air content of air entrained concrete falls outside specified limits, make a check test immediately on another portion of the same sample. In the event of a second failure, consider concrete to have failed to meet the requirements of the specifications, and do not use such concrete in the structure.
2. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results are equal to, or exceed specified strength and no individual test result (average of two cylinders) is below specified strength by more than 500 psi.
3. Completed concrete work will be accepted when requirements of "Specifications for Structural Concrete for Buildings," ACI 301, Chapter 18, have been met.

I. Concrete Test Reports:

1. Reports shall be made and distributed immediately after the respective tests or inspections are made.
2. Where reports indicate deviations from the Contract Documents, they shall also include a determination of the probable cause of the deviation and, where applicable, a recommendation for corrective action.
3. Whenever the testing laboratory recognizes a trend of decreasing quality in the concrete due to changing seasons, conditions of curing, or other cause; this shall be brought to the attention of the Architect/Engineer, along with a recommendation for corrective action to be taken before the materials fall below the requirements of these Specifications.

J. Comply with ACI 311, "Guide for Concrete Inspection" and "ACI Manual of Concrete Inspection" (SP-2).

K. Inspect the application of curing compound and monitor all curing conditions to assure compliance with specification requirements. Report curing deficiencies to the Contractor immediately and submit a written report to the Architect/Engineer.

3.4 NON-SHRINK GROUT FOR BASE PLATES

- A. Compressive Strength Tests (by the Testing Laboratory providing services for the Owner): Compressive strength of grout shall be determined by testing grout cubes according to the requirements of ASTM C109 - Modified. Test one set of three cubes at 1 day, and one set of three cubes at 28 days.
- B. Frequency of Testing: One set of cubes (6 cubes) shall be made for every ten base plates and bearing plates or fraction thereof but not less than one set for each day's operation. One set of cubes shall be made for each day's operation of grouting wall panels.

3.5 MASONRY

A. Prism Tests:

1. Prism Preparation: Masonry Subcontractor shall make all prisms for tests in the presence of the Testing Laboratory for each class of masonry (hollow masonry, grouted masonry, or composite masonry) on the project using an assembly of actual masonry units, mortar, and grout (if specified) as planned in the work.
2. Compressive Strength Test Method: Tests shall be run according to the requirements of ASTM C1314. Each strength test shall be defined as the average of three test prisms from the same class of masonry.

3. Frequency of Testing:

- a. Testing Laboratory providing services for Contractor shall, in conjunction with the Contractor and the Masonry Supplier, verify that materials proposed for use in masonry construction comply with the contract documents. This will include verifying the strength (f'm) of the masonry assembly using prism tests prior to construction according to specifications.
- b. The Testing Laboratory providing services for the Owner shall conduct prism tests during construction at the frequency specified below.
 - (1). Interior Non-Load Bearing Walls: One strength test shall be run for each 5,000 square feet of wall or fraction thereof.
 - (2). Exterior Walls and All Load Bearing Walls: One strength test shall be run for each 5,000 square feet of wall area but not less than one strength test for each day's operation for each class of wall. An additional test should be run whenever there is a change in mortar or grout proportions.

B. Mortar:

1. The Testing Laboratory providing services for the Contractor, acting in conjunction with the Contractor and his Masonry Subcontractor, shall provide testing services as required to assist the Contractor in submitting mix designs in accordance with the Specifications for each class of mortar . Refer to the Unit Masonry Specifications for mix design requirements.
2. The Testing Laboratory providing services for the Owner shall review the submitted mix designs for conformance to the specifications and for suitability for use in the project.
3. Field Inspection and Testing: The Testing Laboratory providing services for the Owner shall verify that the proportions of the mortar comply with the submitted mix design and the specifications. This verification shall be done at the beginning of each day of masonry construction from the beginning and continuously during masonry construction.

C. Masonry Grout:

1. Testing Laboratory providing services for Contractor, acting in conjunction with the Contractor and his Masonry Subcontractor, shall provide testing services as required to assist the Contractor in submitting mix designs in accordance with the Specifications for each class of grout .
2. Testing Laboratory providing services for Owner shall review the submitted mix designs for conformance to specifications and for suitability for use in the project.
3. Field Inspection and Testing: The Testing Laboratory providing services for the Owner shall verify that the proportions of the grout comply with the submitted mix design and the specifications. This verification shall be done for each batch of grout from the beginning and continuously during masonry construction.

D. Hollow Concrete Masonry Units:

1. Testing Laboratory providing services for the Contractor, acting in conjunction with the Contractor and his Masonry Subcontractor, shall provide testing services as required to assist the Contractor in verifying the compressive strength of hollow concrete masonry units prior to construction in accordance with the Specifications for each size of unit indicated on the drawings. Refer to the Unit Masonry Specifications for design requirements.

2. Compressive Strength Test Method: Tests shall be run according to the requirements of ASTM C140.
 3. Field Testing: The Testing Laboratory providing services for the Owner shall perform a compressive strength test on hollow concrete masonry units whenever masonry of a different production lot is used on the project. A strength test shall be defined as the average strength of three tested units.
- E. Experience Requirement: Field inspection of masonry construction by the Testing Laboratory providing services for the Owner as herein described shall be performed by qualified technicians with a minimum of ten years experience in masonry testing and inspection.
- F. Field Inspection Requirements: The duties and responsibilities of the Testing Laboratory Inspector in the field shall be as follows:
1. All Masonry Work
 - a. Review and become familiar with project drawings and specifications.
 - b. Review methods of storing and handling of masonry materials and accessories for conformance to project specifications.
 - c. Review the foundation to verify proper foundation construction tolerances, location, size and spacing of reinforcing dowels, and that foundation surfaces are properly prepared to accept the masonry.
 - d. Review all masonry materials used in the field for conformance to project specifications. This shall include masonry units, mortar, grout, portland cement, masonry cement, sand, lime, horizontal joint reinforcement, vertical reinforcement, ties, masonry anchoring devices to the structure, flashing, and control and expansion joint strips.
 2. Continuous Inspection: For Masonry work specified on the drawings or in the local building code as requiring continuous inspection, the field inspector shall continuously inspect the construction procedures of the following items for compliance with specifications:
 - a. Mortar proportions and batching.
 - b. Placing of Masonry units and construction of mortar joints.
 - c. Placing of horizontal joint reinforcement, lintel and bond-beam reinforcement, and vertical reinforcement.
 - d. Installation of flashing, weep holes, anchors, ties, construction joints, control joints, and wall vents.
 - e. Grout space.
 - f. Grout proportions and batching.
 - g. Grouting operations.
 - h. Gather specimens and perform tests on prisms and masonry units as specified above.

3.6 STRUCTURAL STEEL

- A. Inspect all structural steel during fabrication and during and after erection for conformance with Contract Documents and shop drawings. Any cases of insufficient bracing or guying, or other unsafe conditions shall be immediately called to attention of the Contractor and reported to the Architect/Engineer.

B. Shop Inspection:

1. Examination of all steel for straightness and alignment.
2. Examination of all fabricated pieces and checking of it with the erection plans and detail drawings.
3. Visual examination of welding.
4. Ultrasonic testing of all full penetration welds.
5. Examination of galvanizing.
6. Examination of installation of the shop welded shear studs.
7. Examination of the shop painting.

C. Field Inspection:

1. Proper erection of all pieces.
2. Proper installation of all bolts.
3. Plumbness of structure and proper bracing.
4. Proper field painting.
5. Visual examination of all field welding.
6. Inspect all shop-fabricated members, upon their arrival at the jobsite, for defects incurred during transit and handling.

D. Qualifications of Welders: Fabricator and erector shall provide the testing laboratory with names of welders to be employed to work, together with certification that each of these welders has passed qualification tests within the last year using procedures covered in the American Welding Society "Structural Welding Code - Steel," D1.1, latest edition. Verify all welder qualifications.

E. Inspections of shop and field welding shall be "verification inspection," in accordance with Section 6 of the AWS Structural Welding Code and as follows:

1. Visually inspect the welding of all shop fabricated members and note the location of all cover plates, connectors, bearing stiffeners, splices, and fillet welds for proper return around ends and check for seams, folds and delaminations.
2. Warped or out-of-plumb connectors shall be reported prior to any further welding.
3. Ultrasonically test all full penetration welds in accordance with ASTM E 164.
4. Surfaces to be welded and all filler metal shall be carefully inspected. Surface preparations, fit-up and cleanliness of surface shall be noted. Electrodes shall be checked for size, type and condition.
5. Welds shall be sound, clean metal, free of slag inclusions and porosity. Filler metal shall be completely fused with base metal and shall completely penetrate the joint. Root passes shall be checked for penetration from the backside of joint. Welds showing inclusions, porosity, lack of fusion, incomplete penetration or uneven contour (sagging or overlaps) shall be ordered gouged out and rewelded. Welds showing any undercut shall have a small stringer bead ordered to be run in along the toe of undercut using a smaller diameter electrode than that which made the original weld. No craters shall be left in welds. Any welding defects, including porosity, fusion and undercuts in excess of that allowed, shall be cause for rejection. Where craters occur, the inspector shall order them to be filled out with weld metal.

6. The inspector shall check that all welds have been marked with the welder's symbol. The inspector shall mark the welds requiring repairs and shall make a reinspection. The inspector shall maintain a written record of all welds. Work completed and inspected shall receive an identification mark by the inspector. Unacceptable material and work shall be identified by word "reject" or "repair" marked directly on the material.
 7. The testing agency shall advise the Owner and the Architect/Engineer of any shop and/or field conditions which, in its opinion, may require further tests and examination by means other than those specified. Such further tests and examinations shall be performed as authorized by the Owner and the Architect/Engineer.
 8. The Owner reserves the right to use ultrasonic or radiographic inspection to verify the adequacy of all welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.
 9. Verify welding electrodes to be used.
 10. Inspect welding equipment for capacity, maintenance, and working condition.
 11. Unless otherwise specified, test a minimum of 10% of connections with fillet welds. Increase the testing rate for welders having a high rejection rate as required to ensure acceptable welds. Visual inspection is required for all welds. The costs of repairing all defective welds and the costs of retesting by the Testing Laboratory providing services for the Owner shall be borne by the Contractor.
- F. Inspection of bolted construction shall be in accordance with AISC Specification for Structural Steel Buildings and as follows:
1. All bolts shall be visually inspected to ensure that the plies have been brought into snug contact.

3.7 EXPANSION BOLT INSTALLATION

- A. Inspect the drilling of each hole and installation of each structural expansion bolt for compliance with the Contract Documents and shop drawings.
- B. Verify the installation torque for each expansion bolt for compliance with manufacturer's installation instructions.

3.8 OPEN WEB STEEL JOISTS

- A. Scope: The Testing Laboratory providing services for the Owner shall perform inspection of open web steel joists in the fabricating plant and in the field as herein described.
- B. Obtaining Manufacturer's Product Certification: The Testing Laboratory providing services for the Contractor shall obtain product certification for open web steel joists and joist girders as required by the Specifications.
- C. City of Houston Inspection: The Testing Laboratory providing services for the Owner shall perform all inspections as required by the City of Houston inspection program.
- D. Inspection in the Fabrication Plant: Duties of Plant Inspector shall be as follows:
 1. Review Contract Drawings and Specifications for joist requirements.
 2. Verify welder certifications.
 3. Verify all welding operations with SJL requirements.
 4. Verify fabrication with Steel Joist Institute (SJI) requirements.

5. Confirm proper welding of splices and location of splices in joist chord members as specified on the drawings.
 6. Verify camber of joists for dead load.
 7. Check size and length of joists.
 8. Review painting operations for conformance with project specifications.
- E. Inspection in the Field: The duties of the Field Inspector shall be as follows:
1. Inspect joists for damage during shipment.
 2. Verify proper bearing of joist supports.
 3. Verify camber requirements of joists arriving in the field.
 4. Confirm bridging size and location.
 5. Confirm attachment of joists to supports (welding or bolting).
 6. Confirm bolting of joists to supports at column lines as required by OSHA requirements.
 7. Verify that no joists have been damaged during erection.

3.9 STEEL ROOF DECK

- A. Field inspection shall consist of the following:
1. Checking types, gauges, and finishes for conformance with the Contract Documents and the approved Shop Drawings.
 2. Examination for proper erection of all steel deck, including fastenings at supports and side laps, reinforcing of holes, and miscellaneous deck supports.
 3. Certification of welders.
 4. Visual inspection of at least 25 percent of all welds.

3.10 EARTH MOVING OPERATIONS

- A. Visual Inspection and Classification of Footing Subgrade Soils by Geotechnical Engineer: Perform at least 1 test to verify required design bearing capacity; subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata when acceptable to the Geotechnical Engineer.
- B. Field Density Tests: Perform field density tests of subgrade below building and paving slabs, and backfill and fill layers in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922
1. Perform 1 test of each 2,000 sq. ft. building and paving subgrade (minimum of 3 tests)
 2. Perform 1 test of each 2,000 sq. ft. of compacted backfill and fill layer (minimum of 3 tests), and 1 test each of lower, middle and upper trench compacted backfill lifts in each 100 lineal feet of trench (minimum of 6 tests).
 3. Confirm Contractor's Atterberg limits tests for backfill and fill material in accordance with ASTM D 4318.

END OF SECTION 01 45 29