

Section 3 Field Tests

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6-301 General

The resident engineer must ensure that materials incorporated into the project comply with specifications. See Section 3-507, “Inspection,” and Section 3-608, “Testing,” of the *Construction Manual* (manual).

6-301 General

Perform field inspection of material and testing in accordance with the guidelines in this chapter. Maintain a record of field tests and material inspected and released on the job as described in Section 5-102, “Organization of Project Documents” of this manual.

6-302 Field Inspection and Release of Materials

If any materials listed in Table 6-2.1, “Materials Accepted by Resident Engineer,” arrive on the job site use the following procedure:

6-302 Field Inspection and Release of Materials

- When required by the specifications, ensure that the material has a Certificate of Compliance from the supplier stating that the material meets all required specifications for the contract.
- Ensure that the appropriate documentation is included for materials covered by the Buy America requirements.
- Complete Form CEM-4102, “Material Inspected and Released on Job.”

6-303 Field Laboratory

Suitable laboratories and equipment are necessary to perform proper field testing. When economically feasible, a field laboratory should be established for a number of construction projects in the immediate area.

6-303 Field Laboratory

Most laboratories have water, gas, and electricity. Field laboratory facilities are provided by any of the methods covered under Sections 1-4, “Facilities and Equipment,” and 1-5, “Field Expenses and Purchases,” of this manual.

The resident engineer should coordinate with the district materials engineer to establish a field laboratory.

6-304 Field Testing Equipment

Each district materials engineer must have an effective calibration program for equipment used for construction-control testing. Testing equipment must be in proper operating condition and within prescribed tolerances for accuracy.

6-304 Field Testing Equipment

Standards for calibration of testing equipment are described in the appropriate California Tests for calibration and manufacturer’s instructions.

District materials laboratories perform periodic reconditioning and calibration of field laboratory testing equipment. The use of decals attached to testing equipment showing date of last calibration, name of calibrator, the district, and date that the next calibration is due, is a requirement for all testing items listed below. Decals are available from the district warehouse (Stock Number 7690-0040-3).

Acceptance samplers and testers have frequent opportunities to verify that field testing equipment is in good condition and should check the date of last calibration on the decal.

Any testing equipment that does not meet calibration requirements is to be recalibrated or replaced without delay. Each piece of equipment should be recalibrated and reconditioned in accordance with the frequencies listed in the appropriate California Test. More frequent calibration may be required depending on use of equipment and on moving and handling practices.

While the maximum interval between calibrations may be as long as a year, equipment should be calibrated any time there is reason to believe it has been damaged or effected in any way that would affect calibration.

6-304A Scales and Balances

All scales and balances used in field testing must be recalibrated periodically. The district weights and measures coordinator can accomplish this or the district materials engineer can use a service contract to use technicians from private industry to perform the recalibration. Recalibration of this equipment must be performed at least once each year. New scales and balances must be calibrated prior to use.

In the interest of standardization, the following types of scales are recommended for field use:

- A 20-kilogram balance equipped with graduated bars on the beam to give readings under 1,000 grams without recourse to loose weights.
- A 6-kilogram trip scale equipped with agate bearings and double beam. The upper beam should be graduated to 100-gram units, making a range of 1,100 grams directly on the beam without recourse to loose weights. The equipment should include one 1-kilogram and two 2-kilogram weights with scoop and scoop tare, all to provide a full capacity of six kilograms.
- A torsion balance of 500-gram capacity, accurate to 0.10 gram.

When the volume of work is large, an automatic digital scale is advantageous and can be used instead of the 20-kilogram and 6-kilogram scales described above.

6-304B Screens and Sieves

Examine all screens and sieves prior to performing grading tests. Inspection includes examination for broken wires, distortions and sags, and removal of particles stuck in the mesh, all as instructed in California Test 202, "Sieve Analysis of Fine and Coarse Aggregates." At frequent intervals independent assurance samplers and testers follow up by checking the condition of all screens and sieves available for use on the job.

6-304C Portland Cement Concrete Air Meters

Data sheets accompanying newly purchased meters contain operation and calibration information. Supplemental sheets are available through the Office of Materials Engineering and Testing Services (METS).

California Test 504, "Determining Air Content of Freshly Mixed Concrete by the Pressure Method," covers the procedure for operation of the two most common brands in use by Caltrans. California Test 115, "Calibration of Pressure Type Air Meters," covers calibration of these two meters.

6-304D Profilograph

California Test 526, “Operation of California Profilograph and Evaluation of Profiles,” includes the operation and calibration of the profilograph in addition to the evaluation of the profilogram.

Information available from the district materials engineer covers profilograph assembly and operating instructions. This information, in conjunction with the test method, should cover all but major problems concerning profilographs.

In the event of major repairs beyond district capability, send the equipment to METS or return it to the manufacturer.

6-304E Compaction Tubes

California Test 110, “Calibration of Compaction Test Equipment,” outlines the procedure for both calibration and repair.

6-304F Cement-Treated Base Compressive Strength Apparatus

District materials laboratories can check the calibration of the hydraulic jacks used with the apparatus. Occasionally a jack requires repair, and this should be done at the METS machine shop.

6-305 California Test Methods

California Tests include both field tests and laboratory tests. Section 6, “Control of Materials,” of the *Standard Specifications* states that, whenever a reference is made in the specifications to a California Test by number, it means the test in effect on the day “Notice to Contractors” for the work is dated. This means that the test methods for each project are fixed and are not necessarily the latest revisions.

Field personnel who perform tests for compliance with the specifications must use the proper test methods for the project involved. The resident engineer must ensure that the correct versions of test methods are used. The latest revisions of the test methods can be obtained from Engineering Services’ web page.

Use the following guidelines for some of the California Tests performed in the field.

6-305A Method of Determining Approximate Grading of Mineral Aggregate by Dry Sieve Analysis

California Test 202, “Sieve Analysis of Fine and Coarse Aggregates,” requires that fine aggregate is subjected to a prescribed washing procedure before performing the sieve analysis. However, where large numbers of sieve analyses are performed on material from a given source, the tester may use the “Approximate Sieve Analysis of Processed Fine Aggregate” method in Appendix E of California Test 202.

6-305B Fabrication of Cement Treated Base Specimens

Test specimens are fabricated in the field. When compressive strength tests are desired, the specimens are cured, tested in the field, or shipped to the district materials laboratory for testing in accordance with applicable portions of California Test 312, “Designing and Testing Classes ‘A’ and ‘B’ Cement Treated Bases.”

6-305C Determination of Cement or Lime Content

See California Test 338, “Determination of Cement or Lime Content in Treated Aggregate by the Titration Method,” for instructions. The acid base titration and constant neutralization titration tests are used to determine the percentage of portland cement or lime in aggregates that have been treated.

The resident engineer must devise and carry through a cement-determination test program geared to the contractor’s mixing and spreading operation. Increase testing frequency when mixing or spreading equipment is changed or altered or production rates are increased.

California Department of Transportation • Construction Manual • July 2001

6-305D Portland Cement Concrete Compressive Strength Tests

Compressive strength samples are taken in accordance with American Society for Testing and Materials (ASTM) C172, “Standard Practice for Sampling Freshly Mixed Concrete.”

A test for penetration, in accordance with California Test 533, “Test for Ball Penetration in Fresh Portland Cement Concrete,” is made on each batch of concrete from which strength specimens are made.

If air-entrained concrete is used, test the concrete using California Test 504, “Determining Air Content of Freshly Mixed Concrete by the Pressure Method,” on each batch of concrete from which strength specimens are made. If concrete contains lightweight aggregate, air content is determined in accordance with ASTM C173, “Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.”

If the cement content is being checked by California Test 518, “Unit Weight of Fresh Concrete,” determine the cement content for each batch from which strength tests are made.

Review California Test 540, “Making, Handling, and Storing Concrete Compressive Test Specimens in the Field,” to determine the maximum size of coarse aggregate to be incorporated in the test specimen. Be sure to note removal of any oversize aggregate on the sample identification card.

California Test 540 covers the molding, transportation, curing, and storage of concrete cylinders.

6-305D (1) Number of Cylinders Required for a “Test”

Each compressive strength test of concrete is determined to be the average strength of two cylinders. If the strengths at both 14 and 28 days are required, submit two cylinders for the 14-day test and two cylinders for the 28-day test. METS performs the compressive strength test and reports results to the resident engineer on Form MR-0507, “Portland Cement Concrete Test Report.” The resident engineer evaluates the test results.

The “2 cylinders = 1 test” concept applies to all concrete cylinder tests except trial batches.

6-305D (2) Trial Batches

Specifications state that for specified-strength concrete, the concrete must be prequalified by trial batches before it is placed.

Make and test cylinders to prequalify the concrete. The test results must meet the contract specifications before the specified-strength concrete may be considered as prequalified.

Concrete for trial batches must be designed, produced, and tested by the contractor (or its supplier), and a certified trial batch test report must be obtained prior to use of such concrete. The resident engineer must ensure that the certified trial batch test report contains all of the specified data.

The resident engineer must determine whether testing of trial batches will be performed during the life of the contract. Caltrans personnel must witness trial batch testing.

6-305D (3) Identification of Test Cylinders

For compressive strength tests, use Form TL-0502, "Field Sample of Portland Cement Concrete Sample Card." The card must be complete. Do not leave any blank spaces. Designation of the type of concrete must be included (such as Class 1 or 25 MPa).

In accordance with the State Contract Act, aggregate sources must comply with the Surface Mining and Reclamation Act of 1975 (SMARA). Mining operations determined to be in compliance are listed on the AB 3098 SMARA Eligible List. Form TL-0502 should be filled out with the appropriate SMARA Listing number. This list can be obtained from the Division of Construction or at the Department of Conservation's web site:

http://www.consrv.ca.gov/OMR/ab_3098_list/index.htm

Refer to Chapter 7, "Environmental," of this manual for further information on SMARA requirements

In the space for "water-weight per sack," indicate the total weight of water used per sack of cement in the mix based on actual weights (not design weights). On the last blank line of the concrete information box indicate the specified concrete strength or class if any. Otherwise mark the space with a line. Under "remarks" indicate if the unit weight of the hardened concrete cylinder(s) is required. The laboratory will not furnish unit weight data unless it is specifically requested. Make out a sample card for each pair of cylinders shipped in the same carton.

A uniform system of marking cylinders is used. This system consists of the contract number and the sample number. The sample number consists of a series of digits separated by dashes (-) to indicate: method of storage for curing, age at which cylinder(s) are to be tested, the cylinder number of the pair, or the group of 5, which is to be tested, and job coding. Use a flow pen to mark each sample can. Examples of this marking system follows:

Example 6-3.1 Sample Cylinder Label

Contract No.	03-100844
Sample No.	1-28-1/5_ _ _ _ _
Date Cast	_____

In the sample number shown above, the first digit indicates method 1 storage for curing; use only one digit for this designation. The second group of two digits indicates that the cylinder is to be tested at 28 days; use two digits for the test age. The third 1/5 symbol indicates that it is the No. 1 cylinder of a 5-cylinder trial batch sample; the No. 2 cylinder would be marked 2/5, and so on. If only one sample card was made for two cylinders, the third symbol on the card would be 1,2/5. The last four spaces are reserved for any desired job coding consisting of numbers, letters, or a combination of both.

Example 6-3.2 Sample Cylinder Label

Contract No.	03-100844
Sample No.	2-14-2/2_ _ _ _ _
Date Cast	_____

In this example the first digit indicates method 2 storage for curing. The second group of two digits indicates that the cylinder is to be tested at 14 days. The third 2/

2 symbol indicates that it is the No. 2 cylinder of a 2-cylinder test group. Again, if only one sample card is made for the two cylinders, the third symbol on the card would be 1,2/2. The last four spaces represent any desired job coding consisting of numbers, letters, or a combination of both.

6-305D (4) Shipping

Cylinders are shipped to the laboratory in accordance with the provisions of California Test 540, "Making, Handling, and Storing Concrete Compressive Test Specimens in the Field." Cylinders are shipped without removing the mold and are packed in cardboard containers that are available from district warehouse. Each carton holds two cylinders.

If the district transportation laboratory is equipped to test concrete cylinders they should be sent there. Otherwise cylinders may be shipped or delivered either to METS in Sacramento or Los Angeles, whichever is more convenient. Cylinders are not to be shipped cash on deliver to METS. Do not accumulate test cylinders at the job site. Ship them within the time limit specified in California Test 540.

6-305E Relative Compaction Using Nuclear Gauges

California Tests 231, "Relative Compaction of Untreated/Treated Soils and Aggregates (Area Concept Utilizing Nuclear Gauges)," and 375, "Determining the In-Place Density and Relative Compaction of AC Pavement," set forth the procedures for determination of relative compaction by use of nuclear gauges.

In addition to California Test 231, use of nuclear gauges is contained in California Test 121, "Administrative Instructions For Use of Nuclear Gauges," as well as the manufacturer's manual pertaining to the gauge being used. A copy of these documents must be kept with each gauge. Each operator must report missing documents and arrange for their replacement.

The person responsible for general inspection of the work and the person performing the test measurements, are both involved in performing the complete test. The progressive steps are:

- Designating the test area.
- Selecting test sites within the test area.
- Taking physical measurements.
- Determining test maximum value for comparison with the average in-place density (California Test 231 only)
- Evaluation.

6-305F Determining the Accuracy and Suitability of Scales and Meters used in Materials-Processing Plants

California Test 109, "Test for Weighing and Measuring Devices," is the test method for determining the accuracy and suitability of weighing and measuring devices used to proportion materials in materials producing plants. See Section 3-9, "Measurement and Payment," of this manual for weighing and metering procedures.

The maximum interval for retesting proportioning equipment is as follows:

- Asphalt concrete and portland cement concrete batch plants - 1 year
- Asphalt concrete continuous mixing plants - 6 months
- Slurry seal mixer-spreader trucks - 6 months or when aggregate sources are changed.

The equipment may be tested as often as deemed necessary. The district weights and measures coordinator maintains a list of material plants and equipment currently in compliance with California Test 109.

When witnessing California Test 109, the district weights and measures coordinator must also ensure that the plant meets Cal/OSHA requirements.