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Subject: General Information on Concrete Laboratory Inspections

The Cement and Concrete Reference Laboratory (CCRL) uses ASTM Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation (C1077) as the basis for its concrete inspection program. This memorandum is presented in an effort to answer some of the more common questions concerning important details of the inspection and alert participants to those changes from previous inspections. Laboratory personnel participating in previous inspections will find this paper a helpful review in preparing for the inspection. Those laboratories experiencing their first inspection by CCRL will find it helpful in preparing facilities, advising technicians, and minimizing delays.

It is advised that a careful review of these details be undertaken by the laboratory personnel who will be taking an active role in the inspection, in order to maximize the benefits derived from the inspection.

Note: Page 5 should be used as an outline of the minimum requirements that a laboratory's quality system should include.

Scope

This memo is designed to provide information on three separate areas of inspection: concrete, concrete aggregate, and steel reinforcing bar. Laboratories not requesting all three inspections should limit their review of this information to the area(s) requested. The specifications and methods of test to which frequent reference will be made during the course of the inspection are, according to usage, as follows:

Concrete - C31, C39, C138, C143, C172, C173, C231, C470, C511, C617, C1064, C1077, C1231 and E4.

Aggregate - C33, C40, C117, C127, C128, C136, C566, C702, C1077, D75 and E11.

Reinforcing Bar - A370, A615, A996, E4 and E8.

It is anticipated that the laboratory will have current editions of these standards.

Procedures, Apparatus and Quality System

(1) Test Procedures

An important part of the inspection is a demonstration by laboratory personnel of various concrete, concrete aggregate, and steel reinforcing bar test procedures, using appropriate materials furnished by the laboratory. The following test methods may be demonstrated:

Concrete

a) Slump of Portland Cement Concrete ..... (C143)
b) Unit Weight of Freshly Mixed Concrete..... (C138)
c) Air Content of Freshly Mixed Concrete by the Volumetric Method ..... (C173)
d) Air Content of Freshly Mixed Concrete by the Pressure Method..... (C231)
e) Preparation, Curing, Capping and Testing Cylinders ..... (C31, C39, C511, C617 and C1231)
f) Temperature of Freshly Mixed Portland Cement Concrete ..... (C1064)

Concrete Aggregate

a) Reducing Field Samples to Testing Size.....(C702)
b) Organic Impurities in Fine Aggregate for Concrete .....(C40)
c) Total Moisture Content of Aggregate by Drying.....(C566)
d) Sieve Analysis of Fine and Coarse Aggregates .....(C136)
e) Amount of Material Finer than 75 µm (No. 200) Sieve in Aggregate by Washing.....(C117)
f) Specific Gravity and Absorption of Fine Aggregate.....(C128)
g) Specific Gravity and Absorption of Coarse Aggregate.....(C127)

Steel Reinforcing Bar

a) Tensile Test.....(A370, A615, A996 and E8)
b) Bend Test ..... (A370, A615 and A996)

(2) Apparatus

Concrete

Item	Features Checked
a) Curing facilities (C511)	
1) Moist room	Prescribed automatic temperature control and recording thermometer; relative humidity and air temperature of storage area; and free moisture on specimens in storage.
	AND / OR,
2) Water tank	Automatic temperature control and recording thermometer; water temperature; and water saturated with high calcium hydrated lime.
b) Compression machine (C39 and E4)	Accuracy of indication and design of machine; and design and condition of bearing blocks for testing concrete cylinders.
c) Cylinder molds	
1) Reusable molds (C31 and C470)	Dimensions, design and watertightness.
2) Single-use molds (C470)	Dimensions, design, and watertightness; and if cardboard, elongation and absorption. Damage resistance to dry rodding aggregate (**laboratory supplied** dry crushed aggregate No. 57 to No. 4 or No. 67 to No. 4).
d) Capping equipment	
1) Sulfur, gypsum or cement capping (C617)	Dimension and planeness of capping plates; perpendicularity and centering of guides; straightedge and 0.002" feeler stock to check cap planeness; cube mold and cover plate for strength determination; and vent hood for sulfur fumes.
	AND / OR,
2) Unbonded Caps (C1231)	Dimensions and planeness of retaining rings; dimensions of neoprene pads; review of laboratory's qualification data (if required); and a check of accessory equipment (straightedge, 0.20 in. rod, protective cage, saw or grinder, and a means for checking perpendicularity).

Item	Features Checked
e) Tamping rod and slump cone (C31 and C143)	Dimensions and design.
f) Vibrator (C31)	Element dimensions and frequency of vibration.
g) Unit weight equipment (C138)	Dimensions, planeness of rim, and capacity of measure; capacity and accuracy of scales; and availability of strike-off plate and mallet.
h) Air content equipment (Volumetric Method) (C173)	Design and capacity of meter and measuring cup; and specified mallet, funnel, strike-off bar and syringe.
i) Air content equipment (Pressure Method) (C231)	Design; calculation of expansion factor; and prescribed mallet, strike-off bar and syringe.
j) Temperature measuring device (C1064)	Range and readability; and availability of certified reference device.

Aggregate

Item	Features Checked
a) Sample drying equipment	Temperature control of ovens.
b) Sample splitters (C702)	Physical condition and width of chutes; width of feeder and availability of two receptacles.
c) Sieves (E11)	Physical condition, size of openings and availability of specified sizes.
d) Mechanical sieving devices (C136)	Physical condition and correct motion.
e) Balances (C127, C128 and C136)	Sensitivity and accuracy of indication.
f) Weights	Accuracy.
g) Organic impurities (C40)	Availability of colorless bottles; reagent grade sodium hydroxide solution; and reference standard color solution or glass color standard.
h) Equipment for specific gravity and absorption of fine aggregate (C128)	Volumetric flask or equivalent; dimensions of conical mold; and weight and dimensions of tamper.
i) Equipment for specific gravity and absorption of coarse aggregate (C127)	Design and volume of sample containers; design and condition of suspension apparatus; capacity of balance; and temperature of water.

Reinforcing Bar

Item	Features Checked
a) Measuring equipment	Elongation gauge or suitable ruler; center punch or scribe; and optional dividers.
b) Grips for tensile test (A370 and E8)	Selection, design and condition of grips and grip liners.
c) Bending jig for reinforcing bars (A615 and A996)	Design and physical condition of apparatus; and prescribed bending pins specified for bar sizes tested.
d) Weighing equipment (A6l5 and A996)	Adequate equipment to determine permissible variation in weight.

(3) Quality System

Concrete & Aggregate Quality Assurance System

Item	Features Checked
a) Equipment checklist	Availability of inventory; records and frequency of calibrations; and written descriptions of calibration procedures.
b) Personnel records	Registered engineer on staff; experience of supervisors; descriptions of training and performance evaluation programs; documentation of training and evaluation; and pertinent certifications.
c) Laboratory records	Written procedures for: identification, transfer and test results of specimens; handling technical complaints; external services used; and quality assurance practices.
d) Reports	Identification of client, project and sample; test results and person performing test; deviations from standards; and signature of engineer.
e) Organization	Complete legal name and address of the laboratory; other facilities under technical direction of the laboratory; principal officers of the organization; description of the laboratory's management structure; and technical services offered.

Preparation for Inspection

In many instances inspections are delayed because apparatus is not readily available, or is not in the best mechanical or physical condition when it is first examined by the inspector. A careful review of the items listed on the previous pages, before the inspector's arrival, will facilitate the inspection operation and minimize the disruption of the laboratory's normal routine. Those pieces of equipment which the laboratory would like to present for inspection should be cleaned and collected in a single accessible location for the inspector's examination. Further delays might be avoided by determining that all written procedures and records are current and ready for review. The availability of a quality control manual and personnel records should facilitate the inspection of those articles described in C1077. Please review page 5 of this document for a detailed list of the minimum requirements for paperwork associated with the quality system. Any optional tests that the laboratory might wish to include for inspection should be clearly conveyed to the Cement and Concrete Reference Laboratory prior to the scheduled inspection, and the associated apparatus and procedures carefully prepared for review.

QUALITY SYSTEM
Minimum Requirements for Written Procedures and Documentation

TRAINING

- Description of levels of training
- Type of testing to see if levels are reached
- Name or title of individual responsible

PERFORMANCE EVALUATION

- Method of performance evaluation
- Criteria used (e.g., ASTM standards)
- Name or title of individual responsible

STANDARD OPERATING PROCEDURES

Identification - description of numbering system
- Where does number originate?
- Who assigns numbers?
- When are they assigned?
- Who is responsible for the system?

Transfer from the field to the laboratory
- Who picks up the cylinders?
- How are they to be transferred? (padded containers)
- When are they picked up?
- Who is responsible for the system?

Recording test results
- What records are to be filled out?
- When are tests performed?
- Who is responsible for the system?

TEST REPORTS – OTHER DATA (C39)

- Identification number
- Diameter
- Cross sectional area
- Maximum Load
- Compressive strength
- Type of fracture (if not conical)
- Defects (specimen or caps)
- Age of specimen

TECHNICAL COMPLAINTS

- Name or title of individual responsible
- Data and calibrations reviewed
- Word discussed with technician
- Reply issued

EXTERNAL TECHNICAL SERVICES

- Equipment calibrations checked?
- How is testing competency established?

INVENTORY

- Equipment name
- Identification number

DESCRIPTION OF CALIBRATION PROCEDURES

- Reference ASTM specifications
- Reference manufacturer's instructions (e.g., C231 - B type)
- Laboratory's instructions (e.g., compression machine - when & who)
- Name or title of individual responsible
- Calibration frequencies

CALIBRATION RECORDS

- Date of calibration
- Identification of the specific piece of equipment
- Name of individual performing the calibration
- Specific criteria (see below)

Specific Criteria for Calibration Records

- Slump cone.....Dimensions
- Unit weight measure .....Weight & temperature of water; multiplying factor
- Unit weight scales.....Test point(s) and result(s)
- Pressure meter.....Size of calibration vessel; calibration reading; expansion factor
- Cylinder mold .....Dimensions and watertightness
- Compression machine.....Test points and percentage of error
- Sieve accuracy .....Results of split sample or proficiency sample
- Mechanical sieving device.....Length of time for proper efficiency
- Specific gravity .....Results of duplicate samples