

## DESCRIPTION OF INSPECTION

The inspection was designed to include a review of the laboratory's quality assurance system; an examination of the apparatus prescribed for use in the methods of test for concrete indicated in ASTM C1077; and an observation of the concrete test procedures required in ASTM C1077. Any additional test methods requested by the laboratory included an examination of the apparatus or procedures prescribed in the test methods.

The ASTM Standards on which the work was based are as follows: C31/C31M, C39/C39M, C138, C143/C143M, C172, C173/C173M, C231, C470/C470M, C511, C617, C1064/C1064M, C1077, C1231/C1231M and E4.

### Documentation

#### Quality Assurance System (C1077)

Documentation maintained by the laboratory was reviewed for compliance with C1077 requirements. This documentation consists of procedures which establish that a quality system is in place in the laboratory and records which confirm that on-going compliance is maintained. The laboratory's quality system was examined for procedures which cover the following areas: technician training, certification and evaluation; calibration and verification of equipment; standard operating procedures; handling of technical complaints; and ensuring the quality of external technical services utilized. A review was conducted to determine that the following records were available and contained the minimum information required by C1077: personnel records of training, evaluation, experience, and education; calibrations and verifications of equipment; equipment inventory; test results; and final test reports.

The qualifications of the laboratory director were reviewed to establish that the laboratory was under the technical direction of a registered professional engineer with five years experience in construction materials testing as required by C1077.

### Apparatus

#### Facilities for Curing Test Specimens (C31 and C511)

The availability of storage facilities for curing concrete test specimens was confirmed. Each water storage tank or moist room used was then checked for conformance to the requirements of C511.

During the examination, temperature and relative humidity readings were taken as appropriate to determine that the curing environment conformed to the requirements of applicable standards. An observation was made to determine that each specimen in moist storage had free water on the entire surface area. A

a check was made to determine that each curing unit was equipped with thermostatic temperature control and a temperature recorder as required by C511. In addition, the water in the storage tanks was checked for lime saturation.

Records associated with the temperature recorder were also reviewed to confirm verification of the device at the required frequency and that the temperatures recorded were reviewed on at least a weekly basis.

### Compression Test Apparatus (C31, C39, C470, C617 and C1231)

Apparatus used in making compressive strength tests of concrete and listed in this section may be used by other methods but in the interest of brevity are only described here. These items include the cylinder molds and vibrators used in fabricating specimens, the capping equipment and materials used to obtain smooth load bearing surfaces on specimens, and the compression machine in which specimens are tested.

Cylinder Molds - Several cylinder molds of each type and size used by the laboratory were checked for design, dimensions, and watertightness as required by C470. Where applicable molds were also subjected to strength, elongation and absorption tests described in the specification.

Vibrators - Vibrators used in consolidating test specimens made from low-slump concrete were checked for conformance to the requirements for such devices set forth in C31.

Capping Equipment and Materials - The apparatus used in capping concrete cylinders were checked for conformance to the requirements of C617, with particular attention being given to the dimensions, planeness, surface condition, and thickness of capping plates. The preparation and use of the capping material was observed and special safety and verification apparatus were checked. In addition, the planeness and perpendicularity of the caps on several specimens were verified by the inspector.

Unbonded Caps - An alternative to the sulfur, gypsum or cement capping methods of C617 is the unbonded method described in C1231. The retaining rings and pads were checked for conformance to the design requirements of the test method. The availability of required accessory equipment to determine perpendicularity of the cylinder, to assess the planeness of cylinder ends and to saw or grind irregular end surfaces of the cylinders was checked. Where applicable, the laboratory's qualification data and calculations were reviewed to determine conformance to the requirements of the test method.

Compression Machine - Unless otherwise noted, only one testing machine was inspected. During this inspection, several of the more important mechanical and design features were noted; the design, dimensions, and surface planeness of bearing blocks used in testing concrete cylinders were checked for conformance to the requirements of C39; and the accuracy of load indication was verified.

The verification tests were made using force measuring instruments (load cells) traceable to the National Institute of Standards and Technology. In these tests, each load indicator was set at the zero position customarily employed by the laboratory. The selection of test points was made based on loads consistent with the range of use of the material being inspected. Test loads were approached by increasing the load from a lower load as specified in Method E4.

### Tamping Rods (C31)

The tamping rods which were available for use in various rodding operations were checked for conformance to the design and dimensional requirements of C31.

### Slump Cones (C143)

Each slump cone presented for inspection was checked for conformance to the design and dimensional requirements of C143, and the physical condition and verification records were observed.

#### Unit Weight Apparatus (C138)

The capacity of each scale or balance used in determining the unit weight of plastic concrete was recorded, and the accuracy checked for conformance to the requirements of C138. The design, dimensions, and physical condition of each unit weight measure presented for inspection were checked for conformance to the requirements of the standard; a check was made to determine that the required flat strike-off plate was available; and a review of records of the verification made in accordance with C29 was also conducted.

#### Apparatus for Air Content of Plastic Concrete (Volumetric Method) (C173)

At least one of the air meters used in determining the air content of concrete by the volumetric method was checked for conformance to the design requirements of C173, and observations were made to determine that the necessary funnel, strike-off bar, metal measuring cup, mallet, syringe, tamping rod and verification records were available.

#### Apparatus for Air Content of Plastic Concrete (Pressure Method) (C231)

At least one of the air meters used in determining the air content of freshly mixed concrete by the pressure method was checked for conformance to the design requirements of C231, and observations were made to determine that the necessary syringe, tamping rod, mallet, strike-off bar, and verification records were available.

#### Temperature of Concrete (C1064)

A thermometer or other temperature measuring device typical of that used by laboratory personnel was checked for compliance to the requirements of the specification. A reference temperature measuring device and its pertinent calibration or verification records were examined.

#### Miscellaneous

The containers used to transport cylinders from the field to the laboratory were inspected to ensure that the cylinders were protected from damage due to jarring, freezing temperatures, and moisture loss. Also, transportation arrangements were discussed with the laboratory to determine that the time of transportation for concrete specimens did not exceed the maximum time specified.

A check was made to determine that the laboratory had been supplied with a copy of the latest edition of the ASTM Book of Standards pertaining to the testing of concrete.

#### Optional Methods (C1077)

At the discretion of the laboratory, selected optional test methods as set forth in C1077 may be presented for inspection. If presented, the inspection of these test methods for concrete consists of an examination of prescribed equipment and specified procedures for the individual test method.

### Procedures

The concrete testing procedures which were observed and discussed during the inspection were as follows: sampling concrete, slump, unit weight, air content by the volumetric method, air content by the pressure method, temperature of concrete, and compressive strength. The review of the strength test covered fabrication of cylinders, capping either using the bonded or unbonded system or both, when applicable storage after capping, measurement before testing, density, and testing of cylinders. The laboratory's conformance to specified procedures was as indicated in the summary of findings.

All departures noted were reviewed in detail with laboratory personnel with particular attention being given to those matters described in the footnote section.