Designation: C 801 – 98

# Standard Test Method for Determining the Mechanical Properties of Hardened Concrete Under Triaxial Loads[1]

This standard is issued under the fixed designation C 801; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method covers the procedures for testing hardened concrete when subjected to triaxial stress conditions. Materials other than concrete, cement paste, or mortar are excluded. When the determination of the strength of concrete under a triaxial state of stress is made according to this test method, two of the three principal stresses are always equal. There is no provision made for the measurement of pore pressures; therefore all strength values are in terms of total stress.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are mathematical conversions to SI units which are provided for information only and are not considered standard.

1.3 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*

C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens[2]

C 192 Practice for Making and Curing Concrete Test Specimens in the Laboratory[2]

C 512 Test Method for Creep of Concrete in Compression[2]

C 617 Practice for Capping Cylindrical Concrete Specimens[2]

E 4 Practices for Load Verification of Testing Machines[2]

## 3. Significance and Use

3.1 This test method provides data useful in determining the strength and deformation characteristics of concrete such as shear strength at various lateral pressures, angle of shearing resistance, strength in pure shear, deformation modulus, and creep behavior.

## 4. Apparatus

4.1 *Loading Device*—A suitable device for applying and measuring axial load to the specimen. It must be of sufficient capacity to apply the required loads at specified rates. It should be verified at suitable time intervals in accordance with the procedures given in Practices E 4, and should comply with the requirements prescribed therein.

4.2 *Triaxial Compression Chamber*—A device in which the test specimen may be enclosed in an impermeable, flexible membrane, placed between two hardened bearing blocks, and subjected to hydraulic pressure and deviator stress. The bearing blocks must be of steel, the bearing faces of which should be hardened to a minimum of 55 HRC, and which should not depart from plane surfaces by more than 0.0005 in. (0.0127 mm) when the blocks are new and should be maintained within a permissible variation of 0.001 in. (0.0254 mm). In order to develop the required hydraulic pressure, the apparatus should consist of a high pressure cylinder with an overflow valve, a base, suitable entry ports for filling the cylinder with hydraulic fluid and applying the lateral pressure, and hoses, gages and valves as needed (**1, 2, 3, 4**).[3] Fig. 1 and Fig. 2 illustrate triaxial chambers which have proved to be satisfactory.

4.3 *Combination Devices*—Alternatively, devices may be used which combine the function of loading device and pressure chamber. Fig. 3 illustrates one such device (**5, 6, 7, 8**).

4.4 *Pressure-Maintaining Device*—A hydraulic pump, pressure intensifier, or other system of sufficient capacity to maintain the desired pressures in the triaxial compression chamber.

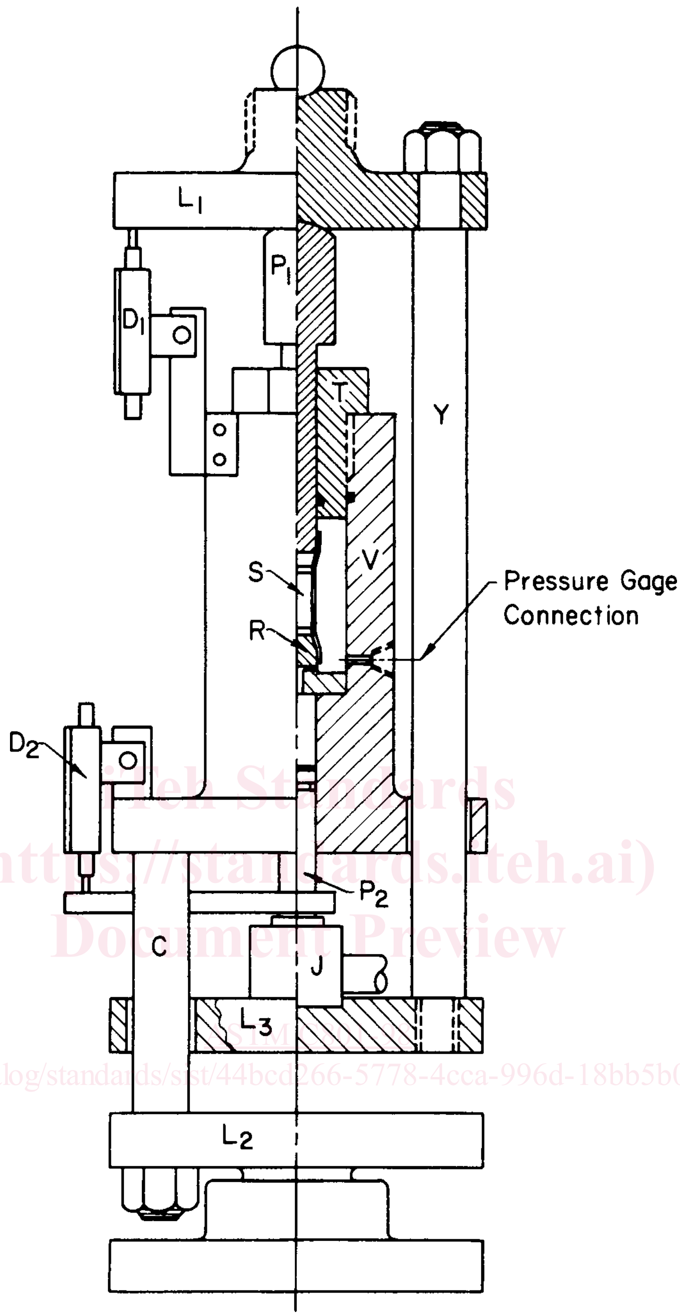
4.5 *Strain-Measuring Devices*—Suitable devices must be provided for the measurement of strain in the specimen. Such devices should be readable to the nearest 0.0001 in. (0.00254 mm) and accurate to within 0.0001 in. (0.00254 mm) in any 0.001-in. (0.0254-mm) range, and within 0.0002 in. (0.00508 mm) in any 0.0100-in. (0.254-mm) range. Such devices may consist of micrometer screws, dial micrometers or linear variable differential transformers securely attached to the high pressure cylinder, and designed to measure bearing block travel (**5, 6, 7, 9**).

[1] This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.61 on Testing for Strength.

Current edition approved Nov. 10, 1998. Published March 1999. Originally published as C 801 – 75. Last previous edition C 801 – 91.

[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] The boldface numbers in parentheses refer to the list of references at the end of this test method.






S—Specimen
V—Pressure vessel
C—Columns (3)
$L_1$—Plate bearing on upper piston, $P_1$
$L_2$—Plate bearing on platen of testing machine
$L_3$—Plate suspended by columns Y
J—Hydraulic jack
$P_2$—Piston
R—Stopper
T—Threaded plug
$D_1$,$D_2$—Dial gages

**FIG. 1 Section Through Test Cell (8)**

4.5.1 Vibrating wire or electrical resistance strain gages may be embedded in the concrete, aligned along the axis of the specimen for measuring axial deformation, or they may be affixed to the surface of the specimen, in which case they should be placed at two diametrically opposite locations and at midlength of the specimen. The effective gage length should be at least three times the nominal maximum size of the aggregate, and at least half the specimen length.

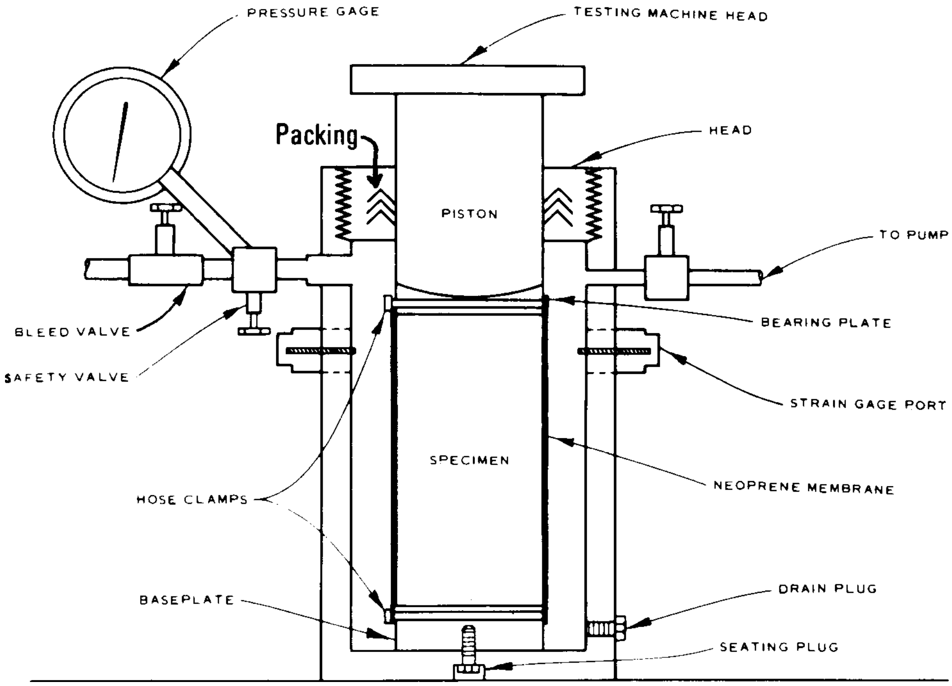



**FIG. 2 Diagram of Triaxial Apparatus (1)**



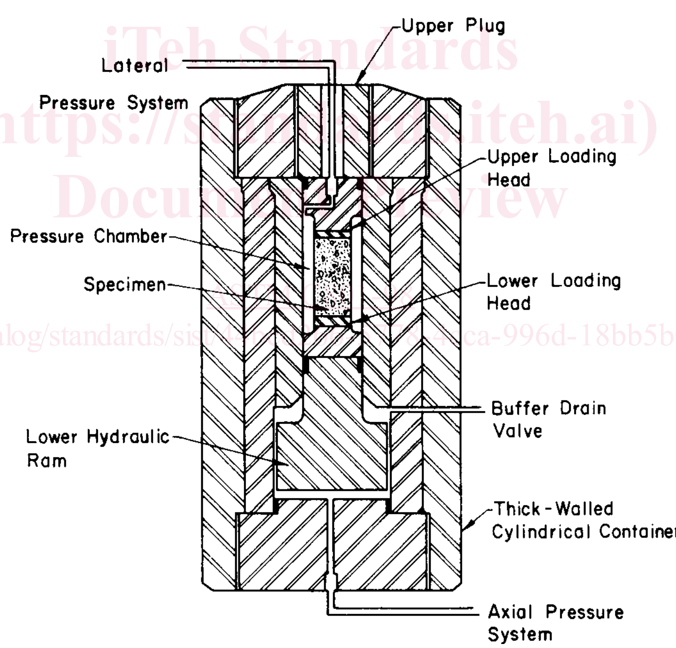



**FIG. 3 Section Through Triaxial Testing Machine (7)**

4.5.2 Electrical resistance or vibrating wire strain gages may be applied circumferentially or embedded in the concrete at midlength to measure lateral strains. Gage length and numbers of gages should be such as to provide average values of lateral strain, reducing the effect of localized strains (**10**).

4.6 *Flexible Membrane*—A flexible membrane of suitable material to exclude the confining fluid from the specimen, and which does not significantly extrude into abrupt surface pores. It should be sufficiently long to extend well onto the bearing blocks and when slightly stretched be of the same diameter as the specimen (**2, 9, 10**)

NOTE 1—Neoprene rubber tubing of 1/16-in. (1.588-mm) wall thickness and of 40 to 60 Durometer hardness. Shore, Type A, has been found generally suitable for this purpose.

## 5. Test Specimens

5.1 Test specimens must be right circular cylinders within the tolerances specified herein, prepared in accordance with Practice C 192. The relationship of aggregate size to specimen size shall be in accordance with that required in Practice C 192.

5.1.1 The sides of the specimen must be generally smooth and free of abrupt irregularities with all elements straight to