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Standard Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Cylindrical Concrete ~~Cylinders~~Specimens[1]

This standard is issued under the fixed designation C1231/C1231M; 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 practice covers requirements for a capping system using unbonded caps for testing concrete cylinders molded in accordance with Practice C31/C31M or C192/C192M, or cores obtained in accordance with Test Method C42/C42M. *Unbonded neoprene caps of a defined hardness are permitted to be used for testing for a specified maximum number of reuses without qualification testing up to a certain concrete compressive strength level. Above that strength, level neoprene caps will require qualification testing. Qualification testing is required for all elastomeric materials other than neoprene regardless of the concrete strength.*

1.2 Unbonded caps are not to be used for acceptance testing of concrete with compressive strength below 10 MPa [1500 psi] or above 80 MPa [12 000 psi].

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4 *This standard does not purport to address all of the safety concerns, 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.* (**Warning—**Concrete ~~cylinders~~specimens tested with unbonded caps rupture more violently than comparable ~~cylinders~~specimens tested with bonded caps. The safety precautions given in the Manual of Aggregate and Concrete Testing are recommended.[2]*)*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

C31/C31M Practice for Making and Curing Concrete Test Specimens in the Field
C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
C42/C42M Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
C192/C192M Practice for Making and Curing Concrete Test Specimens in the Laboratory
C617 Practice for Capping Cylindrical Concrete Specimens
D2000 Classification System for Rubber Products in Automotive Applications

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *pad, n*—an unbonded elastomeric pad.

3.1.2 *unbonded cap, n*—a metal retainer and an elastomeric pad.

[1] This practice 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.

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[2] Section on Safety Precautions, Manual of Aggregate and Concrete Testing, *Annual Book of ASTM Standards*, Vol 04.02.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

4. Significance and Use

4.1 This practice provides for using an unbonded capping system in testing hardened concrete cylinders made in accordance with Practices C31/C31M or C192/C192M ~~in~~ , or cores obtained in accordance with Test Method C42/C42M in lieu of the capping systems described in Practice C617.

4.2 The elastomeric pads deform in initial loading to conform to the contour of the ends of the ~~cylinder~~ test specimens and are restrained from excessive lateral spreading by plates and metal rings to provide a uniform distribution of load from the bearing blocks of the testing machine to the ends of the concrete or mortar ~~cylinders.~~specimens.

5. Materials and Apparatus

5.1 Materials and equipment necessary to produce ends of the reference ~~cylinders~~specimens that conform to planeness requirements of Test Method C39/C39M and the requirements of Practice C617. This may include grinding equipment or capping materials and equipment to produce neat cement paste, high strength gypsum plaster, or sulfur mortar caps.

5.2 *Elastomeric Pads:*

5.2.1 Pads shall be 13 ± 2 mm [½ ± 1/16 in.] thick and the diameter shall not be more than 2 mm [1/16 in.] smaller than the inside diameter of the retaining ring.

5.2.2 Pads shall be made from polychloroprene (neoprene) meeting the requirements of Classification D2000 as follows:

Shore A Durometer	Classification D2000 Line Call-Out
50	M2BC514
60	M2BC614
70	M2BC714

The tolerance on Shore A durometer hardness is ±5. Table 1 provides requirements for use of caps made from material meeting the requirements of Classification D2000, above.

5.2.3 Other elastomeric materials that meet the performance requirements of qualification tests in Section 8 are permitted.

5.2.4 Elastomeric pads shall be supplied with the following information:

5.2.4.1 The manufacturer's or supplier's name,

5.2.4.2 The Shore A hardness, and

5.2.4.3 The applicable range of concrete compressive strength from Table 1 or from qualification testing.

5.2.5 The user shall maintain a record indicating the date the pads are placed in service, the pad durometer, and the number of uses to which they have been subjected.

5.3 ~~*Retainers,*~~*Retainers* are a pair of metal fixtures used to provide support for and alignment of the neoprene pads and the ~~cylinder~~ test specimen ends (Note 1 and Fig. 1). Each retainer (upper and lower) includes a (retaining) ring that is welded to or manufactured integrally with a base plate. The height of the retaining ring shall be 25 ± 3 mm [1.0 ± 0.1 in.]. The inside diameter of the retaining ring shall not be less than ~~102 %~~102% or greater than ~~107 %~~107% of the diameter of the ~~cylinder. The~~ specimen. For test specimens having nominal diameters of 100 mm [4 in.] or less, the thickness of the retaining ring shall be at least ~~12~~9 mm ~~[0.47 in.] for 150 mm [6 in.] diameter retainers and at least 9 mm [0.35 in.] for~~ [0.35 in.] and the thickness of the baseplate shall be at least 8 mm [0.30 in.]. For test specimens having nominal diameters greater than 100 mm [4 ~~in.] diameter retainers.~~ in.], the thickness of the retaining ring and baseplate shall be at least 12 mm [0.47 in.]. The surface of the ~~base plate~~ baseplate that contacts the bearing block of the testing machine shall be plane to within 0.05 mm [0.002 in.]. The ~~thickness of the base plate shall be at least 12 mm [0.47 in.] for 150 mm [6 in.] retainers and at least 8 mm [0.3 in.] for 100 mm [4 in.] retainers. The~~ bearing surfaces of the retainers shall not have gouges, grooves, protrusions, or indentations greater than 0.25 mm [0.010 in.] deep or greater than 32 mm^2 ~~[0.05~~ [0.05 $in.^2$] in surface area.

NOTE 1—Retainers made from steel and some aluminum alloys have been found acceptable.

TABLE 1 Requirements for Use of Polychloroprene(Neoprene) Pads

Compressive Strength,[A] MPa [psi]	Shore A Durometer Hardness	Qualification Tests Required	Maximum Reuses
Less than 10 [1 500]		Not permitted	
10 to 40 [1 500 to 6 000]	50	None	100
17 to 50 [2 500 to 7 000]	60	None	100
28 to 50 [4 000 to 7 000]	70	None	100
50 to 80 [7 000 to 12 000]	70	Required	50
Greater than 80 [12 000]		Not permitted	

[A] Compressive strength of concrete at age of testing as specified in Contract Documents. For acceptance testing, it is the specified compressive strength f_c'.

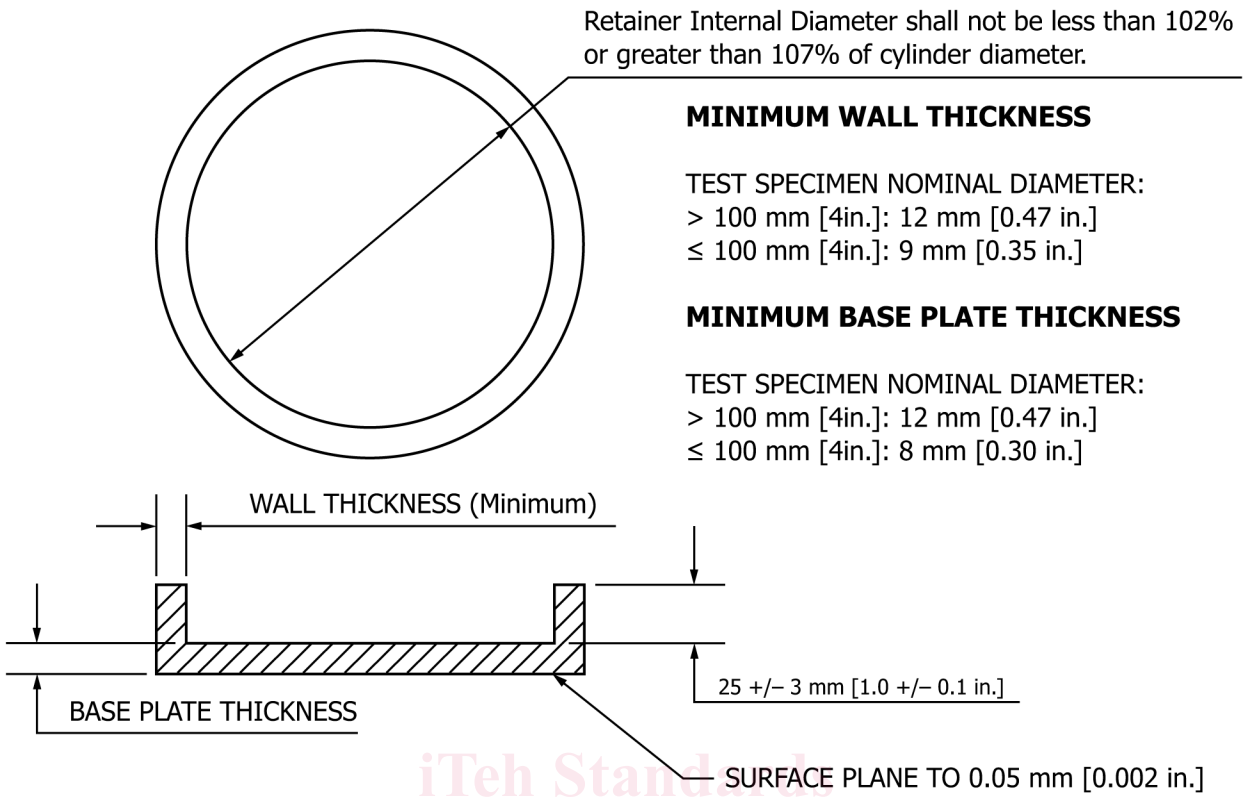

FIG. 1 Example of Retaining Ring and Base Plate

6. Test Specimens

6.1 ~~The specimens shall be either 150 by 300 mm [6 by 12 in.] or 100 by 200 mm [4 by 8 in.]~~ Specimens shall be cylinders made in accordance with Practices C31/C31M or C192/C192M~~. Neither end of a cylinder shall depart from~~, or cores obtained in accordance with Test Method C42/C42M~~perpendicularity to the axis by more than 0.5° (~~. ~~Note 2~~). ~~No individual diameter of a cylinder may differ from any other diameter by more than 2 %.~~

~~Note 2—One method of measuring the perpendicularly of ends of cylinders is to place a try square across any diameter and measure the departure of the longer blade from an element of the cylindrical surface. An alternative method is to place the end of the cylinder on a plane surface and support the try square on that surface. A deviation from perpendicularity of 0.5° is equal to a slope of approximately 1 mm in 100 mm [⅛ in. in 12 in.].~~

6.2 Depressions under a straight edge measured with a round wire gage across any diameter shall not exceed 5 mm [0.20 in.]. If ~~cylinder~~ the specimen ends do not meet this tolerance, the ~~cylinders~~specimen shall not be tested unless irregularities are corrected by sawing or grinding.

7. Procedure

7.1 Unbonded caps are permitted to be used on one or both ends of a ~~cylinder~~ test specimen in lieu of a cap or caps meeting Practice C617, provided the caps meet the requirements of Section 5. Pad hardness shall be in accordance with Table 1.

Note 2—The specified strength in the contract documents is for various stages of construction. This may include strength test requirements for formwork removal or release of prestress in addition to the test requirements for verification of specified compressive strength. Therefore, pad selection is based on the strength requirement for the designated stage of construction.

7.2 Replace pads that do not meet the dimensional requirements of 5.2 or that exceed the maximum reuse limits of Table 1. Insert pad in the retainer before it is placed on the ~~cylinder.~~specimen.

Note 3—Some manufacturers recommend dusting the pads and the ends of the ~~cylinders~~specimens with corn starch or talcum powder prior to testing.

7.3 Complete the load application, testing, calculation, and reporting of results in accordance with Test Method C39/C39M.

Note 4—Some users have reported damage to testing machines from the sudden release of energy stored in the elastomeric pads.

Note 5—Occasionally, ~~unbonded capped cylinders~~ specimens tested with unbonded caps may develop early cracking, but continue to carry increasing load. For this reason Test Method C39/C39M requires ~~cylinders~~ test specimens to be loaded until it is certain that they have been compressed beyond their ultimate capacity.