This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: C497M – 20a

Standard Test Methods for Concrete Pipe, Concrete Box Sections, Manhole Sections, or Tile (Metric)[1]

This standard is issued under the fixed designation C497M; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 These test methods cover testing of concrete pipe, concrete box sections, manhole sections, and tile. The test methods described are used in production testing and acceptance testing to evaluate the properties provided for in the specifications.

1.2 The test methods appear in the following order:

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Base Section Test	6
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Permeability	10
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Joint Shear	14
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1.3 The test specimens shall not have been exposed to a temperature below 4°C for the 24 h immediately preceding the test.

1.4 If any test specimen fails because of mechanical reasons such as failure of testing equipment or improper specimen preparation, it shall be discarded and another specimen taken.

1.5 Specimens shall be selected in accordance with the specifications for the type of pipe or tile being tested.

1.6 These methods are the metric companion of Test Methods C497.

1.7 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

C617 Practice for Capping Cylindrical Concrete Specimens

C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

C822 Terminology Relating to Concrete Pipe and Related Products

C1231/C1231M Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Cylindrical Concrete Specimens

D2240 Test Method for Rubber Property—Durometer Hardness

E4 Practices for Force Verification of Testing Machines

3. Terminology

3.1 *Definitions*—For definitions of terms relating to concrete pipe, see Terminology C822.

4. External Load Crushing Strength Test by the Three-Edge Bearing Test Method

4.1 *Summary of Test Method*—The test specimen is tested in a machine designed to apply a crushing force upon the

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[2] 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.

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specimen in a plane through the vertical axis extending along the length of the specimen.

4.2 *Significance and Use*—The crushing test method shall be either a quality control test performed to establish that the finished, shippable pipe has sufficient strength to withstand the crushing loads stated in the specifications or a proof of design test performed to prove the adequacy of design.

4.3 *Apparatus:*

4.3.1 The testing machine shall be of any type of sufficient capacity and shall be capable of providing the rate of loading prescribed in 4.5.3.

4.3.2 The testing machine shall be substantial and rigid throughout, so that the distribution of the load will not be affected appreciably by the deformation or yielding of any part.

4.3.3 The three-edge-bearing method of loading shall be used. The test specimen shall be supported on a lower bearing of two parallel longitudinal strips and the load applied through an upper beam (Fig. 1, Fig. 2, Fig. 3, and Fig. 4). At the option of the manufacturer, either or both the lower bearing and the upper bearing shall extend the full length or any portion of the length of the specimen.

4.3.4 The lower bearings shall consist of wood or hard rubber strips. Wooden strips shall be straight, have a cross section of not less than 50 mm in width and not less than 25 mm nor more than 38 mm in height and shall have the top inside corners rounded to a radius of 13 mm. Hard rubber strips shall have a durometer hardness of not less than 45 nor more than 60. They shall be rectangular in cross section, having a width of not less than 50 mm, a thickness of not less than 25 mm nor more than 38 mm, and shall have the top inside corner rounded to a radius of 13 mm.

4.3.5 The lower bearing strips shall be fastened to a wooden or steel beam or directly to a concrete base, any of which shall provide sufficient rigidity so that the deflection is not greater than 1/720 of the specimen length when the maximum load is applied. The rigid base shall be at least 150 mm wide. The interior vertical sides of the strips shall be parallel and spaced a distance apart of not more than 25 mm per 300 mm of specimen diameter, but in no case less than 25 mm. The bearing faces of the lower strips shall not vary from a straight line vertically or horizontally by more than 2.5 mm/m of length under no load.

4.3.6 The upper bearing shall be a rigid wood beam with or without an attached hard rubber strip. The wood shall be sound, free of knots, and straight and true from end to end. It shall be fastened to a steel or wood-faced steel beam of such dimensions that deflections under maximum load will not be greater than 1/720 of the specimen length. The bearing face of the upper bearing shall not deviate from a straight line by more than 2.5 mm/m of length. When a hard rubber strip is used on the bearing face it shall have a durometer hardness of not less than 45 nor more than 60, and shall have a width of not less than 50 mm and a thickness of not less than 25 mm nor more than 38 mm and shall be secured to a wood beam meeting the above requirements.

4.3.7 If mutually agreed upon by the manufacturer and the owner prior to the test, before the specimen is placed, a fillet of plaster of paris not exceeding 25 mm in thickness shall be cast on the surface of the upper and lower bearings. The width of the fillet cap, upper or lower, shall be not more than 80 mm/m of the specimen diameter, but in no case less than 25 mm.

4.3.8 The equipment shall be so designed that the load will be distributed about the center of the overall length (L_1) of the specimen (Fig. 1, Fig. 2, Fig. 3, and Fig. 4). At the option of the manufacturer, the center of the load shall be applied at any point of the overall length (L_1) of the specimen. The load shall be applied either at a single point or at multiple points dependent on the length of the specimen being tested and the rigidity of the test frame.

NOTE 1—The user of these test methods is advised that multiple points of load applications to the upper bearing will permit use of lighter beams without excessive deflection.

4.4 *Calibration*—The loading device shall be one which shall provide an accuracy of ±2 % at the specified test loads. A calibration curve shall be used. The machines used for performing the three-edge-bearing tests shall be verified in accordance with Practices E4.

4.5 *Conditioning*—The moisture requirements of 1.3 are not required, at the option of the manufacturer.

4.6 *Procedure:*

4.6.1 Place the specimen on the two lower bearing strips in such a manner that the pipe or tile rests firmly and with uniform bearing on each strip.

4.6.2 Mark the two ends of the specimen at a point midway between the lower bearing strips and then establish the diametrically opposite point on each end. Place the upper bearing so that it is aligned with these marks.

4.6.3 For reinforced concrete pipe, any rate or load application up to a maximum of 109.4 kN/linear metre of pipe per minute shall be used up to 75 % of the specified design strength, at which time the rate of loading shall be reduced to a maximum uniform rate of 43.8 kN/linear metre of pipe per minute. If both the design strength and the ultimate strength are being determined, a specified rate of loading need not be maintained after the design strength has been reached. For nonreinforced concrete pipe, any rate of load application up to a maximum of 109.4 kN/linear metre of pipe per minute shall be used up to 75 % of the specified ultimate strength, at which time the rate of loading shall be reduced to the maximum uniform rate of 43.8 kN/linear metre of pipe per minute.

4.6.4 As defined in Terminology C822, the design strength is the maximum load, expressed as a D-load, supported by the pipe before a crack having a width of 0.3 mm occurs throughout a continuous length of 300 mm or more measured parallel to the longitudinal axis of the pipe barrel. The crack is 0.3 mm in width when the point of the measuring gauge will, without forcing, penetrate 1.5 mm at 75 mm maximum intervals, throughout the specified distance of 300 mm. Measure the width of the crack by means of a gauge made from a leaf in thickness (as in a set of standard machinist gauges),