Designation: E 514 – 0~~3~~4

Standard Test Method for Water Penetration and Leakage Through Masonry[1]

This standard is issued under the fixed designation E 514; 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 Department of Defense.

[1] This test method is under the jurisdiction of ASTM Committee C15 on Manufactured Masonry Units and is the direct responsibility of Subcommittee C15.04 on Research.

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1. Scope*

1.1 This laboratory test method[2] provides a procedure for determining the resistance to water penetration and leakage through unit masonry subjected to wind-driven rain.

1.2 *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.* For a specific hazard statement see Section 5.

2. Referenced Documents

2.1 *American Concrete Institute Standard:*[3]

ACI 531~~1~~0/ASCE 5/TMS 402 Building Code Requirements for ~~Concrete~~ Masonry ~~Structures~~

~~2.2 *Brick Institute of America Standard:*[4]~~

~~Construction of Brick Masonry, *Building Code Requirements*~~ *Structures*

[2] This test method is based upon those used by the National Bureau of Standards and described in *NBS Report BMS7*, "Water Permeability of Masonry Walls," 1933, and *NBS Report BMS82*, "Water Permeability of Walls Built of Masonry Units," 1942.

~~[3] Available from~~

[3] Published by The Masonry Society, www.masonrysociety.org; American Concrete ~~Inst., P. O. Box 19150, Detroit, MI 48219.~~ Institute, www.aci-int.org; and American Society of Civil Engineers, www.asce.org.

ACI 530.1/ASCE 6/TMS 602 Specifications for ~~Engineered Brick~~ Masonry~~–~~ Structures

3. Significance and Use

3.1 This test method provides information that aids in evaluating the effect of four principal variables: materials, coatings, wall design, and workmanship.

3.2 Water penetration and leakage through masonry is significantly affected by air pressure in the test chamber. Data from tests made at different pressures are not comparable.

3.3 The performance of a masonry wall is a function of materials, construction, wall design, and maintenance. In service the performance will also depend on the rigidity of supporting structure and on the resistance of components to deterioration by various causes, such as corrosion, vibration, thermal expansion and contraction, curing, and others. It is impossible to simulate the complex conditions encountered in service, such as variations in wind velocity, negative pressure, and lateral or upward moving air and water. Factors such as location, exposure, and wall openings should be considered .

3.4 Given the complexity of variables noted above, this test method establishes comparative behavior between various masonry wall constructions in a given laboratory.

3.5 Even when a single laboratory tests the same wall design utilizing the same wall materials and the same construction practices, variables such as the level of skill of the mason building the specimen, the temperature and humidity in the laboratory at the time of construction, curing of the specimen, the moisture contents of the materials used to build the specimen, and even the use or lack of use of a lime and water wash on the back of the specimen can affect the results of the test making reliable comparisons dubious. For these reasons and the multi-variables listed in 3.1, 3.2, and 3.3, a meaningful, useful, absolute wall leakage rating standard is impractical and discouraged.

4. Apparatus

4.1 *Test Chamber*—~~The~~ Use a test chamber ~~shall be~~ similar to that shown in Fig. 1 and Fig. 2~~and may be constructed of metal, wood, or plastic. It shall provide~~. Provide an opening with a minimum area of 1.08 m^2 (12 ft^2). For example, 900 mm (36 in.) wide and 1200 mm (48 in.) high is suitable. ~~E~~ Line the edges of the chamber in contact with the specimen ~~shall be lined~~ with a closed-cell compressible gasket material or appropriate sealant. ~~A~~ Provide an observation port ~~shall be provided~~ in the face of the chamber. ~~The~~ Provide a 19.0-mm (¾-in.) diameter corrosion-resistant spray pipe ~~shall have~~ with a single line of 1.0-mm (0.04-in.) diameter holes spaced 25.0 mm (1 in.) apart.

4.2 *Fixtures and Appurtenances to Chamber*—Fixtures and appurtenances to the chamber shall ~~consist of~~ include an air line with manometer, a water line with valves, ~~an orifice~~ a flow meter and manometer and a water drain pipe at the bottom of the

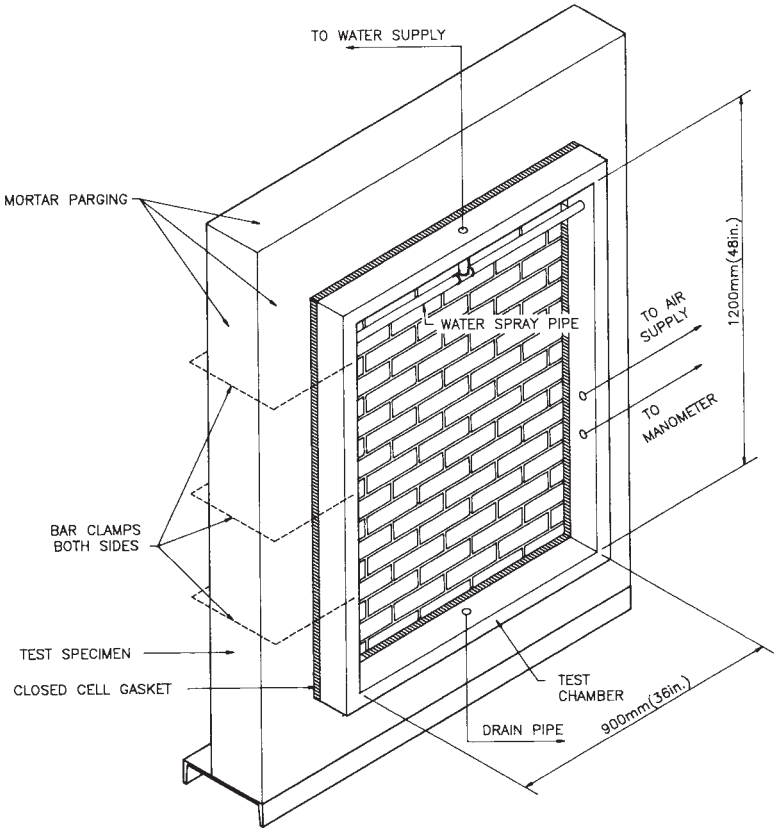

FIG. 1 Isometric Projection of Testing Chamber

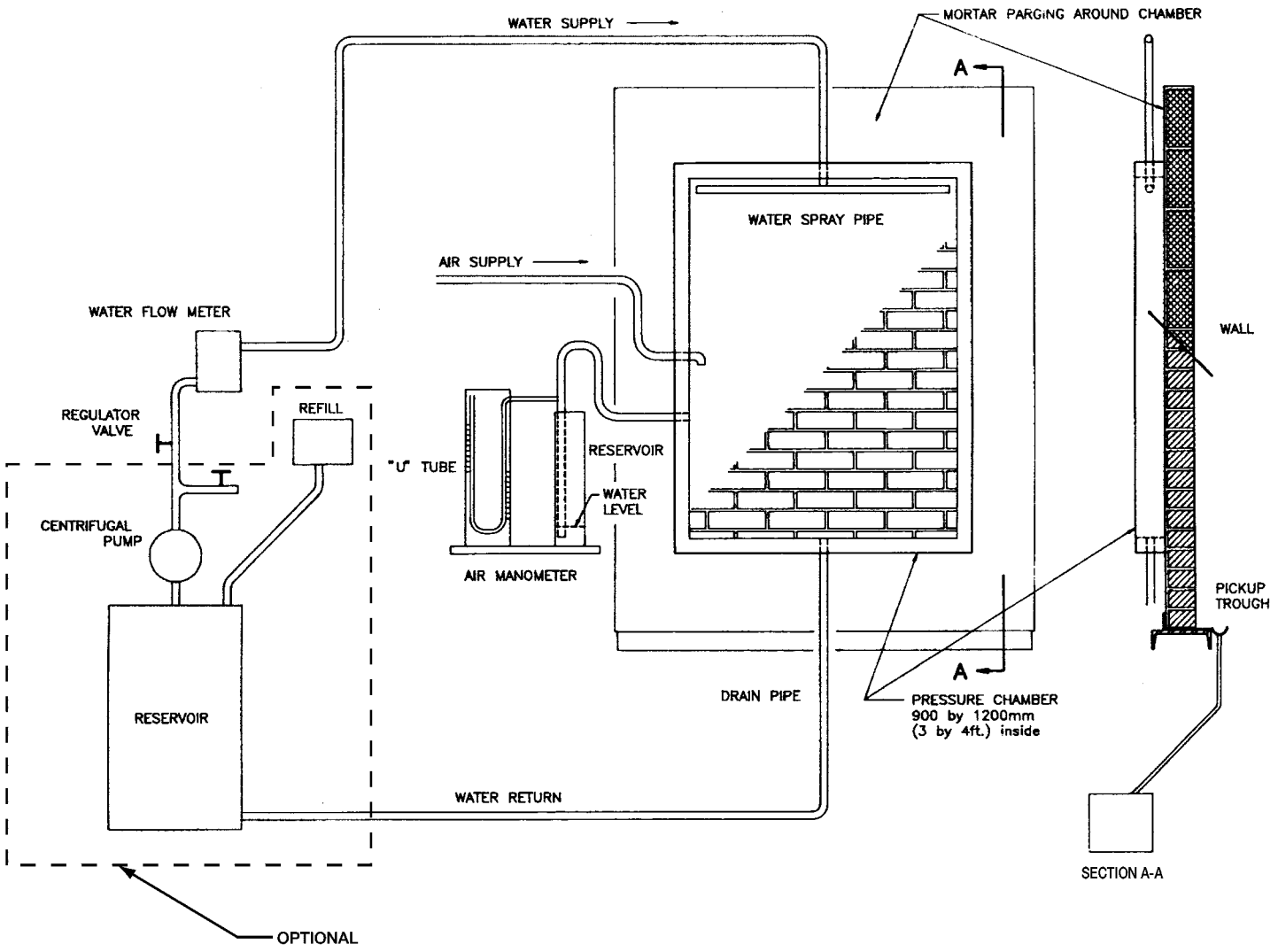

FIG. 2 General Arrangement of Water Penetration Testing Chamber System

chamber. ~~The~~ Position the water spray pipe ~~shall be positioned~~ so that the water impinges the specimen not more than 75.0 mm (3.00 in.) below the top of the test chamber. ~~Th~~

NOTE 1—A drain pipe ~~m~~ thayt discharges into a ~~container~~ reservoir equipped with an adjustable depth air outlet pipe and top baffles has been found to reduce surge.

~~4.3 Other equipment shall consist~~

4.3 *Manometer*—Measure the air pressure in the chamber using a manometer or other device capable of measuring air pressures of at least 51 mm (2.0 in.) of water (71.7 kPa) (10.4 psf) to an accuracy of 2.5 mm (0.1 in.) or 3.6 kPa (0.52 psf). Connect the manometer or other device to the chamber away from the air inlet so that the air flow will not significantly influence the pressure reading.

4.4 Other equipment includes devices for handling the specimen and measuring time, water quantities, temperature, ~~humidity,~~ and ~~air pressure within the test chamber.~~ humidity.

5. Hazards

5.1 The use of this test method will require careful design consideration of both air chamber and support of the wall system to avoid possible injury due to equipment or specimen failure.

6. Temperature and Humidity Conditions

6.1 Maintain the air in the laboratory at a temperature of 24 ± 8°C (75 ± 15°F) and a relative humidity of 55 % ± 25 %.

7. Test Specimens

7.1 *Masonry Materials*—Masonry and associated materials shall be representative of the construction or the materials that are

being considered for the construction. Precondition all materials to a stable condition by storing in laboratory environment for not less than 5 days before use.

7.2 *Size of Test Walls*—The height and length of the specimen shall provide a minimum of 1.08 m^2 (12 ft^2) exposed to the test, plus at least a 200-mm (8-in.) overlap on all edges. The minimum height or length of the specimen shall be 1.22 m (4 ft). The length of the specimen shall be such that at least one head joint in each course of masonry is exposed to the test.

7.3 *Building Wall Specimens*—Methods and workmanship used in the construction of the specimen shall be representative of the construction (Note ~~1).~~ 2). Build the wall specimen on an inverted steel channel section so that the face of the wall to be exposed to test is flush with the outside face of one flange of the channel. As shown in Fig. 3 attach to, or build flashing into masonry forming a trough to collect water that may pass through to the back side of the wall.

NOTE ~~1~~2—Standards for masonry construction are contained in the following documents: ~~Construction of Brick Masonry (Building~~ ACI Standard 530/ASCE 5/TMS 402 Building Code Requirements for ~~Engineered Brick Masonry, Section 5)~~ Masonry Structures and ACI ~~Standard 531-81.~~ 530.1/ASCE 6/TMS 602 Specifications for Masonry Structures.

7.4 *Number of Specimens*—The test shall consist of at least 3 specimens.

7.5 *Storage of Specimens*—Specimens shall be retained in the laboratory during storage and shall be enclosed in an impervious plastic wrap immediately after construction and cured in this manner for 7 days. After 7 days, the wrap shall be removed and aging shall continue for at least 7 more days in laboratory air as stated in 6.1.

8. Procedure

8.1 *Mounting Chamber*— Position the test chamber on the specimen and clamp firmly in place, compressing the gasket to form a seal.

8.2 Apply a 10-mm (⅜-in.) minimum thickness coat of mortar parging to all exposed surfaces of the specimen except the back side of the wall and the area enclosed by the test chamber.

NOTE ~~2~~3—A lime and water wash may be brush applied to back face of the test specimen to make moisture detection easier on dark surfaces. A portland cement and water wash should not be used.

8.3 Adjust the rate of application of water to 138 L/m^2 (3.4 gal/ft^2) of wall per hour.

8.4 Simultaneously, with the application of water, increase the air pressure within the chamber. If the pressure is not specified the specimen will be tested at 500 Pa (10 lbf/ft^2). Supply slightly more air than is needed to maintain pressure and adjust, if

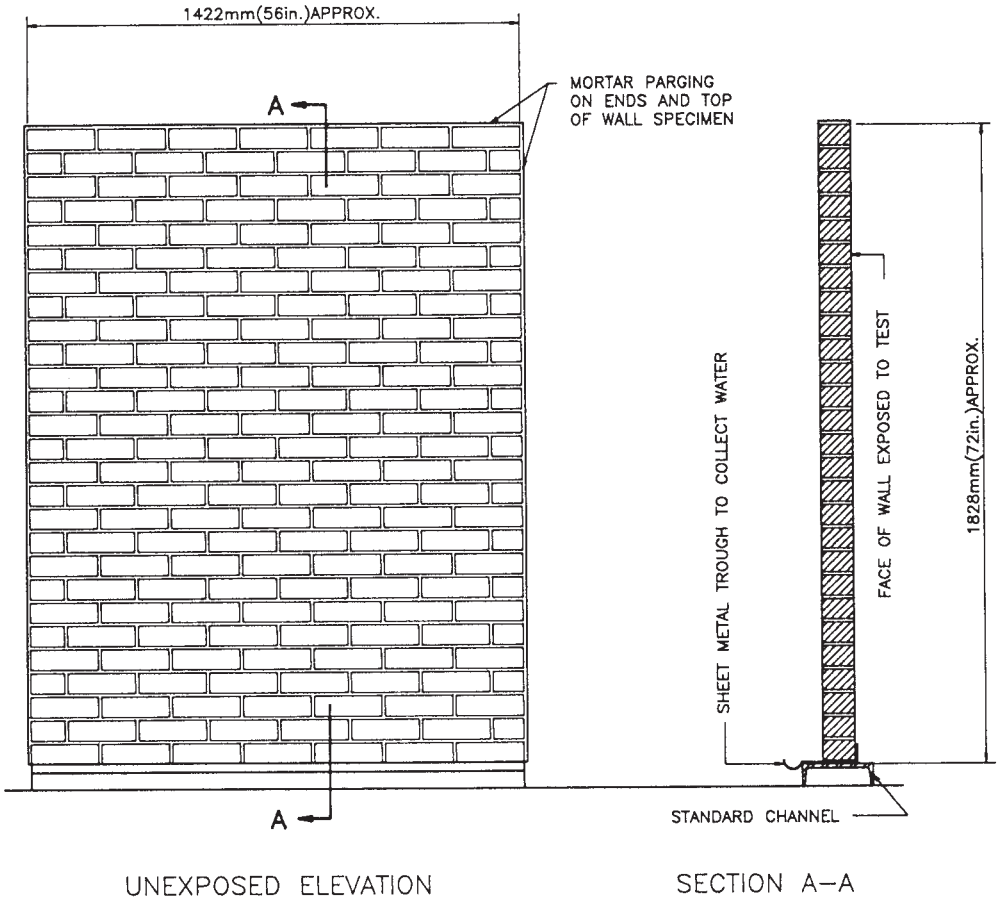

FIG. 3 Typical Brick Masonry Test Specimen

necessary, to prevent excessive surge in the water reservoir.

8.5 Maintain the specified conditions for a period of not less than 4 h.

9. Record of Observation

9.1 During the 4 h of testing, make observations at 30-min intervals. If testing is extended beyond 4 hrs, establish observation intervals beyond 4 h as required to document specimen performance. Record the following:

9.1.1 Time of appearance of dampness on back of specimen.

9.1.2 Time of appearance of first visible water on the back of the specimen.

9.1.3 Area of dampness on back of wall expressed as a percent of the chamber area.

9.1.4 Total water collected from each trough.

10. Retesting

10.1 If required, return the specimens to storage and retest at age 28 days or later and re-evaluate.

11. Report

11.1 Report the following information:

11.1.1 Description of all materials including coatings, masonry units, mortar materials, and composition of mortar used to construct the wall specimens, and their properties as determined by the appropriate standards.

11.1.2 Description of specimen wall design and details of construction. Include photographs and drawings as necessary.

11.1.3 Detailed description of the quality of workmanship used in construction of test specimens.

11.1.4 Conditions of test.

11.1.5 Record of observations as required in Section 9.

11.1.6 Record of temperature and humidity in the laboratory during construction, curing, and test periods.

11.1.7 Age of test specimen at the time of test, and re-test, if applicable.

12. Precision and Bias

12.1 No statement is made either on the precision or on the bias of this test method for testing water penetration or leakage through masonry due to the test variables involved.

13. Keywords

13.1 air-pressure; laboratory test; manometer; masonry; simulated wind driven rain; test chamber; water penetration; water spray pipe

SUMMARY OF CHANGES

Committee C15 has identified the location of the following changes since E 514–02~~2~~3 that may impact the use of this standard.

(1) Section 2, Referenced Documents, and Note 2 were modified to update the references.

(2) Section 4 was modified to include information about a manometer. Fig 2 was modified to show optional equipment as described in Note 1. Text was also changed to the imperative mood.

Committee C15 has identified the location of the following changes since E 514–02 that may impact the use of this standard.

(1) Sections 9 - 11 were updated to include imperative mood and also to include observations for tests beyond 4 hours.