Designation: ~~C627 – 10ε1~~ C627 – 18

Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester[1]

This standard is issued under the fixed designation C627; 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.

~~ε[1] NOTE—Revised 5.4 editorially in July 2017.~~

1. Scope

1.1 This test method covers the evaluation of ceramic floor tile installation systems, using the Robinson[2]-type floor tester.

1.2 This test method is intended solely for evaluating complete ceramic floor tile installation systems for failure under dynamic loads and not for evaluating particular characteristics of ceramic tile, such as abrasion resistance. This test method does not claim to provide meaningful results for other than evaluating complete ceramic floor tile installation systems.

1.3 The values stated in inch-pound units are to be regarded as the standard. The metric (SI) units in parentheses are for information only.

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

1.5 *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:*[3]

C144 Specification for Aggregate for Masonry Mortar

C150 Specification for Portland Cement

2.2 *ASTM Adjuncts:*

Robinson-type Floor Tester[2]

Deflection ~~Gage~~Gauge[4]

3. Summary of Test Method

3.1 This test method consists of preparing ~~installation slabs~~test assemblies that duplicate the type of installation under consideration, subjecting them to one or more tests on the Robinson floor tester, and evaluating the results in a prescribed manner. Description of the installation method must specifically include all variables, for example, the type of materials and mixture proportions of substratum, setting material, and tile grout; type of tile, installation technique, and cure.

4. Significance and Use

4.1 This test method provides a standardized procedure for evaluating performance of ceramic floor tile installations under conditions similar to actual specific usages. It can be used to make comparisons between customary basic installation methods, to establish the influence of minor changes in a particular installation method, and to judge the merit of proposed novel methods.

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[1] This test method is under the jurisdiction of ASTM Committee C21 on Ceramic Whitewares and Related Products and is the direct responsibility of Subcommittee C21.06 on Ceramic Tile.

Current edition approved ~~Sept. 1, 2010~~March 1, 2018. Published ~~September 2010~~April 2018. Originally approved in 1970. Last previous edition approved in ~~2007~~2010 as ~~C627 – 93 (2007).~~C627 – 10ε1. DOI: ~~10.1520/C0627-10E01.~~10.1520/C0627-18.

[2] ~~Developed at the Research Center of the Tile Council of America, Inc. Detailed working drawings of the apparatus~~ Detailed working drawings of the an apparatus known to meet the requirements of this standard are available at a nominal cost from ASTM Headquarters. Order Adjunct No. ADJC062701.

[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.

[4] Detailed working drawings for construction of ~~the deflection gage~~ a deflection gauge known to meet the requirements of this standard are available at nominal cost from ASTM Headquarters. Order Adjunct No. ADJC062702.

5. Apparatus

5.1 *Foundation for Tester*—The foundation for the tester shall consist of a ~~nominally 4-ft (1220-mm)~~ minimum 4 by 4-ft (1220 by 1220-mm) square and 1-ft (300-mm) thick cement ~~slab with two 15- by 15-in. (380- by 380-mm) bearing plates with four 12~~slab. ~~½-in. (318-mm) high tie rods cast into the center of the foundation and with an 8-in. (203-mm) square and 1-ft (300-mm) deep opening in the exact center. The top~~The testing surface of this slab shall be smooth, level, and flat with the maximum deviation from a true plane not to exceed 1/32 ~~in. (0.8 mm). An extension at the bottom of one side of the foundation shall be approximately 4 in. (102 mm) thick and 14 in (356 mm) wide to hold the motor, speed reducer, and drive. A 4-in. high and 8-in. wide tunnel, running from the top of the cement extension and~~ in. (0.8 mm). The foundation may be equipped for a bottom or top driven tester. Please see X1.1 ~~level with it to the center of the 1-ft thick foundation slab permits the transmittal of the drive to the carriage of the tester. Four~~ for construction details for a foundation using a bottom driven tester that has been known to meet the requirements of the test method.~~¾-in. (19-mm) holes, 2½ in. (63.5 mm) deep to hold ½-in. (12.7-mm) threaded lead shields (Star Tamp-Ins) shall be cast into the foundation, one at each corner and located 5 in. (127 mm) in from each side. Four more ¾-in. (19-mm) holes, 2½ in. deep to hold ½-in. threaded lead shield shall be cast into the foundation extension to hold the drive base.~~

5.2 *Tester*—The tester itself shall be a 150 ± 5-lbs (68.1 ± 2.3-kg) ~~carriage, consisting of a piece of~~ carriage ~~½-in. thick, hot-rolled steel plate~~ in the shape of an equilateral ~~triangle with 6-in. (152-mm) radius rounded corners and having a 3~~triangle. ~~⅜-in. (85.7-mm) diameter hole in the exact center.~~ Three swivel caster wheels shall be equally spaced in a circle with 15-in. (381-mm) radius from the center and fastened to the underside of the carriage at the intersection of the bisector of each angle and the 15-in. (381-mm) radius circle. ~~Over each wheel a 16-in. (406-mm) high, 1-in. (25.4-mm) diameter, fully threaded steel rod shall be vertically threaded into the carriage to permit the addition of up to~~ The carraige shall be capable of supporting 750 lbs (340.5 kg) of additional weight, 250 lbs (113.5 kg) of auxiliary weights ~~to~~over each wheel. The auxiliary ~~weights with 1½-in. (38-mm) diameter center openings shall weigh either 25 or 50 lbs (11.5 or 23 kg) each and when stacked on the threaded rod, their total thickness shall not exceed 15 in. in height. They shall be held down firmly by a washer and nut on the threaded rods. If the weight of the carriage with wheels and threaded steel rods, but without auxiliary weights, does not reach the required weight of 150 ± 5 lbs (68.1 ± 2.3 kg), one third of the necessary additional weight shall be permanently added near each steel rod by welding it in place. Conversely, if the total weight of the carriage exceeds the required weight of 150 ± 5 lbs (68.1 ± 2.3 kg), a sufficient number of 1-in. diameter holes may be drilled~~weight stacks shall be sufficiently secured to the carriage. Cutaway diagrams of a bottom-driven apparatus and of a top-driven apparatus are shown in Fig. 1~~into the steel plate,~~. Please see X1.2 ~~equally distributed along~~for construction details[2] ~~the three sides of the triangle, to reduce the weight. A cutaway diagram of the apparatus is shown in~~ for one example of a tester known to meet the requirements of the test method. ~~Fig. 1.~~

5.3 *Drive*—The tester shall be driven by a ~~¾-hp~~ motor and speed ~~reducer.~~ reducer, variable speed drive, or equivalent, capable of rotating the carriage at 15 ± 0.5 rpm during testing. Drive transmittal shall be arranged in such a manner that the plane of travel

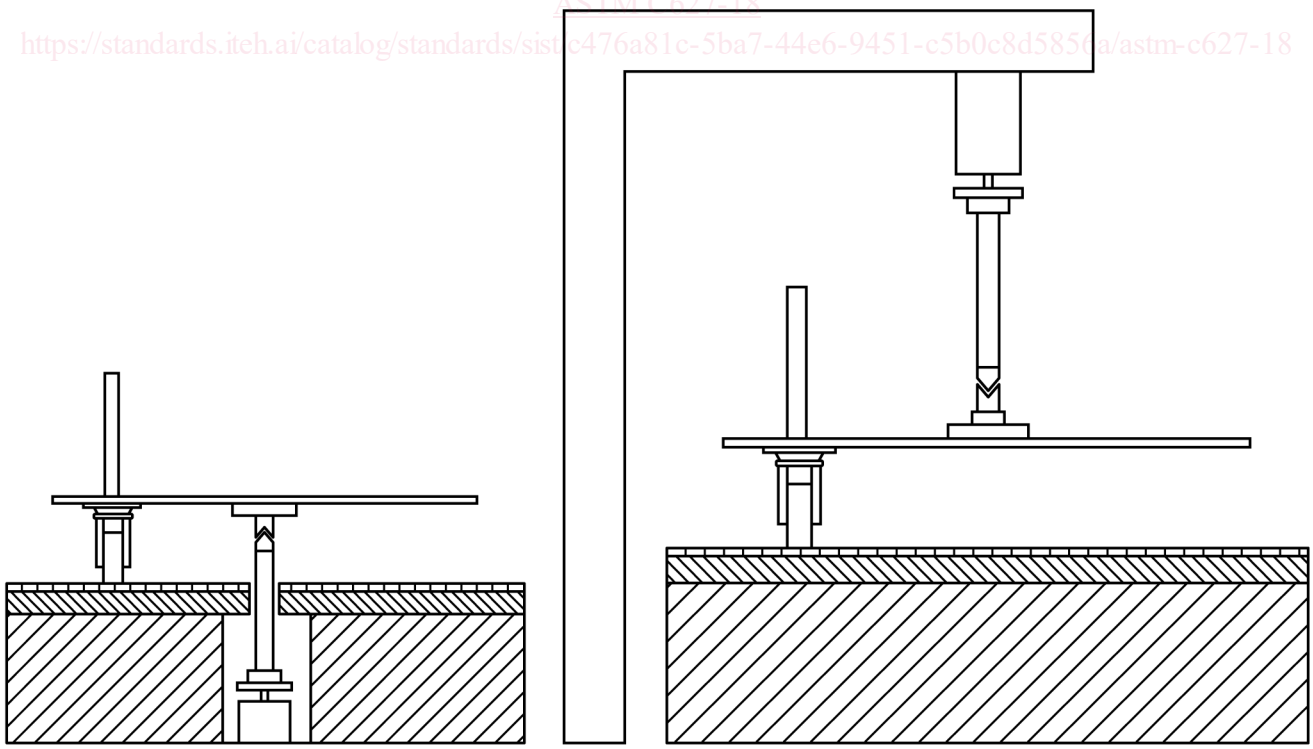


FIG. 1 Bottom- and Top-Driven Floor Tile Installations Systems ~~Tester~~Testers (Not to Scale)

and the elevation of the carriage are free to accommodate various types of test ~~slabs. The carriage shall rotate at the rate of 15 ± 0.5 rpm.~~ assemblies. The drive shaft (whether top or bottom driven tester) shall be equipped with a universal joint between the driveshaft and carriage to allow contact between the wheels and test panel at all times.

5.4 *Revolution Counter or Timer*—A revolution counter, capable of recording up to 1000 revolutions, or an automatic timing device which can be present to stop the tester.

5.5 *Wheels*—The wheels shall be attached to swivel casters with removable axles, equipped with grease fittings. ~~They shall be 4 in.~~All casters shall be of ball bearing contruction. The wheels shall be 4 ± ⅛ in. (102 ± 3 mm) in diameter and ~~have a~~ 1⅜ ± 1/16-in. ~~bearing surface. Three different sets of three wheels each are required, namely one set with a soft rubber bearing surface of 78 ± 3 Shore A durometer hardness, one set with hard rubber bearings surface of 80 ± 3 Shore D durometer hardness, and one set with steel bearing surface. All casters shall be of ball bearing construction.~~(35 ± 1.6 mm) in width. The wheels shall be equipped with roller or ball bearings. Three sets of three wheels each are required, namely:

5.5.1 One set of soft rubber wheels with a 78 ± 3 Shore A durometer hardness[5],

5.5.2 One set of hard rubber wheels with a 80 ± 3 Shore D durometer hardness[5], and

5.5.3 One set of steel wheels with a steel surface. The surface of the steel wheel shall be curved in such a way that the radius in the center is greater than the radius on the edge by approximately 3/128 in. (0.6 mm). See Fig. 2.

5.6 *Weights*—~~Thirty 25-lbs (11.5-kg) or fifteen 50-lbs (23-kg)~~ 750-lbs (340 kg) of auxiliary weights are required. Weights may be of any size or shape so long as they meet the requirements found in 5.2 and the loading schedule found in Table 1. Thirty 25-lb (11.5-kg) disk-shaped, 11-in. (280-mm) diameter bar bell weights ~~with 1~~have been~~¼-in. (32-mm) diameter center openings to fit the 1-in. diameter rods over each wheel are required.~~ known to work. Accuracy of the weights shall be ~~±1 %.~~ ±2 %.

5.7 *Deflection ~~Gage~~—Gauge (optional)*—A ~~jig, equipped with a dial indicator reading in 0.001 in. (0.025 mm) for insertion~~ gauge accurate to 0.001 in. (0.025 mm) which may be inserted between the upper and lower sheet of a plywood base to measure the deflection of the base under the path of the wheels. ~~An assembly drawing is shown in Fig. 2.~~

~~5.7 *Revolution Counter*—A revolution counter, capable of recording up to 1000 revolutions, mounted on the carriage and tripped once each turn by a "finger" mounted on the foundation.~~

~~5.8 *Timer*—An automatic timing device which can be preset to stop the tester and activate a bell alarm after a given time.~~

6. Test Panel Assemblies

6.1 The base upon which the tile are installed, the bonding medium, the type of tile mountings, the type of grout, and the type of tile used may be varied with the requirements of the test.

6.1.1 *Mortar Base for Portland Cement Installations*—A recommended mortar base panel for portland cement installations may be cast without reinforcements into a 2-in. (51-mm) thick ~~regular octagon, measuring 4 ft (1220 mm) from side to side,~~square with minimum dimensions of 4- by 4-ft (1220- by 1220-mm), from a mortar mix consisting of six parts by weight of dry sand, clean and graded (see Specification C144) and one part by weight of portland cement (Type I of Specification C150), with enough potable water to make a relatively dry mortar which, when stroked with a trowel, gives a smooth, slick appearance. ~~One~~ Up to four one half-inch (12.7-mm) diameter, 11-in. (280-mm) long sections of ~~pipe, centered and~~ pipe or metal rod, projecting about 5 in. (127 mm), may be horizontally cast into alternate sides of the ~~octagon~~panel to serve as lifting ~~handles for the panel. A~~handles. An opening up to 6-in. (152-mm) square ~~opening~~ may be cast or cut in the center of the ~~octagon admits~~ mortar base panel to permit entry of the drive shaft ~~of the tester.~~ for bottom driven testers. For conventional-type installation methods, the tile shall be set before the mortar hardens. After ~~proper curing,~~ curing in accordance with the recommendation of the manufacturer or supplier of the product(s) being tested, such a panel is set in place on the foundation of the testing machine with ~~a weak~~ an easily removable plaster. A polyethylene sheet shall be laid between the foundation of the tester and the plaster, so that the mortar-base test panel can be easily removed after completion of the test. A plaster mix of ten parts by weight of dry sand, clean and graded (Specification C144) and one part by weight of gypsum plaster with enough ~~potable~~ water to make a fairly thick slurry has been found satisfactory. Construction details for such a panel are shown in Fig. 3.

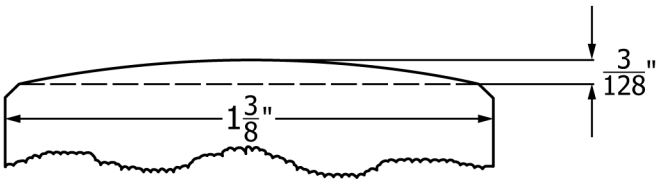
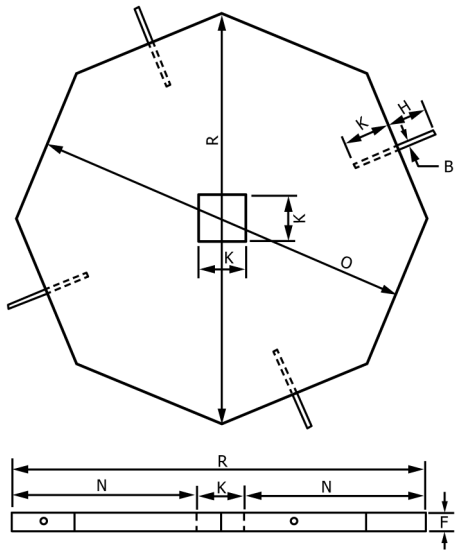


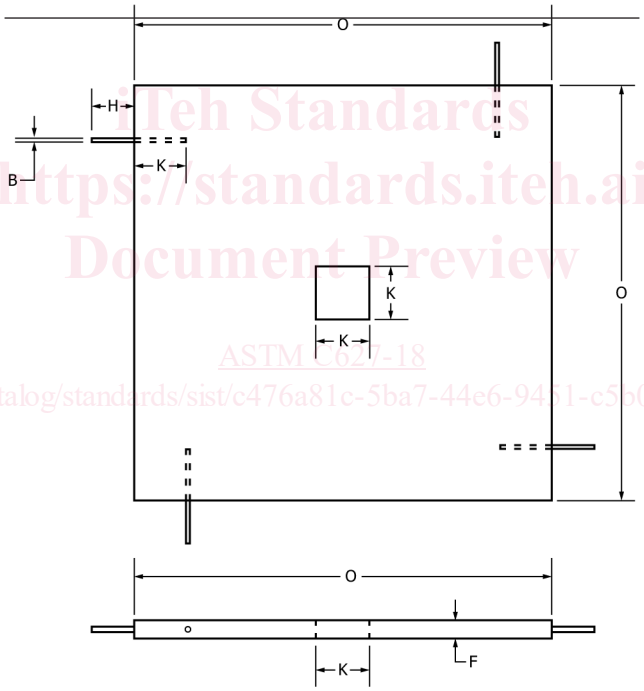
FIG. 2 ~~Deflection Gage (Not to Scale)~~Steel Wheel Surface Profile

[5] The wheels must be conditioned at 73.4 ± 3.6°F (23 ± 2°C) for a minimum of 24 hours prior to measuring the durometer hardness. Shore A and Shore D durometer hardness measurements shall be taken in the center of the wheel width prior to the wheel being placed into service on each test panel.



~~Dimension Table~~

~~Key~~	~~in.~~	~~mm~~



Dimension Table

Key	in.	mm
B (optional)	½	12.7
~~F~~	~~2~~	~~50.8~~
F	2	50.8
~~H~~	~~5~~	~~127.0~~
H (optional)	5	127.0
~~K~~	~~6~~	~~152.4~~
K (optional)	6	152.4
~~N~~	~~23~~	~~584~~
O	48	1219
~~R~~	~~52~~	~~1321~~

FIG. 3 Concrete Base Panel (Not to Scale)

6.1.2 *Concrete Base for Thin-Bed Installations*—The size and construction of such a concrete base shall be the same as that described under ~~6.1~~6.1.1, except that the concrete mix shall consist of three parts of gravel not over ¾ in. (19 mm) in size, two and one-half parts of dry sand, clean and graded (Specification C144), one part of portland cement (Type I of Specification C150) and one part of potable water, all parts by weight. ~~The~~ Unless otherwise specified, the concrete base panel shall be cured for at least seven days before the installation of tile. The concrete base is set in place on the foundation of the tester with plaster as described in 6.1.1.

6.1.3 *Plywood Base for Installations*—The plywood base shall be ~~4 ft (1220 mm) square and~~ of sandwich construction. For maximum stiffness, the plywood face grain direction should be installed so as to run perpendicular to the floor joist or supports. The top shall consist of two sections of ~~19/32-in. tongue and groove plywood (or as otherwise specified)~~ plywood of thickness specified by the manufacturer or supplier of the product(s) being tested such that the joint between the two sections runs perpendicular to the joists and tangential to the center of the wheel ~~path (wheels are 1~~path. runs perpendicular to ~~⅜-in. wide). The~~ the joists and tangential to the center of the wheel path. The joint between the two sections of plywood shall be finished per the recommendation of the manufacturer or supplier of the product(s) being tested. The bottom shall be a minimum ¼-in. (6.4-mm) plywood. In between the top and bottom of the panel on 16-in. (406-mm) centers, shall be four ~~1⅝-in. (41.4-mm) square and~~ 4-ft (1220-mm) long sections of wood which are nominally 2 in. (50 mm) wide (2 by 2 in. [50 by 50 mm] or 2 by 4 in. [50 by 100 mm] lumber) to duplicate the support rendered by joists in an actual installation. ~~There shall be a~~An opening up to 6-in. (152-mm) square ~~opening~~ may be cut in the center of the panel to permit entry ~~to the testing machine drive shaft. Such a panel shall be set in place on the foundation of the testing machine with plaster as described in~~of the drive shaft for bottom driven testers. For ~~5.1, but a polyethylene sheet shall also be~~details of construction of such a panel see Fig. 4~~used between the plywood base and the plaster to keep moisture out of the wood. The panel shall be held in place on the foundation of the testing machine with four bolts, one at each corner. The bolts fit into the "Star Tamp-Ins" cast into the foundation and secure the lower~~. The panel should be reasonably secured to not allow movement of the panel during testing.~~¼-in. (6.4-mm) plywood sheet of the sandwich construction to the foundation. Two-inch (50.8-mm) diameter holes may be drilled into the top of the plywood sandwich, directly above the four bolts, to permit access to them. For details of construction of such a panel see Fig. 4.~~

6.1.3.1 *Plywood Base with Panel-Type or Sheet-Type Underlayment*—If a panel-type underlayment (for example, backerboard) or a sheet-type underlayment (for example, sheet membrane) is to be installed atop the plywood base, it shall consist of two sections such that the joint between the two sections runs parallel to the joists and tangential to the center of the wheel ~~path (wheels are 1~~path. The installation of ~~⅜-in. wide). A~~ the two sections of underlayment atop the plywood base and the preparation of the joint between the two sections of underlayment shall be finished in accordance with the recommendation of the manufacturer or supplier of the product(s) being tested. An opening up to 6-in. (152-mm) square ~~opening~~ may be cut in the center of the underlayment ~~shall align directly with the~~ and plywood base to permit entry ~~to~~of the ~~testing machine drive shaft.~~ drive shaft for bottom driven testers. See Fig. 5 for an illustration.

6.1.4 *Composition Base for Installations*—The construction of the composition base panel shall be identical to that of the plywood ~~base,~~ base outlined in 6.1.3, except that the top of the panel consists of composition board or other panel-type sheeting material as ~~specified.~~ specified by the manufacturer or supplier of the product(s) being tested. The same method shall be used to set the composition base on the foundation of the machine ~~and to fasten it to the foundation~~ as outlined in 6.1.3.

7. Testing Procedure

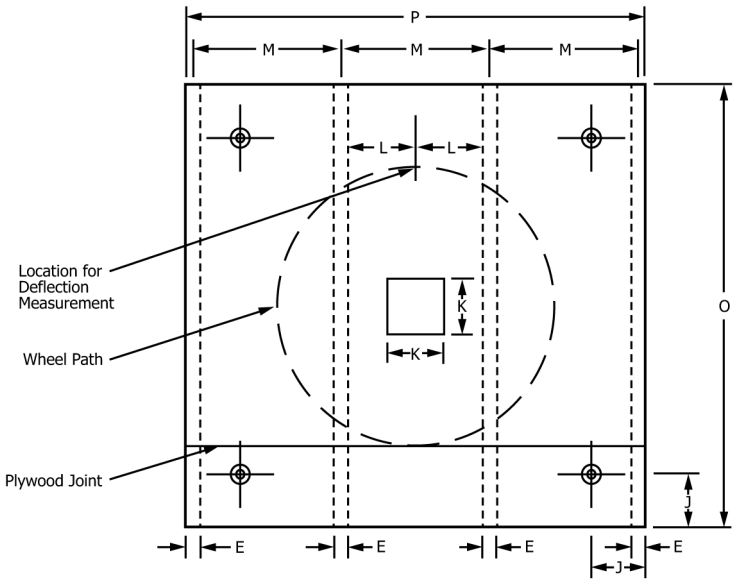
7.1 Prepare a test panel assembly using the required base in accordance with the instructions given in 6.1.1, 6.1.2, 6.1.3, or 6.1.4 and install upon such a panel the type of floor tile by the method that is to be evaluated. A minimum of four grout joints shall be within the wheel path for each installation to be evaluated.

7.2 After curing of the panel in accordance with the recommendation of the manufacturer or supplier of the product(s) being tested, mount the test panel on the foundation of the testing machine in accordance with the instructions given for the type of panel used.

7.3 ~~Prepare a test panel assembly using the required base in accordance with the instructions given in 6.1.1, 6.1.2, 6.1.3, or 6.1.4 and install upon such a panel the type of floor tile by the method that is to be evaluated. After proper curing of the panel, mount the test panel on the foundation of the testing machine in accordance with the instructions given for the type of panel used.~~ Install soft rubber wheels on the machine and place the necessary weights over each wheel to obtain the weight per wheel specified for each cycle as given in Table 1. Be sure to take into consideration that the weight of the 150-lbs (68.1-kg) carriage is distributed so that each wheel is automatically loaded with 50 lbs (23 kg). Therefore, subtract 50 lbs from the weight specified in the column "Total Weight per Wheel." ~~Inspect the wheels for deterioration after each cycle and replace as necessary, discarding any rubber wheels which show evidence of fatigue (radial cracks). Change the type of wheels whenever indicated by the next test cycle. Set the timer for the period called for in the particular cycle, set the revolution counter to zero, and start the tester. Depending upon the type of installation for which the test panel is evaluated, either all or only a certain number of the test cycles may be performed.~~

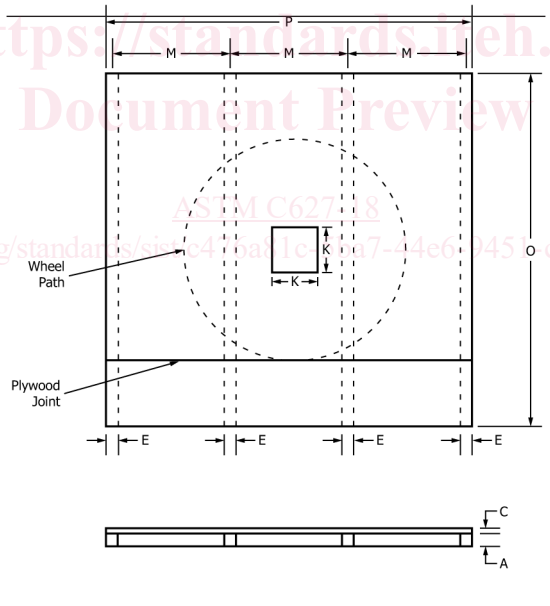
7.3.1 Inspect the wheels for deterioration after each cycle and replace as necessary.

7.3.1.1 Discard any rubber wheels which show evidence of fatigue (radial cracks), if the diameter of the wheel falls below 3⅞ in. (98 mm), or if damage occurs to the wheel which could result in catastrophic damage to the test assembly or equipment.



~~Dimension Table~~

~~Key~~	~~in.~~	~~mm~~



Dimension Table

Key	in.	mm
A	¼	6.35
~~G~~	~~⅝~~	~~15.88~~
C	As specified by the manufacturer or supplier of the product(s) being tested	
~~D~~	~~¾~~	~~19.05~~
E	1⅝	41.28
~~F~~	~~2~~	~~50.8~~
~~G~~	~~2½~~	~~63.5~~
~~H~~	~~5~~	~~127.0~~
~~J~~	~~5 13/16~~	~~147.6~~
~~L~~	~~8~~	~~203.2~~
M	16	406
O	48	1219
P	49⅝	1261