



Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester¹

This standard is issued under the fixed designation C 627; 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 evaluation of ceramic floor tile installation systems, using the Robinson²-type floor tester.

1.2 This test method is intended solely for evaluating complete ceramic floor tile installation systems for failure under 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

C 144 Specification for Aggregate for Masonry Mortar³

C 150 Specification for Portland Cement⁴

3. Summary of Test Method

3.1 This test method consists of preparing installation slabs 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.

5. Apparatus

5.1 *Foundation for Tester*—The foundation for the tester shall consist of a nominally 4-ft (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 12½-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 surface of this slab shall be smooth, level, and flat with the maximum deviation from a true plane not to exceed ⅓ 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 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 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 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 3⅜-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 250 lbs (113.5 kg) of auxiliary weights to 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

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² Developed at the Research Center of the Tile Council of America, Inc. Detailed working drawings of the apparatus are available at a nominal cost from ASTM Headquarters. Order Adjunct No. ADJC062701.

³ *Annual Book of ASTM Standards*, Vol 04.05.

⁴ *Annual Book of ASTM Standards*, Vol 04.01.

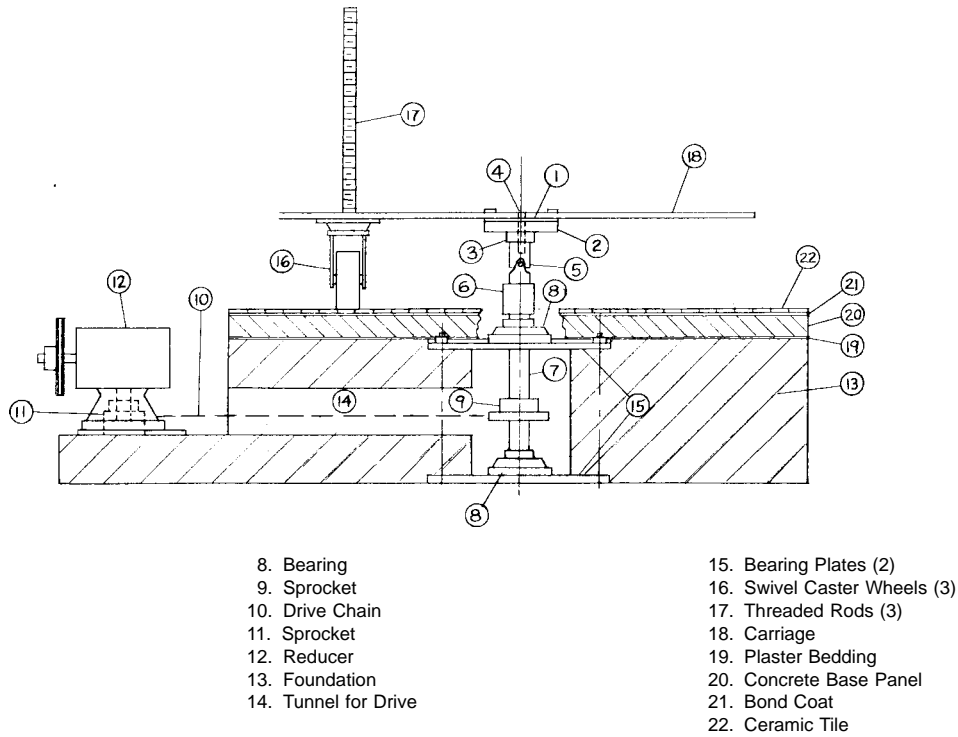


FIG. 1 Floor Tile Installations Systems Tester (Not to Scale)

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 into the steel plate, equally distributed along the three sides of the triangle, to reduce the weight. A cutaway diagram of the apparatus is shown in Fig. 1.²

5.3 *Drive*—The tester shall be driven by a $\frac{3}{4}$ -hp motor and speed reducer. Drive transmittal shall be arranged in such a manner that the plane of travel 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.

5.4 *Wheels*—The wheels shall be swivel casters with removable axles, equipped with grease fittings. They shall be 4 in. in diameter and have a $\frac{1}{2}$ -in. bearing surface. Three different sets of three wheels each are required, namely one set with a soft rubber bearing surface of 70 ± 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.⁵

5.5 *Weights*—Thirty 25-lbs (11.5-kg) or fifteen 50-lbs (23-kg) disk-shaped, 11-in. (280-mm) diameter bar bell weights with $\frac{1}{4}$ -in. (32-mm) diameter center openings to fit the 1-in.

diameter rods over each wheel are required. Accuracy of the weights shall be $\pm 1\%$.

5.6 *Deflection Gage*—A jig, equipped with a dial indicator reading in 0.001 in. (0.025 mm) for insertion 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. 2.⁶

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, from a mortar mix consisting of six parts by weight of dry sand, clean and graded (see Specification C 144) and one part by weight of portland cement (Type I of Specification C 150), with enough potable water to make a relatively dry mortar which, when stroked with a trowel, gives a smooth, slick

⁵ Wheels meeting these specifications may be obtained from Albion Industries, Inc., Albion, MI, and Bond Foundry & Machine Co., Manheim, PA..

⁶ Detailed working drawings for construction of the deflection gage are available at nominal cost from ASTM Headquarters. Order Adjunct No. ADJC062702.

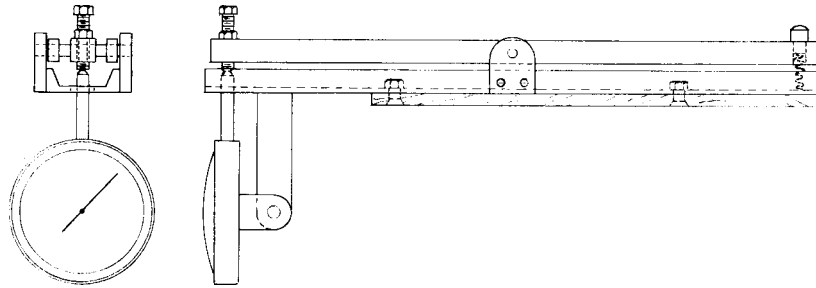


FIG. 2 Deflection Gauge (Not to Scale)

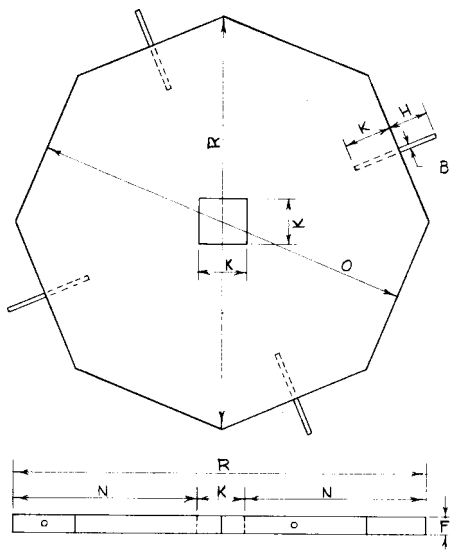
appearance. One half-inch (12.7-mm) diameter, 11-in. (280-mm) long sections of pipe, centered and projecting about 5 in. (127 mm), may be horizontally cast into alternate sides of the octagon to serve as lifting handles for the panel. A 6-in. (152-mm) square opening in the center of the octagon admits the drive shaft of the tester. For conventional-type installation methods, the tile shall be set before the mortar hardens. After proper curing, such a panel is set in place on the foundation of the testing machine with a weak 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 C 144) 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.

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, except that the concrete mix shall consist of three parts of gravel not over 3/4 in. (19 mm) in size, two and one-half parts of dry sand, clean and graded (Specification C 144), one part of portland cement (Type I of Specification C 150) and one part of potable water, all parts by weight. 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 be 5/8-in. (16-mm) plywood (or as otherwise specified) and the bottom shall be 1/4-in. (6.4-mm) plywood. In between the top and bottom of the panel on 16-in. (406-mm) centers, shall be four 1 5/8-in. (41.4-mm) square and 4-ft (1220-mm) long sections of wood to duplicate the support rendered by joists in an actual installation. There shall be a 6-in. (152-mm) square opening 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 5.1, but a polyethylene sheet shall also be 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 1/4-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.

6.1.4 *Composition Base for Installations*— The construction of the composition base panel shall be identical to that of the plywood base, except that the top of the panel consists of composition board or other sheeting material as specified. 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.



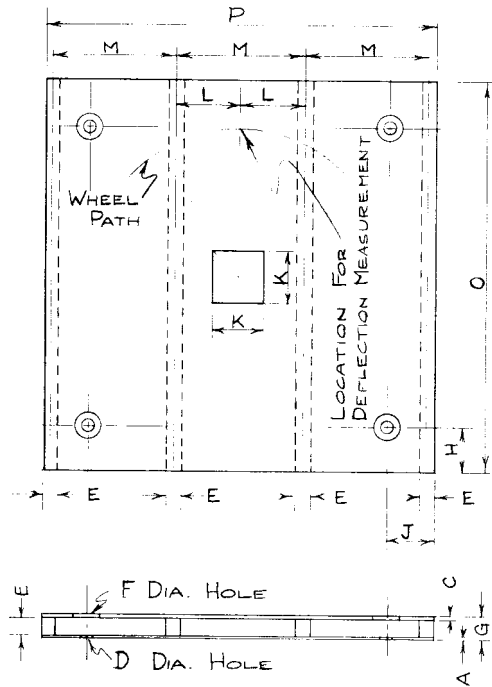
Dimension Table

Key	in.	mm
B	1/2	12.7
F	2	50.8
H	5	127.0
K	6	152.4
N	23	584
O	48	1219
R	52	1321

FIG. 3 Concrete Base Panel (Not to Scale)

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. After proper curing of the panel, mount the test panel on the foundation of the testing machine



Dimension Table

Key	in.	mm
A	1/4	6.35
C	5/8	15.88
D	3/4	19.05
E	1 5/8	41.28
F	2	50.8
G	2 1/2	63.5
H	5	127.0
J	5 13/16	147.6
L	8	203.2
M	16	406
O	48	1219
P	49 5/8	1261

FIG. 4 Plywood Base Panel (Not to Scale)

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

TABLE 1 Loading Schedule for Testing

Cycle	Type of Wheels	Total Weight per Wheel lbs (kg)	Duration of Test, h	Total Number of Revolutions
1	soft rubber	100 (45)	1	900
2	soft rubber	200 (91)	1	900
3	soft rubber	300 (136)	1	900
4	soft rubber	300 (136)	1	900
5	hard rubber	100 (45)	1	900
6	hard rubber	200 (91)	1	900
7	hard rubber	300 (136)	1	900
8	hard rubber	300 (136)	1	900
9	steel	50 (23)	1/2	450
10	steel	100 (45)	1/2	450
11	steel	150 (68)	1/2	450
12	steel	200 (91)	1/2	450
13	steel	250 (114)	1/2	450
14	steel	300 (136)	1/2	450

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.

8. Recording Damage

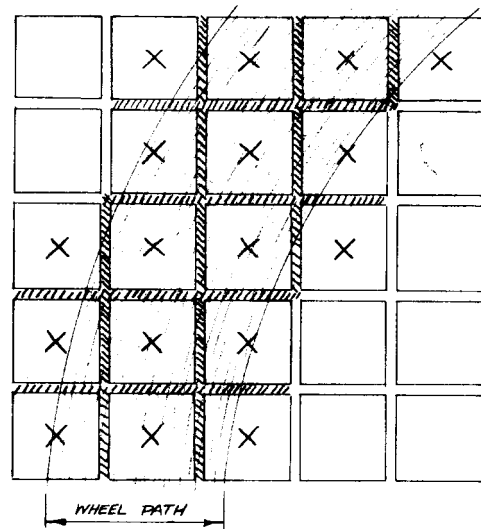
8.1 The record of damage to the installation shall include only the damage to tile contacted by the wheels and the damage to grout joints contacted by the wheels. There are four grout joints surrounding each tile. Fig. 5 shows how tile and grout joints are to be counted for evaluation of the test. Cumulative tile and grout damage shall be recorded as seen at the end of each cycle, without regard at what stage the damage may have occurred. Inspection of the wheel path may be done with the aid of a hand held light source. The following types of damage shall be counted and recorded as number of tile or joints showing damage, including a record if none are damaged in that particular category.

8.1.1 *Chipped Tile*—A tile damaged only on the surface or edge with no cracks passing further than one tile thickness from the edge of the tile.

8.1.2 *Broken Tile*—A tile separated into two or more pieces by a crack or cracks passing through the center area of the tile, that is, within the area farther than one tile thickness from the tile edges.

8.1.3 *Loose Tile*—A tile that sounds hollow, in whole or in part, when tamped with a metal object of a weight approximately equal to the weight of the tile, or which is obviously free of the setting adhesive or mortar.

8.1.4 *Popped-Up Grout Joint*—A grout joint or part of a grout joint that is loose from the installation and is clearly still a solid particle of grout.



NOTE 1—17 tiles in the wheel path; 24 grout joints in the wheel path
FIG. 5 Example of How Tile and Grout Joints are Counted

8.1.5 *Cracked Grout Joint*—A grout joint that shows or has shown an obvious crack parallel or perpendicular to its length, before or after the start of the test. Once a grout joint is counted as cracked it continues to be counted as cracked no matter what else happens to it; therefore, cracked grout joints must be marked as they are counted to keep track of them if they become popped-out or powdered. Do not count a crack unless quite sure that it exists.

8.1.6 *Powdered Grout Joints*—A grout joint that has, after the wheel path has been brushed free of debris, clearly lost a part of itself, but which could not be or has not been classified as popped-up. The wheel path should be brushed only after the presence or absence of the other types of damage have been established.

8.1.7 In tests involving plywood or composition board bases, the deflection of the top sheet of the sandwich construction midway between supporting joints is measured to the nearest 0.001 in. (0.025 mm), by observing the maximum deflection of the needle of the dial indicator when a wheel passes over the spot where the deflection gage is installed.

9. Report

9.1 Report the following information:

9.1.1 Type of base construction,

9.1.2 Type of tile used and type of mounting (if any),

9.1.3 Detailed description of the installation method used, giving bonding medium, grouting composition, and other pertinent data,

9.1.4 Number of test cycles performed, including the length of time for the last cycle if the test had to be stopped before its completion,

9.1.5 Complete statement for each cycle as to condition of the installation, with number and type of failures to tile and grout,

9.1.6 Deflection of plywood or composition board under the load (where applicable), and

9.1.7 Highest number of the test cycle the installation passed.

10. Evaluation

10.1 It is the primary objective of this method to establish the highest number of the cycle that the installation under test survives; therefore, criteria for failure based on the number of tile or joints damaged in each category (8.1.1-8.1.6) have been established.

10.2 An installation shall be considered to have failed to pass any cycle in which the cumulative total number of failures to tile or grout in any one of the following categories exceeds the amount stated:

10.2.1 *Chipped Tile*—5 % of the tile in the wheel path or one tile, whichever is greater.

10.2.2 *Broken Tile*—3 % of the tile in the wheel path or one tile, whichever is greater.

10.2.3 *Loose Tile*—3 % of the tile in the wheel path or one tile, whichever is greater.

10.2.4 *Popped-Up Grout Joint*—5 % of the joints in the wheel path or one joint, whichever is greater.

10.2.5 *Cracked Grout Joint*—5 % of the joints in the wheel path or one joint, whichever is greater.

10.2.6 *Powdered Grout Joints*—5 % of the joints in the wheel path or one joint, whichever is greater.

11. Precision and Bias

11.1 This is a pass or fail method, therefore a precision and bias statement is not applicable.

12. Keywords

12.1 ceramic floor tile installation systems; Robinson-type floor tester

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