

**VEHICULAR PAVER SPECIFICATION**

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There is often misunderstanding on what type of paving units are required for applications with truck traffic. Project specifiers will often mistakenly assume that C1272 paving units are required on all applications with any truck traffic. This is not always true. In many instances C902 paving units will meet the project requirements.

The standard for Heavy Vehicular Paving Brick ASTM C-1272 is intended for paving applications which receive a combination of both heavy vehicles **and** heavy volume. In order to make the intended scope of this standard more clear the ASTM Task Group for paving has recently revised the standard to more accurately define heavy vehicular traffic.

The current standard requires the use of heavy vehicular pavers only when traffic volume exceeds 251 daily equivalent single axle loads (ESAL). An ESAL, as defined by the American Association of State Highway and Transportation Officials (AASHTO) represents the passage of an axle of any mass (load) by a number of 18,000-pound equivalent axle loads. Axle loads from specific vehicles such as passenger car or a semi-tractor trailer are converted to ESAL's using an equivalency factor (EF).

The following is an example for a two-lane flexible pavement in an urban area with daily traffic levels that would represent an ESAL level of 250.

<u>Vehicle Type</u>	<u>Daily Traffic</u>	<u>EF</u>	<u>ESAL</u>
Cars	10,000	0.0008	8
Pickups	350	0.013	4.5
Buses	170	0.69	117.3
Delivery Trucks	50	1.48	74
Semi-Trucks	20	2.31	46.2
ESAL			250

The actual equivalency factors and above computations would vary depending on the specific parameters of a project such as serviceability and structural design requirements, frost and drainage considerations but the example serves to illustrate typical daily traffic volumes corresponding to an ESAL of 250.

**ASTM Specifications**

ASTM C 936 Standard Specification for Solid Concrete Interlocking Paving Units

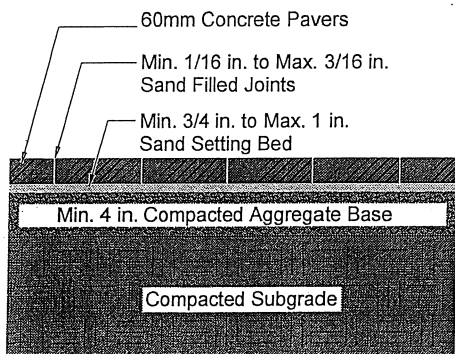
**Physical Property Requirements**

Compressive Strength	8,000 psi
Absorption	5% Max Avg. 7% Max Individual Unit
Minimum Thickness	60mm

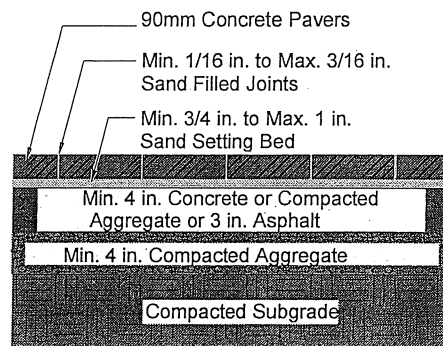
**Dimensional Tolerances**

Length	± 1/16"
Width	± 1/16"
Height	± 1/8"

**Recommended Paving Design Sections**



Typical Residential Patio or Walkway



Typical Residential Driveway

(Note: For more applications / details visit the General Shale website [www.generalshale.com](http://www.generalshale.com) Technical Resource section.)

### Aggregates

Base Stone  
ASTM D 2940  
DOT Road Base

Sand – Setting Base  
ASTM C 33  
Course Concrete Sand

Sand - Jointing  
ASTM C 144  
Masonry Sand  
(Use after initial compaction  
with concrete sand)

### Drainage

Slope surface a minimum of 1/4" per foot (2% slope) for adequate water run-off and drainage.

### Geotextile

Prevents aggregates from mixing or migrating into base. Recommended for soft clay base materials.

### Cutting Pavers

Wet saw is recommended; splitters are okay for smaller jobs.

### Estimating Materials

#### Sub Base Aggregate

3/4" crusher run. For every 100 sq. ft. of area figure 2 tons material for 4" thick base.

#### Setting Sand / Bed Sand

For every 125 sq. ft. of area figure 1 ton of sand for jointing and 1" thick setting bed.



## Standard Specification for Pedestrian and Light Traffic Paving Brick<sup>1</sup>

This standard is issued under the fixed designation C 902; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope\*

1.1 This specification covers brick intended for use as paving material subjected to pedestrian and light vehicular traffic. The units are designed for use in pedestrian applications and vehicular areas that are subjected to low volumes of vehicular traffic, such as residential driveways and streets and commercial driveways (passenger drop-offs). The units are not intended to support heavy vehicular traffic covered by Specification C 1272 or for industrial applications covered by Specification C 410.

NOTE 1—Heavy vehicular traffic is defined as high volumes of heavy vehicles (trucks having 3 or more axles) in Specification C 1272.

1.2 The property requirements of this specification apply at the time of purchase. The use of results from testing of brick extracted from masonry structures for determining conformance or nonconformance to the property requirements (Section 4) of this specification is beyond the scope of this specification.

1.3 Brick are manufactured from clay, shale, or similar naturally occurring earthy substances and subjected to a heat treatment at elevated temperatures (firing). The heat treatment must develop sufficient fired bond between the particulate constituents to provide the strength and durability requirement of this specification (see firing, fired bond, and incipient fusion in Terminology C 43).

1.4 The brick are available in a variety of sizes, colors, and shapes. They are available in three classes according to exposure environment and three types according to type of traffic exposure.

1.5 The values stated in inch-pound units are to be regarded as the standard.

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

C 43 Terminology of Structural Clay Products

C 67 Test Methods for Sampling and Testing Brick and Structural Clay Tile

C 88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

C 410 Specification for Industrial Floor Brick

C 418 Test Method for Abrasion Resistance of Concrete by Sandblasting

C 1272 Specification for Heavy Vehicular Paving Brick

### 3. Classification

3.1 Light traffic paving brick are classified according to the severity of their use-environment. Two types of environment are considered: (1) weather and (2) traffic:

#### 3.1.1 Weather:

Weathering resistance is specified by one of three classes. When the Class is not specified, the requirements for Class SC shall govern.

3.1.1.1 Class SX—Brick intended for use where the brick may be frozen while saturated with water.

3.1.1.2 Class MX—Brick intended for exterior use where resistance to freezing is not a factor.

3.1.1.3 Class NX—Brick not intended for exterior use but which may be acceptable for interior use where protected from freezing when wet.

NOTE 2—A surface coating may be applied to any class of brick of this standard when protected from freezing while wet. The function of the coating is to prevent penetration of dirt or liquids into the pores of the brick. Coatings should be applied only after complete drying of the paving.

#### 3.1.2 Traffic:

Abrasion resistance is specified by one of three types. When the Type is not specified, the requirements for Type II govern.

3.1.2.1 Type I—Brick subjected to extensive abrasion.

NOTE 3—Type I pavers would be used in such places as sidewalks and driveways in publicly occupied spaces.

3.1.2.2 Type II—Brick subjected to intermediate abrasion.

NOTE 4—Type II pavers would be used in such places as heavily traveled residential walkways and residential driveways.

3.1.2.3 Type III—Brick subjected to low abrasion.

NOTE 5—Type III pavers would be used in such places as floors or patios in single-family homes.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee C15 on Manufactured Masonry Units and is the direct responsibility of Subcommittee C15.02 on Brick and Structural Clay Tile.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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.

**TABLE 1 Freeze Thaw Resistance Property Requirements**

Designation	Compressive Strength, flatwise, gross area, min, psi (MPa)		Cold Water Absorption, max, %		Saturation Coefficient, max <sup>A</sup>	
	Average of 5 Brick	Individual	Average of 5 Brick	Individual	Average of 5 Brick	Individual
Class SX	8000 (55.2)	7000 (48.3)	8.0	11.0	0.78	0.80
Class MX	3000 (20.7)	2500 (17.2)	14.0	17.0	no limit	no limit
Class NX	3000 (20.7)	2500 (17.2)	no limit	no limit	no limit	no limit

<sup>A</sup> The saturation coefficient is the ratio of absorption by 24-h submersion in room temperature water to that after 5-h submersion in boiling water.

#### 4. Physical Properties

4.1 *Freeze Thaw Resistance*—Use one of the following methods:

4.1.1 *Physical Property Requirements*—The brick shall conform to the physical requirements for the class specified as prescribed in Table 1.

4.1.1.1 *Absorption Alternative*—If the average water absorption is less than 6.0 % after 24-h submersion in room-temperature water, the requirement for saturation coefficient shall be waived.

4.1.2 *Freezing and Thawing Test Alternative*—The requirements for water absorption (24-h cold) and saturation coefficient specified in 4.1.1 shall be waived provided a sample of five brick, meeting all other requirements, passes the freezing and thawing test as described in the Rating section of the Freezing and Thawing procedures of Test Methods C 67 with no breakage and not greater than 0.5 % loss in dry weight of any individual unit.

NOTE 6—The 50 cycle freezing and thawing test is specified only as an alternative when brick do not conform to either Table 1 requirements for maximum water absorption and saturation coefficient, or to the restrictive absorption requirements in 4.1.1.1.

4.1.2.1 *Sulfate Soundness Test Alternative*—The requirements for water absorption (24-h cold) and saturation coefficient specified in 4.1.1 shall not be required if a sample of five brick survives 15 cycles of the sulfate soundness test in accordance with Sections 4, 5, and 8 of Test Method C 88 with no visible damage.

NOTE 7—The sulfate soundness test is an optional substitute test for the freezing-and-thawing test (4.1.2).

4.1.3 *Performance Alternative*—If information on the performance of the units in a similar application of similar exposure and traffic is furnished by the manufacturer or his agent and is found acceptable by the specifier of the pavement material, or his agent, the physical requirements in 4.1.1 may be waived.

4.1.4 *Molded Brick (Soft Mud, Semi-Dry Pressed, and Dry Pressed Brick)*—The requirements listed in Table 1 shall be changed for molded brick to permit maximum absorption of 16.0 % average and 18.0 % individual, and minimum compressive strengths of 4000 psi (27.6 MPa) average and 3500 psi (24.1 MPa) individual for Class SX, provided that the requirements for saturation coefficient of Table 1 are met.

NOTE 8—The resistance of brick to weathering cannot be predicted with complete assurance at the present state of knowledge. There is no known test that can predict weathering resistance with complete accuracy.

Brick in general is superior in weathering resistance to other building materials. There are innumerable instances of satisfactory performance beyond 200 years and even into the thousands of years. Nevertheless,

there are some brick that cannot survive a few winters of a severe freezing and thawing environment.

The durability requirements of the specification attempt to exclude such brick. This specification utilizes the best knowledge available at this time and is based on extensive research by several investigators. The durability requirements have an excellent correlation with in-use performance. Nevertheless, it is known that some brick that meet this specification may not be serviceable in severe climates. Furthermore, other brick that do not meet these specifications may show superior serviceability in the most severe climate. The best indication of brick durability is its service experience record.

4.2 *Abrasion Resistance*—The brick shall meet the requirements of either column (1) or (2) of Table 2 for the applicable traffic use (see 3.1.2).<sup>3</sup>

NOTE 9—Skid/slip resistance should be considered by the purchaser for uses of brick where pedestrian traffic is anticipated. Methods of testing this characteristic are under study and it is hoped that a specification for this property can be added in future revisions of this standard when suitable test methods are developed.

#### 5. Efflorescence

5.1 Brick are not required to be tested for efflorescence to comply with this specification unless requested by the specifier or purchaser. When the efflorescence test is requested by the specifier or purchaser, the brick shall be sampled at the place of manufacture, and tested in accordance with Test Methods C 67, and a rating for efflorescence shall be “not effloresced.” If the rating for efflorescence is “effloresced,” the brick represented by the testing do not meet the efflorescence requirements of this specification.

#### 6. Size and Tolerances

6.1 The size of the brick shall be as specified by the purchaser or produced by the manufacturer as a stock item.

6.2 The tolerances on dimension and warpage shall depend on the application specified. When the application is not specified, the requirements for Application PS shall govern.

6.2.1 *Application PS*—Paving brick intended for general use and installed with a mortar joint between individual units, or in an installation without mortar joints between units when they are laid in running or other bonds not requiring extremely close dimensional tolerances.

6.2.2 *Application PX*—Paving brick intended for installation without mortar joints between the units, where exceptionally close dimensional tolerances are required as a result of special bond patterns or unusual construction requirements.

<sup>3</sup> McBurney, J. W., Brink, R. H., Eberle, A. R., “Relation of Water Absorption and Strength of Brick to Abrasive Resistance,” *Proceedings, ASTM*, Vol 40, 1940, pp. 1143–1151.

**TABLE 2 Abrasion Resistance Property Requirements<sup>A</sup>**

	(1) Abrasion Index, <sup>B</sup> max	(2) Volume Abrasion Loss, <sup>C</sup> max, cm <sup>3</sup> /cm <sup>2</sup>
Type I	0.11	1.7
Type II	0.25	2.7
Type III	0.50	4.0

<sup>A</sup> Select the sample according to the sampling procedure of Test Methods C 67. The brick shall meet the requirements of either column (1) or (2). The values listed shall not be exceeded by any individual unit within the sample.

<sup>B</sup> The abrasion index is calculated from the cold absorption in percent and the compressive strength in pounds per square inch as follows:

$$\text{Abrasion index} = \frac{100 \times \text{absorption}}{\text{compressive strength}} \quad (1)$$

Compressive strength values are influenced by specimen shape (particularly the height to width ratio of the test specimen). Therefore, a shape is specified which conforms to the data on which the abrasion index is based.<sup>4</sup>

The compressive strength shall be determined on specimens measuring 3 $\frac{7}{8}$  by 3 $\frac{7}{8}$  by 2 $\frac{1}{4}$  in.  $\pm$  1/4 in. (98 by 98 by 57 mm  $\pm$  6 mm) for length, width, and height respectively. The brick shall be without core holes, other perforations or frogs. Other shaped specimens may be used provided that the producer submits evidence acceptable to the purchaser that the change in shape gives equivalent strength results to those of the specified shape.

The abrasion resistance should be determined according to Column 2 in those cases where the procedural requirements for compressive strength cannot be met.

<sup>C</sup> The volume abrasion loss shall be determined in accordance with Test Method C 418, with the following changes in procedure:

(1) The sand shall be a natural silica sand from Ottawa, IL, graded to pass a No. 50 (300- $\mu$ m) sieve and retained on a No. 100 (150- $\mu$ m) sieve.

(2) The test shall be run on dry brick.

(3) The duration of the test shall be 2 min.

(4) The rate of sand flow shall be 400 g/min.

(5) The volume loss shall be determined by filling the abraded depression with modeling clay, striking off level with the original surface of the brick, and removing and weighing the modeling clay. The volume loss shall be calculated from the bulk density of the modeling clay. The bulk density shall be determined on each lot of modeling clay.

An alternative method of determining the weight of clay used in filling the sand-blast cavity is to determine the weight of the modeling clay sample before and after filling the cavity.

**TABLE 3 Tolerances on Distortion**

Specified Dimension in. (mm)	Permissible Distortion, max in. (mm)	
	Application PX	Application PS
8 (203) and under	1/16 (1.6)	3/32 (2.4)
Over 8 (203) to 12 (305)	3/32 (2.4)	1/8 (3.2)
Over 12 (305) to 16 (406)	1/8 (3.2)	5/32 (4.0)

**6.2.3 Application PA**—Paving brick manufactured and selected to produce characteristic architectural effects resulting from nonuniformity in size, color, and texture of individual units. (The textures may exhibit inclusion of nonuniform nodules of mineral substances or purposely introduced cracks that enhance the appearance of the units.) The requirements on warpage and dimensional tolerances as specified in 6.3 and 6.4 do not apply to this application.

**6.3 Dimensional Tolerance**—Brick shall not depart from the specified size by more than the individual tolerance for the application specified as prescribed in Table 4.

**TABLE 4 Tolerances on Dimensions**

Dimension, in. (mm)	Maximum Permissible Variation from Specified Dimension, plus or minus in. (mm)		
	Application PS	Application PX	Application PA
3 (76) and under	1/8 (3.2)	1/16 (1.6)	no limit
Over 3 to 5 (76 to 127) incl	3/16 (4.7)	3/32 (2.4)	no limit
Over 5 to 8 (127 to 203) incl	1/4 (6.4)	1/8 (3.2)	no limit
Over 8 (203)	5/16 (7.9)	7/32 (5.6)	no limit

**6.4 Warpage**—The concave and convex warpage (distortion) of any face intended to be the exposed surface or edge of the paving shall not exceed the values of Table 3 when sampled and measured in accordance with Test Methods C 67.

## 7. Material and Finish

**7.1** If brick having a particular color, color range, or texture are desired, these features shall be specified separately by the purchaser. The texture of the finished face shall conform to an approved sample consisting of not less than four brick, each representing the texture desired. The color range shall be indicated by the approved sample.

**7.2** The brick shall be free of cracks or other imperfections detracting from the appearance of a designated sample when viewed from a distance of 15 ft (4.6 m) for Application PX and a distance of 20 ft (6 m) for Application PS.

**7.3** The parts of the brick that will be exposed in place shall be free of chips that exceed the limits given in Table 5.

**7.4** Unless otherwise agreed upon by the purchaser and the seller, a delivery of brick shall contain not more than 5 % brick that do not meet the combined requirements of Tables 4-5, including broken brick.

**7.5** After brick are placed in usage the manufacturer or the manufacturer's agent shall not be held responsible for compliance of brick with the requirements of this specification for chippage and tolerances.

## 8. Sampling and Testing

**8.1** The brick shall be sampled and tested in accordance with applicable sections in Test Methods C 67.

**8.2** The manufacturer or the seller shall furnish specimens for tests. The place or places of selection shall be designated when the purchase order is placed.

**NOTE 10**—Unless otherwise specified in the purchase order, the cost of the tests is typically borne as follows: If the results of the tests show that the brick do not conform to the requirements of this specification, the cost is typically borne by the seller. If the results of the tests show that the brick do conform to the requirements of the specification, the cost is typically borne by the purchaser.

## 9. Keywords

9.1 brick; fired masonry unit; light traffic; paving; pedestrian traffic