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# American National Standard Specification ANSI A136.1

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## American National Standard Specifications for Organic Adhesives for Installation of Ceramic Tile A136.1 — 20xx [Revised]

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### 1.0 Purpose

This standard is for the use of manufacturers of organic adhesives, tile producers, architects, installing mechanics, and testing laboratories in producing, specifying, and testing organic adhesives for the installation of ceramic tile. It provides a basis for promoting the quality of organic adhesives to be used under appropriate installation procedures specified in the current ANSI A108.4.

### 2.0 Scope

**2.1** It is recognized that there are varying degrees of water resistance required in ceramic tile installations. Applications involving continuous water immersion, chemical resistance, and similar conditions may not be satisfied by products meeting this standard and therefore such applications should be referred to the manufacturer and considered upon an individual basis.

**2.2** This standard covers organic adhesives for the installation of ceramic tile in interior areas requiring Type I and Type II water resistance and specified minimum requirements and methods of test for stability in storage, shear strength at intervals of time and water soaking, shear strength under accelerated aging, heat resistance, impact, requirements for manufacturer's instructions for installation, and labeling.

**2.3** The quality of ceramic tile adhesives is determined by both strength and durability. This standard promotes improved flexibility and aging characteristics while maintaining more than adequate bond strength.

**2.4** The methods used to prepare test specimens for the various strength requirements of this standard result in a bonded area of 50 ±5 percent of the tile surface. This factor is considered in evaluating the strength of adhesives tested under this standard.

**2.5** This standard covers only organic adhesives in single package units ready for use.

### 3.0 Classification

**3.1** Type I - Organic adhesives for installation of ceramic tile in interior areas.

A. On walls and ceilings having —

1. Commercial construction; dry or limited water exposure requirements.
2. Light construction; dry or limited water exposure requirements.
3. Light construction; wet requirements

B. On floors and countertops having —

1. Residential construction requirements

**3.2** Type II - Organic adhesives for installation of ceramic tile in interior areas on walls and ceilings having Light construction; dry or limited water exposure.

**3.3** All sections of ANSI A136.1 requirements pertain to both Type I and Type II specifications with the exception of Section 5.2.2.1 below which pertains only to Type I.

## 4.0 Definitions

**4.1 Ceramic tile:** for purposes of testing under this standard, shall be ceramic tile as described under 6.2.1.1 below.

**4.2 Organic adhesive:** For the purposes of this standard, shall be an adhesive in which organic material is used as the principal bonding component.

**4.3 Commercial construction; dry or limited water exposure walls:** Dairies, breweries, commercial kitchens, laundries, or other similar areas with like service requirements.

**4.4 Light construction; dry or limited water exposure walls:** Residential kitchens and toilet rooms, commercial dry area interiors and decoration, or similar areas with like service requirements.

**4.5 Light construction; wet walls:** Tub enclosures and showers or other similar areas with like service requirements.

**4.6 Residential construction floors:** Residential floors.

## 5.0 Requirements

**5.1 Stability in storage:** After 4 weeks storage under accelerated conditions as specified in 6.1 below, the adhesive shall not change appreciably in volume or viscosity, shall not segregate in such a manner that it cannot be readily restored by hand-mixing with a paddle for not more than 10 minutes, and shall have substantially the same working qualities as another sample of recent manufacture, as obtained from the manufacturer at that time, strictly for the purpose of comparison.

**5.2 Shear strength:** When the adhesive is tested in accordance with 6.2, it shall comply with the following requirements of shear strength.

**5.2.1 Shear strength, conditioned, dry:** Not less than 50 psi (3.5 kg/cm<sup>2</sup>) when tested at a temperature of 73.4 ±6°F (23 ±2°C)\* in accordance with the method described in 6.2.3.1 below.  
*\*This standard atmospheric temperature is specified by ASTM Committee D-14 on adhesives.*

**5.2.2 Shear strength, conditioned, after water immersion:**

**5.2.2.1 TYPE I** - Not less than 50 psi (3.5 kg/ cm<sup>2</sup>) when tested at a temperature of 73.4 ±3.6°F (23 ±2°C) immediately after immersion in water for seven (7) days in accordance with the method described in 6.2.3.2 below.

**5.2.2.2 TYPE II** - Not less than 20 psi (1.9 kg/ cm<sup>2</sup>) when tested at a temperature of 73.4 ±3.6°F (23 ±2°C) twenty (20) hours after final immersion in water of the last cycle in accordance with the method described in 6.2.3.2 below.

**5.2.3 Shear strength, room temperature, after 28 days air drying:** Not less than 50 psi (3.5 kg/cm<sup>2</sup>) when tested at a temperature of 73.4 ±3.6°F (23 ±2°C) in accordance with the method described in 6.2.3.3 below.

**5.2.4 Shear strength after accelerated aging:** Not less than 75 percent of the actual shear strength, conditioned, dry computed and reported under 5.2.1 when tested at a temperature of 73.4 ±3.6°F (23 ±2°C) in accordance with the method described below in 6.2.3.4 (e.g. if 100 psi (7.0 kg/cm<sup>2</sup>) average is obtained under 5.2.1, an average of at least 75 psi (5.2 kg/cm<sup>2</sup>) must be obtained under 6.2.3.4). However, in no case shall the shear strength after completion of the accelerated aging test be lower than 50 psi (3.5 kg/cm<sup>2</sup>).

**5.3 Heat resistance:** Not less than 10 lbs. (4.5 kg) per tile assembly when tested at 120 ±2°F (48.8 ±1.1°C) in accordance with the method described in 6.2.3.5 below.

**5.4 Impact test:** All tiles must remain bonded after impact when tested in accordance with the method described in 6.2.3.6 below.

**5.5 Stain test:** Staining shall not exceed 70 percent penetration of the thickness of the tile when tested in accordance with the method described in 6.3 below.

**5.6 Resistance to mold growth:** Tile adhesive shall not support mold growth when tested in accordance with the method described in 6.4 below.

## **6.0 Sampling and testing procedures**

**6.1 Stability in storage:** Two containers of at least 1-gallon each of the bonding adhesive, obtained at the same time and having the same lot or batch number, shall be tested as follows:

The two, 1-gallon containers shall be stirred until homogeneous and quickly repacked into eight, 1-quart, triple-tight cans to avoid loss of volatiles. Four quarts shall be stored for a four week period— two weeks at a temperature of 120 ±2°F (48.8 ±1.1°C), and two weeks at a temperature of 35 ±2°F (1.7 ±1.1°C). Any significant evidence of change in volume or viscosity shall be observed. At the end of the last storage period, after the containers have attained room temperature, if there is any evidence of separation, the bonding adhesive shall be hand-mixed with a paddle for not longer than 10 minutes. The bonding adhesive, in the containers inspected at the end of the four week period after mixing, shall be compared with a sample of recent manufacture.

The remaining four quarts shall be used as in Sections 6.2 through 6.4 below.

### **6.2 Shear strength**

**6.2.1 Materials:** Materials used for testing methods specified herein shall be as follows:

**6.2.1.1** The ceramic tiles shall be glazed wall tile, 4¼ in. x 4¼ in. (108 mm x 108 mm) having a nominal thickness of 5/16 inch (8 mm), water absorption of 13-15 percent according to ASTM C373.

In order to obtain comparable test results, the tile selected shall be standard grade, of one glaze color, obtained from one manufacturer.

**6.2.1.2** The bonding material shall be the commercial product transferred into 1-quart cans, as outlined under 6.1. Lids shall be kept tightly closed at all times when not in use.

**6.2.1.3** The template used in applying the bonding adhesive shall be made of polytetrafluoroethylene\* of .0625 ±0.002 inch (1.59 mm ±50 microns) thickness and shall conform to the exact measurements as shown in Figure 2.0.

\*Such as "Teflon", a product of Dupont.

**6.2.1.4** The oven used throughout this specification shall be a mechanical convection type such as the Thelco Model 18, or equivalent provided with lattice-type shelves. The heating element shall be external to the oven chamber with air circulation dependent upon the movement of warm air provided by a turbo blower and directed and circulated through diffuser. See Figure 4.0.

**6.2.1.5 Spacers:** Spacer rods shall be made from straight high-carbon steel drill rod. They shall have a diameter of 1/32 inch (0.8 mm) and shall be 2 inches in length.

**6.2.1.6 Storage prior to test:** All materials mentioned herein for the purpose of conducting the following tests, shall be stored at a temperature of 73.4 ±3.6°F (23 ±2°C) and a relative humidity of 50 ±5 percent for a minimum of 24 hours prior to test.

## **6.2.2 Preparation of bonded tile assemblies**

### **6.2.2.1 Bonded tile assemblies for all tests specified shall be prepared as follows:**

All bonded tile assemblies shall be made at a temperature of 73.4 ±3.6°F (23 ±2°C), 50 ±5 percent relative humidity, free of drafts or direct sunlight. The porous, unglazed back of each tile shall be wiped or brushed to remove any loose particles.

With a T-square, or carpenter square, draw a pencil line on the porous side of the tile ¼-inch (6 mm) in from the tile edge and perpendicular to the back pattern ribs. See Figure 3.0. (This line will serve as a guide in the overlapping of tile, as explained below.)

The template is placed over the porous side of a test tile. Sufficient adhesive is troweled across the template and screeded clean so as to neatly and completely fill the holes in the template. The template is then carefully removed vertically.

Spacer rods are then inserted diagonally in each of the four corners of the tile, 1 inch into the specimen to provide easy removal. See Figure 3.0.

Exactly 2 minutes after the adhesive has been applied, the porous side of an uncoated tile shall be brought into contact with the coated tile with the back pattern ribs parallel and the tiles offset by exactly ¼-inch (6 mm), using the previously scribed pencil line as a guide, so that the edges of the tiles exactly parallel and a total overlap area of 17 square inches (109.8 cm<sup>2</sup>) is obtained.

Having placed the bonded tile assembly on a level surface, the assembly shall then be immediately subjected to a total load of 15 lbs. (6.8 kg) (e.g. a 1 quart can filled with #3 lead shot), for a period of exactly 3 minutes. After exactly 1 hour remove spacer rods carefully. Tiles bonded in this manner are considered bonded tile assemblies.

**6.2.2.2 Drying:** After the bonded tile assemblies have been prepared, they shall be stored at a temperature of 73.4 ±3.6°F (23 ±2°C) and a relative humidity of 50 ±5 percent for a period of 72 hours. After the drying period is complete, any excess adhesive shall be removed from the assemblies. They shall also be checked to assure correct parallelism. Any assemblies found to be not parallel shall not be used for these tests.

**6.2.2.3 Conditioning of bonded tile assemblies:** When specified in subsequent test methods the term “conditioned” shall refer to tile assemblies which have been prepared according to this procedure. Immediately following drying, the assemblies shall be aged in a horizontal position for 21 days in an air circulating oven, as described in 6.2.1.4, at  $120 \pm 2^\circ\text{F}$  ( $48.8 \pm 1.1^\circ\text{C}$ ). Tile assemblies shall be placed in the oven such that a minimum of 1 inch is allowed between each assembly in all directions.

Remove assemblies after 21 days and further condition for a period of 24 hours at a temperature of  $73.4 \pm 3.6^\circ\text{F}$  ( $23 \pm 2^\circ\text{C}$ ) and a relative humidity of  $50 \pm 5$  percent immediately prior to testing.

### 6.2.3 Procedure

**6.2.3.1 Shear strength at room temperature:** Five bonded tile assemblies prepared, dried and conditioned in accordance with 6.2.2 shall be tested in a vertical position by compression loading at a rate of 0.50 inch (13 mm) per minute so that the adhesive is stressed in shear to failure. Jigs, fixtures, or devices\* must be employed to exert the compression load directly parallel and in line with the layer of adhesive in the test assembly. Failure of the material shall occur when the bond breaks suddenly, or when the stress causing deformation of the adhesive has reached a maximum value. If a tile breaks, the stress producing this failure shall not be used in computing the shear strength of the bonding material. Shear strength shall be calculated in accordance with the method described in 6.2.4 below.

*\*Tinius Olsen, Dillon or equivalent machines have been found to be satisfactory for these purposes.*

**6.2.3.2 Shear strength wet, Type I:** Five bonded tile assemblies prepared, dried, and conditioned in accordance with the method outlined in 6.2.2 shall be immersed in distilled or deionized water at  $73.4 \pm 3.6^\circ\text{F}$  ( $23 \pm 2^\circ\text{C}$ ) for a period of 7 days. Assemblies shall then be removed, wiped with a cloth and, within 2 minutes, tested in shear to failure in accordance with the method described in 6.2.3.1. Shear strength shall be calculated in accordance with the method described in 6.2.4.

**Shear strength wet, Type II:** Five bonded tile assemblies prepared, dried, and conditioned in accordance with the method outlined in 6.2.2 shall be immersed in distilled or deionized water at  $73.4 \pm 3.6^\circ\text{F}$  ( $23 \pm 2^\circ\text{C}$ ) for a period of 4 hours. Assemblies shall be removed and wiped with a cloth. Allow tile assemblies to recover for a period of 20 hours at  $73.4 \pm 3.6^\circ\text{F}$  ( $23 \pm 2^\circ\text{C}$ ),  $50 \pm 5$  percent relative humidity. Repeat for a total of 4 cycles. After fourth cycle, assemblies are to be tested in shear to failure in accordance with 6.2.3.1. Shear strength shall be calculated in accordance with the method described in 6.2.4.

**6.2.3.3 Shear strength 28 days:** Five bonded tile assemblies shall be prepared in accordance with the method described in 6.2.2.1 and shall be aged for a period of 28 days at a temperature of  $73.4 \pm 3.6^\circ\text{F}$  ( $23 \pm 2^\circ\text{C}$ ) and a relative humidity of  $50 \pm 5$  percent. The assemblies shall then be tested in shear to failure in accordance with the method described in 6.2.3.1. Shear strength shall be calculated in accordance with the method described in 6.2.4.

**6.2.3.4 Accelerated aging:** Five bonded tile assemblies shall be prepared in accordance with the method described in 6.2.2.1 and shall be dried according to 6.2.2.2.

At the end of this period, the assemblies shall be immediately transferred to an air circulating oven at  $140 \pm 2^\circ\text{F}$  ( $60 \pm 1.1^\circ\text{C}$ ) for a period of 28 days.

At the end of the 28 day period of accelerated aging, the assemblies shall be further conditioned for a period of 24 hours at a temperature of  $73.4 \pm 3.6^\circ\text{F}$  ( $23 \pm 2^\circ\text{C}$ ) and a relative humidity of  $50 \pm 5$  percent. The assemblies shall then be tested in shear to failure in accordance with the method outlined in 6.2.3.1.

**6.2.3.5 Heat resistance:** Two bonded tile assemblies prepared, dried, and conditioned in accordance with 6.2.2 shall be suspended vertically in an air-circulating oven at  $120 \pm 2^\circ\text{F}$  ( $48.8 \pm 1.1^\circ\text{C}$ ). The top tile shall be held in a mechanical clamp to ensure vertical alignment. A load of 10 lbs. (4.5 kg) shall be suspended from the bottom tile and allowed to hang freely. (This load shall be applied by running a steel wire over the top edge of the bottom tile and hanging a 5 lb. (2.3 kg) weight from each end of the wire.)

The bonded tile assembly shall maintain a 10 lb. (4.5 kg) static load in shear without failure for 24 hours.

**6.2.3.6 Impact test:** Prepare two impact test assemblies as follows: Using a good contact bond cement, laminate the reverse or backside of a 3/8 in. x 12 in. x 12 in. (10 mm x 305 mm x 305 mm) piece of gypsum wallboard (complying with ASTM C1396/C1396M) to a 1/8 in. x 12 in. x 12 in. (3 mm x 305 mm x 305 mm) steel plate.

Rule the face side of the gypsum wallboard into four adjacent 4 1/4 in. x 4 1/4 in. (108 mm x 108 mm) square areas laid out in a square geometrically centered so that the edges of the square are parallel to the edges of the wallboard. Apply the adhesive under test to the back of four individual tiles in accordance with 6.2.2.1 above. Immediately place the coated tiles in the pattern laid out on the gypsum wallboard without the use of spacer rods, making sure tiles are butted to each other.

Place a 3/4 in. x 12 in. x 12 in. (19 mm x 305 mm x 305 mm) plywood board on the four tiles and then place a 15 lb. (6.8 kg) total load on the center of the plywood for a total period of 3 minutes.

Condition the assembly at a temperature of  $73.4 \pm 3.6^\circ\text{F}$  ( $23 \pm 2^\circ\text{C}$ ) and a relative humidity of  $50 \pm 5$  percent for 72 hours. At the end of this period, remove excess adhesive from edges of tile and then place the assemblies in an air-circulating oven at  $120 \pm 2^\circ\text{F}$  ( $48 \pm 1.1^\circ\text{C}$ ) for an additional 72 hours. The assembly shall then be further conditioned at  $140 \pm 2^\circ\text{F}$  ( $60 \pm 1.1^\circ\text{C}$ ) for a period of 28 days. At the end of this period remove the assembly from the oven and further condition it at a temperature of  $73.4 \pm 3.6^\circ\text{F}$  ( $23 \pm 2^\circ\text{C}$ ) and a relative humidity of  $50 \pm 5$  percent for a period of 24 hours.

Support the impact assembly on a square frame of 2 in. x 4 in. (40 mm x 90 mm), the inside dimensions of which are 10 in. x 10 in. (254 mm x 254 mm), so that the edges of the tiles will be 3/4 in. (19 mm) from the frame on all sides.

A 2-lb. (0.9 kg) steel ball, with a screw eye attached shall be supported by a thin cord, or string, and secured to a laboratory ring stand, or other suitable holding device. The ball shall be suspended above the center of the test panel so that the distance between the bottom of the ball and the surface of the steel plate is exactly 48 in. (1.2 m). The string will then be burned to enable the ball to fall free. Any other suitable method which produces a 48 in. vertical free fall of the 2-lb. steel ball may be substituted for the above.

This impact test is performed only once to each panel.

#### **6.2.4 Calculation of shear strength**

In calculating shear strength, the load at failure of each of the five assemblies subjected to a test shall be recorded and the average of the five values calculated for determining the shear strength in pounds per square inch of bonded area. Divide the average of the five values by 8.5 square

inches (54.8 cm<sup>2</sup>). The average actual bonded area produced by the template method of assembly is 8.5 square inches (54.8 cm<sup>2</sup>). Any individual value which varies from the average by more than 15 percent, plus or minus, shall be discarded and not used for determining the shear strength. If less than 3 values remain for averaging, the test shall be rerun using ten bonded tile assemblies. The average of these 10 tile values shall be taken as the shear strength and none shall be discarded.

**6.3 Stain test:** Apply adhesive to the back of four test tiles so that a continuous film 1/8 in. (3 mm) thick covers the entire back of the tiles. Cover the adhesive with a 5 x 5 in. (127 mm x 127 mm) piece of aluminum foil, folding excess foil over the edges of each tile so that solvent penetration is directed into the tile. Allow test specimens to be conditioned at a temperature of 73.4 ±3.6°F (23 ±2°C) and a relative humidity of 50 ±5 percent for 7 days in a vertical position to simulate an actual wall application.

At the end of the 7 day period, crack the tile through the center by striking with a blunt instrument on the face of the tile. The depth of adhesive stain penetration into the tile is made visible by exposing the broken tile edge to a "black light," such as a GE 20 watt 24 inch black light tube F 20 T 12/BLB or other lamp of equal spectral characteristics. For visual comparison, repeat the examination using an uncoated test tile.

The maximum depth of stain for each tile shall be expressed as a percentage of the tile thickness. The maximum penetration for test tiles shall be reported.

**6.4 Test for mold growth:** The organism used for this test shall be *Aspergillus Niger*. The stock cultures shall be stored in a refrigerator at 37.4°F - 50°F (3°C - 10°C) prior to use. Stock cultures stored for more than 4 months shall not be used. The culture medium shall be potato dextrose agar from Difco Products, Inc.; Detroit, Michigan or its equivalent.

Dissolve 39 grams of the agar in 1 liter of water, using heat. Autoclave the medium and two 1 inch (25 mm) square pieces of tile at 15 psi (1.1 kg/cm<sup>2</sup>) for 15 minutes. Cover the unglazed side of one piece of sterile tile with an 1/8 inch (3 mm) layer of adhesive. Place the coated tile with the adhesive side up in a sterile Petri dish and pour sterile agar into the dish until the surface of the agar is level with the edge of the adhesive. Inoculate with the organism.

For control purposes, one Petri dish containing only the agar medium and the other piece of tile shall be inoculated with the test organism to determine the viability of the inoculum.

Place the Petri dishes in an incubator at 82.4°F - 86°F (28°C - 30°C) and at a relative humidity of 85 to 95 percent. After 14 days of incubation, examine to ascertain whether the adhesive supports mold growth. (At the end of the inoculation period the control shall be well covered with a mold growth.)

**Deleted:** kept for not more than 4 months

**Deleted:** approximately

**Comment [MSOffice1]:** Language is now mandatory and reflects the intent of the standard.

## **7.0 Manufacturer's instructions**

**7.1 Application:** The container shall be clearly labeled. The necessary directions for application and the general instructions shown below shall appear on the container.

- Use installation procedures set forth in ANSI A108.4.
- Type of adhesive shall be specified prominently on label to indicate it meets or surpasses requirements of ANSI A.136.1 TYPE I or TYPE II, for interiors only.
- Instructions for storage, including any provisions for freezable type materials.
- Instructions for practical handling on the job in reference to surface skinning time.
- Types of tools to be used, and approximate coverage.
- Solvent and methods of cleaning the tools and work.
- If solvents are suggested for thinning or cleaning tools or work, the necessary precautions shall be stated on the label to eliminate any hazard from their use.

**7.2 Storage:** The manufacturer shall certify that the adhesive will meet the requirements of this specification for a minimum period of not less than one year of storage in accordance with the manufacturer's instructions.

## **8.0 Toxicity and flammability**

**8.1 Labels:** The labels on the containers shall state plainly: tendencies of the material to be toxic or irritating to the workman under normal application conditions; tendencies toward flammability; and shall set forth precautions to be observed for protection of the workman.

**End of ANSI A136.1**