Section 1
Overview


This test method covers various test procedures for epoxy materials specified in "DMS-6100, Epoxies and Adhesives." The tests performed depend upon the requirements set forth for each particular material.

This test method includes the following test procedures:

♦ Compressive Strength
♦ Viscosity of Mixed Components
♦ Difference in Viscosity
♦ Stability
♦ Gel Time
♦ Tensile Bond
♦ Tensile Bond for Type I Epoxy
♦ Thixotropy
♦ Tensile Shear Strength
♦ Impact Strength
♦ Wet Strength
♦ Wet Pullout Strength
♦ Grind
♦ Bond Strength of fresh concrete to cured concrete
♦ Old Concrete to New Grout Mix
♦ Hiding Power
♦ Water Gain
♦ Contact Time.
Units of Measurement

The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.
Section 2

Component Ratios

Determine the weight per gallon/liter of each component according to ASTM D 1475, “Standard Test Method for Density of Liquid Coatings, Inks, and Related Products.” For all tests performed on the mixed epoxy, determine the proper weight ratio of resin and hardener components based on the weight per gallon/liter and the specified volume ratio.
Section 3
Procedures

Compressive Strength

The following procedure applies to epoxies types I and IV.

Apparatus

Use the following apparatus:

♦ PVC tubing, 1 in. × 2 in. (25 mm × 50 mm) in length for use as molds
♦ machine lathe
♦ mold release grease
♦ plastic film and rubber bands to seal bottoms of the molds
♦ metal ointment can, 6 fl. oz. (170 mL) size
♦ balance, with minimum capacity of 2000 g, which meets the requirements of "Tex-901-K, Verifying the Calibration of Weighing Devices used for Laboratory Testing"

♦ compression testing machine as described in Section 5.1 of ASTM D 695, "Standard Test Method for Compressive Properties of Rigid Plastics," capable of a constant rate of crosshead movement of 0.05 in./min. and capable of applying a maximum load of at least 10,000 lbf. Use compression plates that are flat and parallel to each other in a plane normal to the vertical loading axis.

Procedure

Use the following procedure to determine the compressive strength of epoxy types I and IV.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | Set up the molds.  
♦ Set up at least 3 of the PVC molds for each test sample.  
♦ Coat the inside of the molds with release grease.  
♦ Seal the bottom of the molds with a plastic film to prevent leakage.  
**NOTE:** For type I epoxy, set up 2 sets of 3 molds. |
| 2    | Cast the epoxy specimens.  
♦ Use the component ratios to determine the amount of each component necessary to make 200 g of mixed epoxy.  
♦ Weigh the components into a metal can. |
## Compressive Strength Test

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| ♦ | Mix components for 3 min.  
♦ | Fill the molds with the epoxy. |
| ♦ | Condition the epoxy specimens.  
♦ | For type I epoxy, allow specimens to cure at the temperature specified. Cure one set of specimen for 24 hr. and the second set for 48 hr.  
♦ | For type IV epoxy, allow the specimen to cure for 48 hr. at 77°F (25°C). |
| ♦ | Test the epoxy specimens.  
♦ | Compress specimens in a compression-testing machine.  
♦ | Test specimen at a rate of 0.05 in. (1.3 mm) per min.  
♦ | Record the load at failure or at 0.1 in. (2.5 mm) crosshead travel, whichever occurs first. |
| ♦ | Calculate the compressive strength.  
♦ | Use the calculations listed under "Calculations."  
♦ | Average the results from all the specimens.  
♦ | Report results in psi (kPa). |

### Calculations

Use the following calculation to determine compressive strength.

\[
(C_S = \frac{L}{\pi r^2}, \text{psi})
\]

Where:

♦ \( C_S \) = compressive strength, psi (kPa)

♦ \( L \) = load, lb. (N)

♦ \( r \) = radius of the specimen, in. (m).

### Viscosity of Mixed Components

The following procedure applies to epoxies types III, IV, V, VII, and IX.

#### Apparatus

Use the following apparatus:

♦ Brookfield viscometer

♦ friction top cans, 1 pt. (500 mL) and 1 qt. (1 L)
thermometer, range 66 to 80°F (19 to 27°C), 0.2 division (F17 thermometer as shown in ASTM E 1, “Standard Specification for ASTM Liquid-in-Glass Thermometers”)

spatula

balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K

stopwatch.

**Procedure**

The following procedure describes the viscosity test.

### Viscosity of Mixed Components Test

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | ♦ Set up the viscometer according to manufacturer’s instructions.  
     ♦ Level the instrument.  
     ♦ Set the speed control at 20 rpm.  
     NOTE: Set the speed control at 10 rpm if the viscosity of the material is greater than 1200 poise.  
     ♦ Choose the proper spindle for the viscosity measurement and attach the spindle to the viscometer.  
     NOTE: Type of spindle is dependent on measured viscosity range and type of viscometer. |
| 2    | Mix the epoxy.  
     ♦ Measure the temperature of each component of epoxy and ensure the temperature of each is 77 ±2°F (25 ±1°C).  
     ♦ Using the mixing ratios, determine the amount of resin and hardener needed to make 400 g of mixed epoxy.  
     ♦ Weigh components into a 1 pt. (500 mL) can.  
     ♦ Mix the epoxy for 3 min. |
| 3    | Immerse the spindle into the epoxy.  
     ♦ Adjust the height of the viscometer to bring the liquid level to the indentation in the spindle.  
     ♦ Ensure that there is at least a 1 in. (25 mm) clearance between the bottom and sides of the spindle and the container when immersing the spindle to the proper depth in the sample.  
     NOTE: With disk type spindles, first immerse the spindle in the liquid at an angle to eliminate air bubbles, and then attach the spindle to the shaft. |
| 4    | Measure the viscosity.  
     ♦ Start the viscometer.  
     ♦ Allow the reading to stabilize.  
     ♦ Record the viscosity. |
Difference in Viscosity

The following procedure applies to epoxy type II.

Apparatus

Use the following apparatus:

♦ Brookfield viscometer
♦ friction top cans, 1 pt. (500 mL)
♦ thermometer, range 66 to 80°F (19 to 27°C), 0.2 division (F17 thermometer as shown in ASTM E 1)
♦ spatula
♦ balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K
♦ stopwatch.

Procedure

The following procedure describes the viscosity test for type II epoxy.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | Set up the viscometer according to manufacturer’s instructions.  
♦ Level the instrument.  
♦ Set the speed control at 20 rpm.  
**NOTE:** Set the speed control at 10 rpm if the viscosity of the material is greater than 1200 poise.  
♦ Choose the proper spindle for the viscosity measurement and attach the spindle to the viscometer.  
**NOTE:** Type of spindle is dependent of measured viscosity range and type of viscometer.  
| 2    | Prepare the epoxy.  
♦ Measure the temperature of each component of the epoxy and ensure the temperature of each is 77 ±2°F (25 ±1°C).  
♦ Place 400 g of each component into separate 1 pt. (500 mL) cans.  
| 3    | Immerse the spindle into one of the components.  
♦ Adjust the height of the viscometer to bring the liquid level to the indentation in the spindle.  
♦ Ensure that there is at least a 1 in. (25 mm) clearance between the bottom and sides of the spindle and the container when immersing the spindle to the proper depth in the sample.  
| 4    | Measure the viscosity.  
♦ Start the viscometer.  
♦ Allow the reading to stabilize.  
♦ Record the viscosity.  
| 5    | Repeat measurement for the second component.  
♦ Stop the viscometer.  

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<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>♦</td>
<td>Clean the spindle.</td>
</tr>
<tr>
<td>♦</td>
<td>Repeat the procedure beginning at Step 2.</td>
</tr>
<tr>
<td>6</td>
<td>Use the 2 measurements to calculate and report the difference in viscosity.</td>
</tr>
</tbody>
</table>

**Calculations**

Difference in viscosity \(= \frac{v_2 - v_1}{v_1} \times 100\)

Where:

♦ v1 = lower viscosity reading
♦ v2 = higher viscosity reading.

**Stability**

The stability test applies to epoxy types II, V, VII, and VIII.

♦ For the stability on type II epoxy, measure the viscosity of the individual components.
♦ For the stability on types V, VII, and VIII epoxy, measure the viscosity on the mixed epoxy.

**Apparatus**

Use the following apparatus:

♦ Brookfield viscometer
♦ friction top cans, 1 pt. (500 mL) and 1 qt. (1 L)
♦ thermometer, range 66 to 80°F (19 to 27°C), 0.2 division (F17 thermometer as shown in ASTM E 1)
♦ oven capable of maintaining a temperature of 120°F (49°C).
♦ metal spatula
♦ balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K
♦ stopwatch.
Procedure

The following procedure describes the stability test after 14 day heat aging at 120°F (49°C) for epoxy types II, V, VII, and VIII.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | ♦ Fill separate 1 qt. (1 L) cans with resin and hardener.  
     | ♦ Place the resin and hardener in the oven, set at 120°F (49°C), for 14 days. |
| 2    | Remove epoxy from oven and allow the material to cool to 77 ±2°F (25 ±1°C). |
| 3    | Set up the viscometer according to manufacturer’s instructions.  
     | ♦ Level the instrument.  
     | ♦ Set the speed control at 20 rpm.  
     | NOTE: Set the speed control at 10 rpm if the viscosity of the material is greater than 1200 poise.  
     | ♦ Choose the proper spindle for the viscosity measurement and attach the spindle to the viscometer.  
     | NOTE: Type of spindle is dependent of measured viscosity range and type of viscometer. |
| 4    | Prepare the epoxy.  
     | ♦ Measure the temperature of each component of the epoxy, and ensure the temperature of each is 77 ±2°F (25 ±1°C).  
     | ♦ For type II epoxy, place 400 g of each component into separate 1 pt. (500 mL) cans.  
     | ♦ For types V, VII, and VIII epoxy, use the mixing ratios and measure 400g of resin and hardener into a 1 pt. (500 mL) can. Then mix the epoxy for 3 min. |
| 5    | Immerse the spindle into the epoxy.  
     | ♦ Adjust the height of the viscometer to bring the liquid level to the indentation in the spindle.  
     | ♦ Ensure that there is at least a 1 in. (25 mm) clearance between the bottom and sides of the spindle and the container, when immersing the spindle to the proper depth in the sample.  
     | NOTE: With disk type spindles, first immerse the spindle in the liquid at an angle to eliminate air bubbles, and then attach the spindle to the shaft. |
| 6    | Measure the viscosity.  
     | ♦ Start the viscometer.  
     | ♦ Allow the reading to stabilize.  
     | ♦ Record the viscosity.  
     | ♦ For type II epoxy, repeat Steps 5 and 6 for the second component. |
| 7    | Use the stability calculation to determine the stability.  
     | ♦ For type II epoxy, use the viscosities determined from the difference in viscosity test as the viscosity of original material.  
     | ♦ For types V, VII, and VIII epoxy, use the viscosities determined from the viscosity of mixed components test as the viscosity of original material. |
Calculations

\[ Stabiliy = \frac{v_2 - v_1}{v_1} \times 100 \]

Where:

- \( v_1 \) = viscosity of original material
- \( v_2 \) = viscosity of aged material.

Gel Time Tests

The following procedures apply all types of epoxy.

Apparatus (Except Type X)

Use the following apparatus:

- thermometer, range 66 to 80°F (19 to 27°C) (F17 thermometer as shown in ASTM E 1)
- balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K
- metal ointment can, 6 fl. oz. (170 mL) size
- metal spatula
- wooden block, minimum thickness of 1 in. (25 mm)
- round, wooden toothpick
- stopwatch.

Procedure

The following procedure describes the gel time test except for type X.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | Test Preparation.  
  ♦ Measure the temperature of each component of the epoxy and ensure the temperature of each is 77 ±2°F (25 ±1°C).  
  ♦ Using the component ratios, determine the amount of each component necessary to make a total 100 g of mixed adhesive.  
  \textit{NOTE}: Condition the type I epoxy to the specified temperature. |
| 2    | Weigh the components. Weigh 100 g total of adhesive into a 6 fl. oz. (170 mL) metal ointment can. |
### Gel Time Test (Except for Type X)

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 3    | Start the stopwatch and begin mixing.  
♦ Mix the 2 components for 3 min. with a spatula.  
♦ During the mixing, scrape the sides and bottom of the can periodically.  
*NOTE:* For adhesives that gel in less than 3 min., mix the components for 1 min. |
| 4    | After mixing, let the adhesive set.  
♦ Place the can with the mixed adhesive on a wooden block.  
♦ Insert toothpick in the center of mixed material. |
| 5    | Probe the material to determine the gel time.  
♦ If adhesive has a gel time less than 20 min., probe adhesive every minute until it gels.  
♦ If adhesive has a gel time above 20 min., probe the mixed adhesive every min. starting 16 min. from the initiation of mixing until center of material gels.  
*NOTE:* An adhesive reaches its gel point when a ball of cured material forms in the center. |
| 6    | Record the elapsed time as the gel time. |

### Apparatus for Epoxy Type X

Use the following apparatus:

♦ thermometer, range 66 to 80°F (19 to 27°C) (F17 thermometer as shown in ASTM E 1)  
♦ balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K  
♦ friction top can, 1 pt. (500 mL), with friction lip removed  
♦ metal spatula  
♦ wooden block, minimum thickness of 1 in. (25 mm)  
♦ glass stirring rod  
♦ stopwatch.

### Procedure

The following procedure describes the gel time test for epoxy type X

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | Test Preparation.  
♦ Measure the temperature of each component of the epoxy and ensure the temperature of each is 77 ±2°F (25 ±1°C). |
### Gel Time Test For Epoxy Type X

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>♦ Using the component ratios, determine the amount of each component necessary to make a total 300 g of mixed epoxy.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Weigh the components. Weigh a total of 300 g of epoxy into a 1 pt. (500 mL) can.</td>
</tr>
</tbody>
</table>
| 3 | Start the stopwatch and begin mixing.  
♦ Mix the 2 components for 5 min. with a spatula.  
♦ During the mixing, scrape the sides and bottom of the can periodically. |
| 4 | After mixing, set aside the epoxy.  
♦ Place the can on a wooden block.  
♦ Allow mixed material to sit for 35 min. |
| 5 | Determine the gel time.  
♦ Probe mixed material every 5 min. with a glass-stirring rod until it gels.  
♦ Record the elapsed time as the gel time.  
**NOTE:** An epoxy reaches its gel point when a ball of cured material forms in the center. |

### Tensile Bond

The tensile bond test requires the use of cement mortar briquettes. The procedure applies to epoxy types II, III, V, VII, and VIII.

**Apparatus**

Use the following apparatus:

♦ metal spatula

♦ metal ointment can, 6 fl. oz. (170 mL)

♦ oven capable of maintaining a temperature of 120°F (49°C)

♦ a constant rate of crosshead movement testing machine as described in Section 5.1 of ASTM D 638, "Standard Test Method for Tensile Properties of Plastics," capable of maintaining a constant rate of travel of 0.05 in./min. (1.3 mm/min.) and applying a tensile force of at least 500 lbf. (2.2 kN) Use grips to hold specimens as described in Section 4.7 of ASTM C 190, “Standard Test Method For Tensile Strength Of Hydraulic Cement Mortars,” (Discontinued 1991; No Replacement)

♦ cement (Type III)

♦ washed river sand aggregate sieved though a No. 4 sieve

♦ molds as described in ASTM C 190
metal shims, 1 in. (25.4 mm) square and 0.037 ±0.003 in. (0.94 ±0.08 mm) thick

trowel with a steel blade 4 to 6 in. (100 to 150 mm) in length with straight edges

rubber tamper with a cross section of 1/2 × 1 in. (13 × 25 mm) and a length of 5 to 6 in. (120 to 150 mm). The tamping face must be flat and at right angles to the length of the tamper.

moist cabinet or room conforming to the requirements of ASTM C 511, "Standard Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes"

water storage tank, conforming to the requirements of ASTM C 511

glass graduate, conforming to the requirements of ASTM C 190

balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K.

**Prepare Mortar Briquettes**

The following procedure describes the preparation of mortar briquettes

<table>
<thead>
<tr>
<th>Preparing Mortar Briquettes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step</strong></td>
</tr>
</tbody>
</table>
| 1 | Prepare molds.  
  ♦ Obtain molds as described in ASTM C 190.  
  ♦ Place a shim vertically in the 1 in. waistline of each briquette mold.  
  ♦ Coat the inside of the molds in release material.  
  ♦ Set the mold on top of an ungreased sheet of glass. |
| 2 | Obtain components for making the cement mortar.  
  ♦ The mortar is 1-part cement to 3-parts aggregate.  
  ♦ Weigh 750 g of river sand.  
  ♦ Weigh 250 g of cement.  
  ♦ Measure 125 mL of water. |
| 3 | Mix components to make the mortar.  
  ♦ Thoroughly mix sand and cement.  
  ♦ Create a crater in the center of the sand and cement mixture.  
  ♦ Pour water into the center of the crater.  
  ♦ Scoop the material from the sides into the crater over the top of the water within 30 sec. of adding the water.  
  ♦ For the next 30 sec., trowel the dry mortar around the outside of the cone over the remaining mortar for the absorption of water.  
  ♦ Complete the operation with vigorous mixing, squeezing, and kneading the mortar by hand for 1.5 min. During the mixing operation, protect hands with rubber gloves. |
Preparing Mortar Briquettes

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Fill the molds with concrete on both sides of the shim. Compact the concrete using the following procedure: ♦ Press the mortar firmly with the rubber tamper, applying a force of approximately 15 to 20 lbf. Tamp each briquette 12 times. ♦ Add more mortar and compact again until mold is complete. ♦ Heap more mortar above the mold and smooth it off with a trowel.</td>
</tr>
<tr>
<td>5</td>
<td>Condition the briquettes. ♦ Place the mold with the briquettes in a moist cabinet and cure for 24 hr. ♦ After 24 hr., remove the briquettes from the mold and immerse them in the water storage tank for 6 days.</td>
</tr>
<tr>
<td>6</td>
<td>Remove the briquettes from the water storage tank, and allow the briquettes to dry before use.</td>
</tr>
</tbody>
</table>

Procedure

The following procedure describes the tensile bond test.

**Tensile Bond Test**

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Prepare the briquettes. ♦ Divide the briquettes into sets of 6 briquettes. ♦ Sandblast the bonding face of each mortar briquette to remove the laitance on the surface. ♦ After sandblasting, clean the bonding faces of the briquettes with compressed air. (<em>NOTE:</em> Do not touch bonding faces after sandblasting.)</td>
</tr>
<tr>
<td>2</td>
<td>Mix the epoxy. ♦ Ensure that the initial temperature of each epoxy component is 77 ±2°F (25 ±1°C). ♦ Using the component ratios, determine the amount of each component necessary to make a total 50 g of mixed epoxy. ♦ Weigh 50 g of total epoxy components into a metal ointment can. ♦ Mix with a spatula for 3 min.</td>
</tr>
<tr>
<td>3</td>
<td>Prepare the specimen. ♦ Place a small amount of epoxy on the bonding face of each briquette. ♦ Use a spatula to spread the epoxy uniformly across the bonding face. ♦ Adhere the faces of 2 briquettes together with light pressure, and repeat for the remaining briquettes. ♦ Remove the excess epoxy from the edges of the bonded area with a spatula and stand upright. ♦ Make 1 set of 3 specimens for epoxy types II, V, VII, and VIII. ♦ Make 2 sets of 3 specimens for epoxy type III. (<em>NOTE:</em> Allow no more than 10 min. to elapse during preparation of the specimens. For type II, allow no more than 6 min.)</td>
</tr>
</tbody>
</table>
4 Cure and condition specimens. All specimens are cured in air.
   - For type II, cure the specimens for 2 hr. at 77 ±2°F (25 ±1°C).
   - For type III, cure 1 set of 3 specimens for 6 hr. at 77 ±2°F (25 ±1°C). Cure the second set for 48 hr. at 77 ±2°F (25 ±1°C), and then place the specimens in the oven for 1 hr. at 120 ±2°F (49 ±1°C).
   - For types V and VII, cure the specimens for 6 hr. at 77 ±2°F (25 ±1°C).
   - For type VIII class A, cure the specimens for 24 hr. at 77 ±2°F (25 ±1°C).
   - For type VIII class B, cure the specimens for 6 hr. at 77 ±2°F (25 ±1°C).

5 Set up the tensile machine for testing.
   - Start up tensile machine according to manufacturer's instructions.
   - Balance and calibrate the tensile machine.
   - Place the grips on the machine.
   - Set the crosshead speed to 0.05 in./min. (1.3 mm/min.)

6 Test the specimen.
   - Load a briquette into the tensile machine.
   - Start the testing machine and load until break.
   - Record the load at break.
   - Repeat test for the remaining specimen.
   - For type III set of specimen cured at 120°F (49°C), test each specimen, one at a time, immediately after removing it from the oven.

7 Report the average load at break as the tensile bond strength.

### Tensile Bond for Type I Epoxy

**Apparatus**

Use the following apparatus.

- metal spatula
- metal ointment can, 6 fl. oz. (170 mL)
- balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K
- third-point loading apparatus as described in ASTM C 78, "Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)"
- environmental chamber, capable of maintaining temperatures of 60 ±2°F (16 ±1°C), 80 ±2°F (27 ±1°C), and 105 ±2°F (41 ±1°C)
**Procedure**

The following procedure describes the tensile bond test (third-point loading test) for type I epoxy.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | Prepare the blocks.  
   ♦ Prepare and cure flexural concrete specimens as described in ASTM C 78.  
   ♦ Cut 2 cured concrete beams in half. |
| 2    | Mix the epoxy.  
   ♦ Ensure that the ambient temperature in the chamber and the initial temperature of each epoxy component is the temperature specified.  
   ♦ Using the component ratios, determine the amount of each component necessary to make a total 100 g of mixed epoxy.  
   ♦ Weigh 100 g of epoxy components into a metal ointment can.  
   ♦ Mix with a spatula for 3 min. |
| 3    | Prepare the specimen.  
   ♦ Place a layer of epoxy on the bonding face of each block. The bonding face is the side opposite to the cut.  
   ♦ Use a spatula to spread the epoxy uniformly across the bonding face.  
   ♦ Adhere the faces of 2 halves together to make a complete block. |
| 4    | Allow the blocks to cure for 24 hr. at the specified temperature. |
| 5    | Test the specimen.  
   ♦ Test the blocks in the third point loading apparatus as described in ASTM C 78.  
   ♦ Report the average of the 2 blocks. |

**Thixotropy**

The thixotropy test applies to the following epoxy types: I, II, III, VIII, and X.

**Thixotropy Test (Except Type X)**

Refer to the following table to determine the conditioning temperatures, the form thickness, and measurement type required for each type of epoxy.

<table>
<thead>
<tr>
<th>Testing Parameter</th>
<th>Type I</th>
<th>Type II</th>
<th>Type III</th>
<th>Type VIII</th>
</tr>
</thead>
</table>
| **Conditioning Temperature** | As specified  
   60 ±2°F (16 ±1°C)  
   80 ±2°F (27 ±1°C)  
   or  
   105 ±2°F (41 ±1°C) | 120 ±2°F (49 ±1°C) | 120 ±2°F (49 ±1°C) | 77 ±2°F (25 ±1°C) |
| **Form Thickness** | 0.1 in. (2.5 mm) | 0.1 in. (2.5 mm) | 0.05 in. (1.3 mm) | 0.25 in. (6.4 mm) |
| **Measurement Type** | Sag | Sag | Thickness Retained | Sag |
| **Special Instructions** | - | - | - | Test with epoxy and sand mixture |
Apparatus

Use the following apparatus:

- forced-draft oven, capable of maintaining temperatures of 120 ±2°F (49 ±1°C)
- environmental chamber, capable of maintaining temperatures of 60 ±2°F (16 ±1°C), 80 ±2°F (27 ±1°C), and 105 ±2°F (41 ±1°C) [Type I only]
- thickness gauge, with a resolution of at least 0.00005 in. (0.001 mm)
- calipers with a resolution of at least 0.001 in. (0.03 mm)
- smooth, clean metal plate 3 in. × 6 in. (76 mm × 152 mm) approximately 0.1 in. (2.5 mm) thick
- steel forms 3 in. × 6 in. (76 mm × 152 mm) with 2 in. × 4 in. (51 mm × 102 mm) cutout in the center of the following thicknesses: 0.1 in. (2.5 mm), 0.05 in. (1.3 mm), and 0.25 in. (6.4 mm)
- metal spatula
- metal ointment cans, 3 fl. oz. (85 mL)
- balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K.

Procedure

The following procedure describes the thixotropy test for epoxy types I, II, III, and VIII.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | Obtain the epoxy.  
  ♦ Using the component ratios, determine the amount of each component necessary to produce 50 g of mixed epoxy.  
  ♦ Measure each component into separate 3 fl. oz. (85 mL) metal ointment cans. |
| 2    | Obtain the metal plate and form.  
  ♦ Obtain the 3 in. × 6 in. (76 mm × 152 mm) metal plate and the 3 in. × 6 in. (76 mm × 152 mm) metal form with a 2 in. × 4 in. (51 mm × 102 mm) cutout in the center. Use a form of the thickness specified.  
  ♦ If measuring the amount of sag, scribe a mark across the metal plate 1 in. from the edge and parallel to the 3 in. (76 mm) side. The mark will correspond with 1 end of the 2 in. × 4 in. (51 mm × 102 mm) cutout in the steel form. |
| 3    | Condition the epoxy components, metal plate, steel form, and a spatula at the temperature specified. |
| 4    | Mix the epoxy.  
  ♦ Remove the epoxy components and a spatula from the oven or environmental chamber if necessary.  
  ♦ Transfer the resin to the hardener can and mix with a spatula for 3 min. |

NOTE: For type II epoxy, perform Steps 4–7 within 2 min.
### Thixotropy Test

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| **5** | Set up the metal plate and form.  
♦ Remove the steel plate and form from the oven or the environmental chamber if necessary.  
♦ Place them on a horizontal surface with 2 or 3 sheets of paper or a piece of thin cardboard under the steel plate.  
♦ Place the form on the plate, and align the sides of the plate and the form.  
♦ If measuring the amount of sag, align the scribed mark with 1 side of the 2 in. × 4 in. (51 mm × 102 mm) cutout in the form. Make note of where the mark is. |
| **6** | Form the epoxy panel.  
♦ Pour an excess of mixed adhesive immediately into the form.  
♦ Use a spatula to screed adhesive on the top surface of the form.  
*NOTE:* Be careful not to allow the form to shift during the screeding process.  
♦ Slowly lift the form upward.  
*NOTE:* This will leave a 2 in. × 4 in. (51 mm × 102 mm) panel of epoxy on the plate. |
| **7** | Stand the steel plate vertically.  
♦ The 6 in. (152 mm) sides of the plate are vertical and the 3 in. (76 mm) sides are on the top and bottom.  
♦ If measuring the amount of sag, make sure the scribed end of the plate is at the bottom.  
♦ Condition the plate at the temperature specified until the epoxy has hardened. |
| **8** | To determine the amount of sag, perform the following:  
♦ After the adhesive has hardened, remove the plate from the oven or environmental chamber if necessary.  
♦ Measure the distance the epoxy sagged over the edge of scribed line.  
♦ Take 3 measurements, one at the center and one at each edge.  
♦ Average the 3 measurements.  
♦ Report the average to the nearest 0.01 in. (0.5 mm). |
| **9** | To measure the amount of thickness retained by the epoxy, perform the following:  
♦ Remove the plate with the epoxy panel from the oven.  
♦ Allow the plate to cool to room temperature.  
♦ Using the thickness gage, take 8 measurements, 4 on each side of the epoxy layer.  
• Before taking each thickness reading, zero the thickness gauge by measuring the thickness of steel plate next to the 4 readings on each side.  
• Start measuring the epoxy thickness at 0.5 in. (13 mm) from the top and sides, then read down 1 in. (25.4 mm) apart and 0.5 in. (13 mm) from side.  
♦ Average all readings and report to the nearest 0.001 in. (0.05 mm). |
Thixotropy Test for Epoxy Type X

♦ Apparatus

Use the following apparatus:

- balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K
- thermometer, range 66 to 80°F (19 to 27°C) (F17 thermometer as shown in ASTM E 1)
- thickness gauge, with a resolution of at least 0.00005 in. (0.001 mm)
- smooth steel plates 5 in. × 8 in. × 0.1 in. (127 mm × 203 mm × 2.5 mm)
- adjustable film former, such as a Boston Bradley draw-down gauge with a path at least 3 in. wide and the opening set at approximately 16 mils.
- metal ointment can, 6 fl. oz. (170 mL)
- metal spatula.

♦ Procedure

The following procedure describes thixotropy for epoxy type X.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | Determine the thickness of the metal plate.  
     ♦ Determine the average thickness to the nearest 0.001 in. (0.03 mm) of a 2 in. × 4 in. (51 mm × 102 mm) area on a smooth, clean 5 in. × 8 in. (127 mm × 203 mm) steel plate.  
     ♦ The 2 in. × 4 in. (51 mm × 102 mm) area is defined as 3 in. (76 mm) from the top and 1 in. (25 mm) from the bottom along the 8 in. (203 mm) dimension, and 1.5 in. (38 mm) from each side along the 5 in. (127 mm) dimension of the plate.  
     ♦ Using the thickness gage, take 8 random readings, and record the average. |
| 2    | Mix the epoxy.  
     ♦ Ensure that the initial temperature of each epoxy component is 77 ±2°F (25 ±1°C).  
     ♦ Using the component ratios, determine the amount of each component necessary to produce 100 g of mixed epoxy.  
     ♦ Weigh out the components into a metal can.  
     ♦ Stir the 2 components of the epoxy coating for 5 min. |
| 3    | Form the epoxy panel.  
     ♦ Using approximately half of the mixed material, apply the epoxy on the plate in 2 lines of equal amounts, one at top and other at center of the steel plate.  
     ♦ Draw a 16-mil film down the length of the steel plate using the film former. |
| 4    | Stand the steel plate vertically.  
     ♦ After forming the epoxy film, stand the steel panel in a vertical position on its short edge.  
     ♦ Make sure that no more than 10 min. elapse between the mixing time and the placing of the steel panel in the vertical position.  
     ♦ Let stand overnight. |
| 5    | Measure the thickness retained by the epoxy. |
Thixotropy Test

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>♦</td>
<td>After the epoxy has hardened, measure the average thickness of coating covering the 2 in. × 4 in. (51 mm × 102 mm) area of the steel plate defined in Step 1.</td>
</tr>
<tr>
<td>♦</td>
<td>Take 8 random readings.</td>
</tr>
<tr>
<td>6</td>
<td>Determine the average cured coating thickness by subtracting the average steel panel thickness from the average of total panel plus coating thickness.</td>
</tr>
</tbody>
</table>

Adhesive Shear Strength

**Apparatus**

Use the following apparatus:

♦ steel specimens 1 in. × 6.5 in. × 0.064 in. (25 mm × 165 mm × 1.6 mm)

♦ sandblasting machine

♦ garnet blasting abrasive, 36 mesh

♦ A testing machine as described in Section 5 of ASTM D 1002, "Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)."

**Procedure**

The following procedure describes the adhesive shear strength test for type II epoxy.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Follow the procedure outlined in ASTM D 1002, &quot;Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal).&quot;</td>
</tr>
<tr>
<td>2</td>
<td>Prepare the surfaces of the individual precut specimens by sandblasting to white metal.</td>
</tr>
<tr>
<td>3</td>
<td>Clean blasted ends with compressed air.</td>
</tr>
<tr>
<td>4</td>
<td>Cure the test specimens for 7 days at 70 to 80°F (21 to 27°C) before testing.</td>
</tr>
</tbody>
</table>
Impact Strength

Apparatus

Use the following apparatus:

- balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K
- disk mold to make a 2.5 ±0.5 in. (64 ±1 mm) diameter by 0.37 ±0.01 in. (9.5 ±0.3 mm) thick disk
- sanding lathe
- machined steel plate, 6 × 6 × 0.5 in. (152 × 152 ×13 mm)
- steel pipe, 2 in. (51 mm) inside diameter, approximately 3 ft. (1 m) in length
- steel ball, 1 lb. (454 g)
- metal ointment can, 6 fl. oz. (170 mL).

Procedure

The following procedure describes the impact strength test for type II epoxy.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Obtain at least 3 disk molds to make 2.5 ±0.5 in. (64 ±1 mm) diameter by 0.37 ±0.01 in. (9.5 ±0.3 mm) thick disks.</td>
</tr>
</tbody>
</table>
| 2    | Mix the epoxy.  
   ♦ Ensure that the initial temperature of each epoxy component is 77 ±2°F (25 ±1°C).  
   ♦ Using the component ratios, determine the amount of each component necessary to produce 200 g of mixed epoxy.  
   ♦ Weigh out the components into a metal can.  
   ♦ Mix the epoxy for 3 min. |
| 3    | Make the epoxy disks.  
   ♦ Pour the epoxy into the disk molds.  
   ♦ Carefully tap disks on countertop to level material and remove bubbles.  
   ♦ Cure the disks for 7 days at 70 to 80°F (21 to 27°C). |
| 4    | Prepare the epoxy disks.  
   ♦ Remove the epoxy disks from the molds.  
   ♦ Grind or machine the plane surfaces of the disks flat and parallel.  
   ♦ The thickness of the finished disks is 0.30 ±0.02 in. (8 ±0.5 mm).  
   ♦ Smooth the specimens with a No. 180 grit sandpaper.  
   ♦ Blow clean the disks with oil-free compressed air.  
   *NOTE: Be careful not to heat the disks above 120°F (49°C) when machining or grinding.* |
Impact Strength

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 5    | Set up the impact resistance test.  
      | ✦ Place the finished specimens on a machined steel plate securely attached to a concrete slab.  
      | ✦ Place the 3 ft. (1 m) steel pipe above the machined steel plate such that the top of the pipe is 5 ft. (1.5 m) above the plate.  
      | ✦ Place the epoxy disk on the steel plate directly below the pipe.  
      | ✦ The pipe acts as a guide for the ball to fall on the epoxy disk. |
| 6    | Perform the impact resistance test.  
      | ✦ Drop a 1 lb. (454 g) ball onto the center of the disks from an initial height of 5 ft. (1.5 m)  
      | ✦ Increase the height of the pipe by 6 in. (152 mm) for each successive drop until the specimen fails by cracking or shattering or until reaching a maximum height of 7 ft. (2.1 m).  
      | ✦ Record the height of the drop at which the failure occurs.  
      | ✦ Repeat for the rest of the specimens.  
      | **NOTE**: Do not allow the ball to strike the disk after rebounding from the test drop. |
| 7    | Report the average to the nearest 0.5 ft. lb. (0.7 joule). |

Wet Strength

The wet strength test is required for type II, IV, and IX.

**Apparatus**

Use the following apparatus:

✦ balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K

✦ metal spatula

✦ metal ointment can, 6 fl. oz. (170 mL)

✦ mortar briquettes

✦ water bath, capable of maintaining 100 ±2°F (38 ±1°C)

✦ water bath, capable of maintaining 73 ±2°F (23 ±1°C)

✦ a constant rate of crosshead movement testing machine as described in Section 5.1 of ASTM D 638 capable of maintaining a constant rate of travel of 0.05 in./min. (1.3 mm/min.) and applying a tensile force of at least 500 lbf. (2.2 kN) Use grips to hold specimens as described in Section 4.7 of ASTM C 190.
**Procedure**

The following procedure describes the wet strength test for epoxy types II, IV, and IX.

**Wet Strength Test**

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1. Prepare briquettes | ♦ Obtain 3 sets of mortar briquettes made in accordance with "Prepare mortar briquettes" of the "Tensile Bond" procedure.  
♦ Sandblast the bonding face of each mortar briquette.  
♦ Clean the bonding faces of 3 sets of briquettes with compressed air.  
♦ For type IX epoxy:  
  • Soak the briquettes in distilled or deionized water at 77 ±2°F (25 ±1°C) for 24 hr.  
  • Remove the briquettes from the water bath and blow the bonding faces dry with oil-free compressed air. |
| NOTE: Do not touch bonding faces after sandblasting. |
| 2. Mix the epoxy. | ♦ Ensure that the initial temperature of each epoxy component is 77 ±2°F (25 ±1°C)  
♦ Using the component ratios, determine the amount of each component necessary to make a total 50 g of mixed epoxy.  
♦ Weigh 50 g of epoxy components in a metal can.  
♦ Mix with a spatula for 3 min. |
| 3. Prepare the specimen. | ♦ Place a small amount of epoxy on the bonding face of each briquette.  
♦ Use a spatula to spread the epoxy uniformly across the bonding face.  
♦ Place the faces of 2 briquettes halves together with light pressure, and repeat for the remaining briquettes.  
♦ Remove the excess epoxy from the edges of the bonded area with a spatula and stand upright.  
**NOTE:** For type II epoxy, allow no more than 6 min. to elapse during preparation of the specimens. |
| 4. Condition the specimen. | ♦ Allow the briquettes to cure for 24 hr. at 77 ±2°F (25 ±1°C).  
♦ Immediately transfer the briquettes to an oven at 120 ±2°F (49 ±1°C) for 48 hr.  
♦ Immerse the cured specimens in a distilled or deionized water bath maintained at 100 ±2°F (38 ±1°C) for 4 days.  
♦ Remove specimens and place them in a distilled or deionized water bath at 73 ±2°F (23 ±1°C) for 1 hr. |
| 5. Set up the tensile machine for testing. | ♦ Start up tensile machine according to manufacturer's instructions.  
♦ Balance and calibrate the tensile machine.  
♦ Place the grips on the machine.  
♦ Set the crosshead speed to 0.05 in./min. (1.3 mm/min.). |
| 6. Test the specimen. | ♦ Load a briquette into the tensile machine.  
♦ Start the testing machine and load until break. |
### Wet Strength Test

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>♦</td>
<td>Record the load at break.</td>
</tr>
<tr>
<td>♦</td>
<td>Repeat the test for the remaining specimen.</td>
</tr>
<tr>
<td>7</td>
<td>Report the average load at break as the wet bond strength.</td>
</tr>
<tr>
<td>8</td>
<td>Test one more set of specimens if any of the tested briquettes fail in the mortar at strengths below 270 psi (1862 kPa).</td>
</tr>
</tbody>
</table>

### Wet Pullout Strength

#### Apparatus

Use the following apparatus:

- ♦ balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K
- ♦ rebar, grade 60, #3, 30 in. (760 mm) in length
- ♦ concrete block with a minimum size of 6 in. × 6 in. × 8 in. (150 mm × 150 mm × 200 mm) or a concrete cylinder with a minimum size of 6 in. (150 mm) diameter and 8 in. (200 mm) high. The block or cylinder must be compression rated at 5,000 ±500 lb. (22.3 ±2.2 kN)
- ♦ water bath at 77 ±3°F (25 ±2 °C)
- ♦ carbide tip masonry drill bit, 6 in. × 5/8 in. diameter (150 mm × 13 mm)
- ♦ hammer drill
- ♦ metal ointment can, 6 fl. oz. (170 mL)
- ♦ a constant rate of crosshead movement testing machine as described in Section 5.1 of ASTM D 638 capable of maintaining a constant rate of travel of 0.2 in./min. (5 mm/min.) and applying a tensile force of at least 10,000 lbf. (44.5 kN).
- ♦ mechanical wedge grips, use wedge grips with v-shaped jaw faces to grab the rebar end of the pullout specimen.
Use the fixture shown in Figure 1 to hold the concrete block end of the pullout specimen. This apparatus consists of the following: 1 steel plate, 4 steel rods with threading on both ends, and 4 bolts. The plate must be 10.75 in. × 8.75 in. × 0.5 in. (273 mm × 222 mm × 13 mm). The plate must have 5 holes: four 0.8 in. (20 mm) diameter holes, one in each corner, and one 1.75 in. (44 mm) diameter hole in the center. The 4 steel rods must be 13.75 in. (350 mm) long and 0.77 in. (20 mm) in diameter with 2.25 in. (57 mm) of threading on each end. The threading must be able to fasten into the bottom plate of the testing machine on one end and fasten into the bolts on the other end. The dimensions may be altered to accommodate other testing machines.

Figure 1. Fixture for holding a concrete block during a wet pullout test.
**Procedure**

The following outlines the procedure for wet pullout strength.

**Wet Pullout Strength Test**

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Prepare the concrete block.</td>
</tr>
<tr>
<td>♦</td>
<td>Drill a hole, 5/8 in. (13 mm) diameter and 3.5 in. (90 mm) in depth, located at the center of the top surface of the concrete block or cylinder.</td>
</tr>
<tr>
<td>♦</td>
<td>Remove debris and dust from the hole using moisture-free compressed air.</td>
</tr>
<tr>
<td>♦</td>
<td>Ensure the rebar fits without binding.</td>
</tr>
<tr>
<td>2</td>
<td>Mix the epoxy.</td>
</tr>
<tr>
<td>♦</td>
<td>Ensure that the initial temperature of each epoxy component is 77 ±2°F (25 ±1°C)</td>
</tr>
<tr>
<td>♦</td>
<td>Using the component ratios, determine the amount of each component necessary to make a total 50 g of mixed epoxy.</td>
</tr>
<tr>
<td>♦</td>
<td>Weigh 50 g of epoxy components into a metal can.</td>
</tr>
<tr>
<td>♦</td>
<td>Mix with a spatula for 3 min.</td>
</tr>
<tr>
<td>3</td>
<td>Prepare the specimen.</td>
</tr>
<tr>
<td>♦</td>
<td>Place the epoxy in the hole.</td>
</tr>
<tr>
<td>♦</td>
<td>Insert the rebar the entire depth of the hole.</td>
</tr>
<tr>
<td>♦</td>
<td>Rotate the rebar several times to ensure that the epoxy adequately coats the rebar and to remove air pockets in the epoxy.</td>
</tr>
<tr>
<td>♦</td>
<td>Repeat filling the hole and inserting the rebar as necessary until the hole is full.</td>
</tr>
<tr>
<td>♦</td>
<td>Remove excess epoxy from the surface of the cylinder.</td>
</tr>
<tr>
<td>♦</td>
<td><strong>NOTE:</strong> To ensure a valid test, the rebar must remain plumb and centrally located in the hole.</td>
</tr>
<tr>
<td>4</td>
<td>Cure the specimen.</td>
</tr>
<tr>
<td>♦</td>
<td>Cure the specimen in air for 24 hr. at 77 ±3°F (25 ±2°C).</td>
</tr>
<tr>
<td>♦</td>
<td>Submerge the block into a water-bath at 77 ±3°F (25 ±2°C) in an upright position for 6 days.</td>
</tr>
<tr>
<td>5</td>
<td>Set up the tensile machine for testing.</td>
</tr>
<tr>
<td>♦</td>
<td>Start up tensile machine according to manufacturer's instructions.</td>
</tr>
<tr>
<td>♦</td>
<td>Balance and calibrate the tensile machine.</td>
</tr>
<tr>
<td>♦</td>
<td>Place a wedge grip on the testing machine as the top fixture.</td>
</tr>
<tr>
<td>♦</td>
<td>Screw the four rods into the bottom plate of the testing machine.</td>
</tr>
<tr>
<td>♦</td>
<td>Set the crosshead speed to 0.2 in./min. (5 mm/min.)</td>
</tr>
<tr>
<td>6</td>
<td>Load the specimen in the testing machine.</td>
</tr>
<tr>
<td>♦</td>
<td>Place the specimen in between the rods.</td>
</tr>
<tr>
<td>♦</td>
<td>Place the steel plate over the block. Fit the rebar through the center hole and the 4 rods through the 4 holes at the corners of the plate.</td>
</tr>
<tr>
<td>♦</td>
<td>Grip the rebar in the wedge grip.</td>
</tr>
<tr>
<td>♦</td>
<td>Lift the block 2 in. and adjust the block to ensure the rebar is pulling straight. With the block lifted, tighten the 4 nuts to the steel plate.</td>
</tr>
<tr>
<td>7</td>
<td>Test the specimen.</td>
</tr>
<tr>
<td>♦</td>
<td>Start the testing machine and load until break.</td>
</tr>
</tbody>
</table>
Wet Pullout Strength Test

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>♦</td>
<td>Record the load at break.</td>
</tr>
<tr>
<td>8</td>
<td>Report the load at break as the wet pullout strength.</td>
</tr>
</tbody>
</table>

Grind – Epoxy X

The grind test is only required for epoxy type X.

Apparatus

Use the following apparatus:

♦ balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K
♦ metal spatula
♦ metal ointment can, 3 fl. oz. (85 mL)
♦ tapered gage, a hardened steel, stainless steel, or chrome-plated steel block approximately 7.5 in. (190 mm) in length, 3.5 in. (90 mm) in width, and 1 in. (25 mm) in thickness. The top surface of the block is ground smooth and planar and contains a 5 in. (127 mm) long by 2 in. (50 mm) wide path. The path is tapered uniformly in depth lengthwise from about 4 mils (100 μm) at 0.4 in. (10 mm) from one end to zero depth at the other with intermediate calibrations in accordance with the depth at those points. The preferred calibration is Hegman units.
♦ scraper, a double edged hardened steel, stainless steel, or chrome-plated steel blade 3.75 in. (95 mm) long, 1.5 in. (40 mm) wide, and 0.25 in. (6.4 mm) thick. The two edges on the 3.75 in. sides are rounded to a radius of 0.015 in. (0.38 mm).

Procedure

The following procedure describes the grind test for epoxy type X.

Grind Test

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Prepare the epoxy.</td>
</tr>
<tr>
<td>♦</td>
<td>Weigh 10 g of the resin component into a metal can.</td>
</tr>
<tr>
<td>♦</td>
<td>Add 2 g of xylene.</td>
</tr>
<tr>
<td>♦</td>
<td>Stir until it is a homogenous mixture.</td>
</tr>
<tr>
<td>2</td>
<td>Perform the grind test on the epoxy resin according to ASTM D 1210, &quot;Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage.&quot;</td>
</tr>
</tbody>
</table>
### Grind Test

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 3    | Record the results.  
**NOTE:** Refer to ASTM D 1210 for guidance on interpretation of test results. |

### Bond Strength of Fresh Concrete to Cured Concrete

This test method applies to types V and VII epoxy.

**Apparatus**

Use the following apparatus:

- balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K
- metal spatula
- metal ointment can, 3 fl. oz. (85 mL)
- mortar briquettes
- sand and cement to prepare mortar as described in ASTM C 190
- briquette molds as described in ASTM C 190
- a constant rate of crosshead movement testing machine as described in Section 5.1 of ASTM D 638 capable of maintaining a constant rate of travel of 0.05 in./min. (1.3 mm/min.) and applying a tensile force of at least 500 lbf. (2.2 kN). Use grips to hold specimens as described in Section 4.7 of ASTM C 190.

**Procedure**

The following procedure describes the bonding fresh to cured concrete test.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | Prepare briquettes  
♦ Obtain briquettes made in accordance with "Prepare Mortar Briquette" of the "Tensile Bond" procedure.  
♦ Sandblast the bonding face of each mortar briquette.  
♦ Clean the bonding faces of the briquettes with compressed air.  
**NOTE:** Do not touch bonding faces after sandblasting. |
| 2    | Mix the epoxy.  
♦ Ensure that the initial temperature of each epoxy component is 77 ±2°F (25 ±1°C)  
♦ Using the component ratios, determine the amount of each component necessary to make a |
### Bonding Fresh Concrete to Cured Concrete Test

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>♦</td>
<td>total 50 g of mixed epoxy.</td>
</tr>
<tr>
<td>♦</td>
<td>Weigh 50 g of epoxy components into a metal ointment can.</td>
</tr>
<tr>
<td>♦</td>
<td>Mix with a spatula for 3 min.</td>
</tr>
<tr>
<td>♦</td>
<td>Apply epoxy to the briquettes.</td>
</tr>
<tr>
<td>♦</td>
<td>Take one of the briquettes and place a small amount of epoxy on the bonding face.</td>
</tr>
<tr>
<td>♦</td>
<td>Use a spatula to spread the epoxy uniformly across the surface.</td>
</tr>
<tr>
<td>♦</td>
<td>Repeat for the remaining briquettes.</td>
</tr>
<tr>
<td>♦</td>
<td>Mold new mortar to the briquettes to make complete tensile specimen.</td>
</tr>
<tr>
<td>♦</td>
<td>Prepare new mortar as described in the ‘Tensile Bond’ procedure.</td>
</tr>
<tr>
<td>♦</td>
<td>Place each briquette into a briquette mold.</td>
</tr>
<tr>
<td>♦</td>
<td>Mold the new mortar against each of the 3 briquettes to form 3 complete tensile specimens.</td>
</tr>
<tr>
<td>♦</td>
<td>Cure the specimen for 7 days, according to ASTM C 190.</td>
</tr>
<tr>
<td>♦</td>
<td>Set up the tensile machine for testing.</td>
</tr>
<tr>
<td>♦</td>
<td>Start up tensile machine according to manufacturer's instructions.</td>
</tr>
<tr>
<td>♦</td>
<td>Balance and calibrate the tensile machine.</td>
</tr>
<tr>
<td>♦</td>
<td>Place the grips on the machine.</td>
</tr>
<tr>
<td>♦</td>
<td>Set the crosshead speed to 0.05 in./min. (1.3 mm/min.)</td>
</tr>
<tr>
<td>♦</td>
<td>Test the tensile specimen.</td>
</tr>
<tr>
<td>♦</td>
<td>Load a specimen into the tensile machine.</td>
</tr>
<tr>
<td>♦</td>
<td>Start the testing machine and load until break.</td>
</tr>
<tr>
<td>♦</td>
<td>Record the load at break.</td>
</tr>
<tr>
<td>♦</td>
<td>Repeat the test for the remaining specimen.</td>
</tr>
<tr>
<td>♦</td>
<td>Report the average load at break as the bond strength.</td>
</tr>
<tr>
<td>♦</td>
<td>Test one more set of specimens if any of the tested specimens fail in the mortar at strengths below 270 psi (1862 kPa).</td>
</tr>
</tbody>
</table>

### Old Concrete to New Grout Mix

This test procedure applies to type VIII epoxy only.

**Apparatus**

Use the following apparatus:

- ♦ balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K
- ♦ metal spatula
- ♦ friction top can, 1 pt. (500 mL), with friction lip removed
- ♦ mortar briquettes
briquette molds as described in ASTM C 190

a constant rate of crosshead movement testing machine as described in Section 5.1 of ASTM D 638 capable of maintaining a constant rate of travel of 0.05 in./min. (1.3 mm/min.) and applying a tensile force of at least 500 lbf. (2.2 kN) Use grips to hold specimens as described in Section 4.7 of ASTM C 190.

**Procedure**

The following procedure describes old concrete to new grout test for type VIII epoxy.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | Prepare the briquettes.  
♦ Obtain 3 briquettes made in accordance with "Prepare Mortar Briquette" of the "Tensile Bond" procedure.  
♦ Sandblast the bonding face of each mortar briquette.  
♦ Clean the bonding faces of the briquettes with compressed air.  
*NOTE:* Do not touch bonding faces after sandblasting. |
| 2    | Mix the epoxy grout.  
♦ Ensure that the initial temperature of each epoxy component is 77 ±2°F (25 ±1°C).  
♦ Using the component ratios, determine the amount of each component necessary to make a total 250 g of mixed grout.  
♦ Weigh the grout components in a 1 pt. (500 mL) can.  
♦ Mix with a spatula for 3 min. |
| 3    | Mold epoxy grout to the briquettes to make complete tensile specimen..  
♦ Place each briquette into a briquette mold.  
♦ Mold the epoxy grout against each of the 3 briquettes to form 3 complete tensile specimens.  
♦ Cure the specimen for 7 days at 77 ±2°F (25 ±1°C). |
| 4    | Set up the tensile machine for testing.  
♦ Start up tensile machine according to manufacturer's instructions.  
♦ Balance and calibrate the tensile machine.  
♦ Place the grips on the machine.  
♦ Set the crosshead speed to 0.05 in./min. (1.3 mm/min.) |
| 5    | Test the tensile specimen.  
♦ Load a specimen into the tensile machine.  
♦ Start the testing machine and load until break.  
♦ Record the load at break.  
♦ Repeat the test for the remaining specimen. |
| 6    | Report the average load at break as the bond strength.  
♦ Test one more set of specimens if any of the tested specimen fail in the cement mortar at strengths below 270 psi (1862 kPa). |
**Hiding Power**

This test procedure applies to type X epoxy only.

**Apparatus**

Use the following apparatus:

- balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K
- black and white paper charts that are smooth and level, and impervious to paint liquids. The black area must have a maximum reflectance of 1% and the white area a minimum reflectance of 78%. The white area must be nonflourescent.
- draw down gauge, 5 mil
- vacuum platter or other suitable device
- reflectance measurement instrument that allows diffusely reflected, radiant flux to be incident upon the measuring element. It must employ a photometric system, including source, filters, and receptor, that provides a response closely similar to the product of the spectral luminous efficiency function of the CIE standard observer and source C. It must provide readings to at least the third decimal place and permit estimation to the fourth.
- metal ointment can, 6 fl. oz. (170 mL).

**Procedure**

The following procedure describes the hiding power test for epoxy type X.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | Mix the epoxy.  
   ♦ Ensure that the initial temperature of each epoxy component is 77 ±2°F (25 ±1°C).  
   ♦ Using the component ratios, determine the amount of each component necessary to make a total 50 g of mixed epoxy.  
   ♦ Weigh the components into a metal can.  
   ♦ Mix with a spatula for 5 min. |
| 2    | Draw down a 5 mil thick film on the black and white paper chart.  
   ♦ Place the black and white paper chart on a flat surface.  
   ♦ Pour 2 horizontal lines of mixed epoxy on the black and white paper, one on each color.  
   ♦ Make the lines the width of the draw down gage.  
   ♦ Put the draw down gage at the top of the paper, and draw it down at approximately 2.4 in./sec. (61 mm/sec.). |
| 3    | Allow the film to dry.  
   ♦ Place the black and white paper chart in a well-ventilated dust free location. |
### Hiding Power

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>♦</td>
<td>Allow to dry overnight.</td>
</tr>
<tr>
<td>4</td>
<td>Measure the reflectance and determine the contrast ratio.</td>
</tr>
<tr>
<td>♦</td>
<td>Measure the reflectance at 3 random points on each color.</td>
</tr>
<tr>
<td>♦</td>
<td>Calculate the contrast ratio by dividing the reflectance on white substrate ((Y_w)) into the reflectance on black substrate ((Y_b)).</td>
</tr>
</tbody>
</table>

### Water Gain

This test procedure applies to type VIII epoxy only.

**Apparatus**

Use the following apparatus:

- ♦ disk mold to make a 2.5 ±0.5 in. (64 ±1 mm) diameter by 0.37 ±0.01 in. (9.5 ±0.3 mm) thick disk
- ♦ distilled or deionized water
- ♦ glass container, approximately 6 to 10 in. (152 to 254 mm) deep and 4 to 5 in. (102 to 127 mm) in diameter
- ♦ silicon carbide sandpaper No. 180 grit
- ♦ machine lathe
- ♦ analytical balance with a minimum capacity of 100 g, which meets the requirements of Tex-901-K.

**Procedure**

The following procedure describes the water gain test.

<table>
<thead>
<tr>
<th>Water Gain Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>
### Water Gain Test

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>♦</td>
<td>Pour the epoxy into the disk molds.</td>
</tr>
<tr>
<td>♦</td>
<td>Carefully tap disks on countertop to level material and remove bubbles.</td>
</tr>
<tr>
<td>♦</td>
<td>Cure the disks for 7 days at 70 to 80°F (21 to 27°C).</td>
</tr>
<tr>
<td>4</td>
<td>Prepare the epoxy disks.</td>
</tr>
<tr>
<td>♦</td>
<td>Remove the epoxy disks from the molds.</td>
</tr>
<tr>
<td>♦</td>
<td>Grind or machine the plane surfaces of the disks flat and parallel.</td>
</tr>
<tr>
<td>♦</td>
<td>The thickness of the finished disks must be 0.30 ±0.02 in. (8 ±0.5 mm).</td>
</tr>
<tr>
<td>♦</td>
<td>Smooth the specimens with No. 180 grit sandpaper.</td>
</tr>
<tr>
<td>♦</td>
<td>Blow clean the disks with oil-free compressed air.</td>
</tr>
<tr>
<td></td>
<td><em>NOTE:</em> Be careful not to heat the disks above 120°F (49°C) when machining or grinding.</td>
</tr>
<tr>
<td>5</td>
<td>Weigh the disks on an analytical balance to the nearest 0.001g.</td>
</tr>
<tr>
<td>6</td>
<td>Immerse the disks in a water bath.</td>
</tr>
<tr>
<td>♦</td>
<td>Fill a water bath with distilled or deionized water.</td>
</tr>
<tr>
<td>♦</td>
<td>Ensure the water temperature is maintained at 77 ±4°F (25 ±2°C).</td>
</tr>
<tr>
<td>♦</td>
<td>Immerse the disks in the water bath for 24 hr.</td>
</tr>
<tr>
<td>7</td>
<td>Weigh the saturated disks to determine the water gain.</td>
</tr>
<tr>
<td>♦</td>
<td>Remove one of the disks from the water bath.</td>
</tr>
<tr>
<td>♦</td>
<td>Wipe the surface water off with a dry cloth.</td>
</tr>
<tr>
<td>♦</td>
<td>Immediately weigh the disk to the nearest 0.001g.</td>
</tr>
<tr>
<td>♦</td>
<td>Repeat for the other 2 disks.</td>
</tr>
<tr>
<td>8</td>
<td>Calculate the percent increase in weight of each disk. Average the results and report to the nearest 0.1%.</td>
</tr>
</tbody>
</table>

### Calculations

**Increase in weight**

\[
\text{Increase in weight, } \% = \frac{\text{wet weight} - \text{conditioned weight}}{\text{conditioned weight}} \times 100
\]

Where:

- increase in weight, \% = percent increase in the weight of the sample
- wet weight = weight in grams of the sample after soaking in water
- conditioned weight = weight in grams of the conditioned sample before soaking in water.

### Contact Time

This test procedure applies to type I epoxy only.
Apparatus

Use the following apparatus:

♦ balance, with minimum capacity of 2000 g, which meets the requirements of Tex-901-K
♦ metal spatula
♦ metal ointment can, 6 fl. oz. (170 mL)
♦ mortar briquettes.

Procedure

The following procedure describes the contact time test.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | Prepare the briquettes.  
      ♦ Obtain 3 sets of mortar briquettes made in accordance with "Prepare Mortar Briquette" of the "Tensile Bond" procedure.  
      ♦ Sandblast the bonding face of each mortar briquette.  
      ♦ Clean the bonding faces of the briquettes with compressed air.  
      *NOTE:* Do not touch bonding faces after sandblasting. |
| 2    | Mix the epoxy.  
      ♦ Condition epoxy components to the temperature specified.  
      ♦ Using the component ratios, determine the amount of each component necessary to make a total 50 g of mixed epoxy.  
      ♦ Weigh 50 g of epoxy components in a metal can.  
      ♦ Mix with a spatula for 3 min. |
| 3    | Prepare the specimen.  
      ♦ Take one of the briquettes and place a small amount of epoxy on the bonding face.  
      ♦ Use a spatula to spread the epoxy uniformly across the surface.  
      ♦ Repeat for remaining briquettes.  
      ♦ Let the briquette halves sit for 60 min. at the temperature specified. |
| 4    | After 60 min., put 2 briquette halves together. If the briquettes adhere together, the epoxy meets the 60 min. contact time requirement. If the epoxy has hardened and the briquettes do not stick together, the epoxy does not meet the 60 min. contact time requirement. |
Section 4

Archived Versions

The following archived versions of Test Method "Tex-614-J, Testing Epoxy Materials" are available:

- **614-0899** for the test procedure effective August 1999 through May 2000.
- **614-0600** for the test procedure effective June 2000 through December 2000.
- **614-0101** for the test procedure effective January 2001 through July 2002.
- **614-0802** for the test procedure effective August 2002 through June 2006.