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**Test Procedure for the****OVERLAY TEST****TxDOT Designation: Tex-248-F (Revised)****Effective Date: January 2012**

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**1. SCOPE**

- 1.1 This test method determines the susceptibility of bituminous mixtures to fatigue or reflective cracking. This test method measures the number of cycles to failure.
- 1.2 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.
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**2. APPARATUS**

- 2.1 *Overlay Tester (OT)*—an electro-hydraulic system that applies repeated direct tension loads to specimens. The machine features two blocks, one is fixed and the other slides horizontally. The device automatically measures and records load, displacement, and temperature every 0.1 sec.

The sliding block applies tension in a cyclic triangular waveform to a constant maximum displacement of 0.06 cm (0.025 in.). The sliding block reaches the maximum displacement and then returns to its initial position in 10 sec. (one cycle).

Additionally, the device includes:

- a temperature controlled chamber
- a linear variable differential transducer (LVDT) to measure the displacement of the block
- an electronic load cell to measure the load resulting from the displacement
- aluminum or steel base plates with associated screws to restrict shifting of the specimen during testing
- a mounting jig including a straightedge bar to align the two base plates for specimen preparation
- a space bar

Refer to the manufacturer for equipment range and accuracy of the LVDT and load cell.

- 2.2 *Marking/cutting Template*—Refer to Figure 1 through Figure 3

**Note:** Not required with Shedworks double blade saw.

- 2.3      *3/8-in. Socket Drive Handle with a 3-in. (7.6 cm) extension. Screw driver and wrench with torque capacity of 15 lb.*

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### 3. MATERIALS

- 3.1      Two-part epoxy with a minimum 24 hr. tensile strength of 4.1 MPa (600 psi) and 24 hr. shear strength of 13.8 MPa (2,000 psi) in accordance with Tex-614-J

**Note:** Devcon 2-ton epoxy is recommended.

- 3.2      1/4-in. width adhesive tape

**Note:** DG2501M CHIARTPAK ¼" graphic tape is recommended. However, the tape is not needed if the mounting jigs and plates shown in Figure 4 are used.

- 3.3      Spatula (tongue depressor) and disposal petri-dish to mix the glue

- 3.4      Paint pen or permanent marker

- 3.5      4.5 kg (10 lb.) weight

**Note:** The weight should not overlap the edge of the specimen. The recommended weight size is shown in Figure 5.

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### 4. SPECIMENS

- 4.1      *Laboratory Molded Specimens*—Prepare specimens according to Tex-205-F and Tex-241-F. Specimen diameter must be 150 mm (6 in.), and specimen height must be  $127 \pm 5$  mm ( $5.0 \pm 0.2$  in.). In general, it is recommended that the lab-molded specimens be tested within 5 days from the day of molding. Mold a minimum of two to three 5-inch tall replicate specimens per mix/variable.

**Note:** Mixtures modified with warm-mix asphalt additives or processes must be oven cured at 275°F for 4 hours  $\pm 5$  minutes before molding.

- 4.1.1      Density of the trimmed test specimen must be  $93 \pm 1\%$  (i.e., the air void should be  $7 \pm 1\%$ ).

**Note:** Experience has shown that molded laboratory specimens with  $91 \pm 1\%$  density usually result in trimmed test specimens that meet the  $93 \pm 1\%$  density requirement. This is a guide and depends on experience and knowledge of the specific materials.

**Note:** Mixture weights for specimens prepared in the laboratory typically vary between 4,500 and 5,000 g to achieve density. Mixture weights for specimens prepared in the laboratory vary with different aggregate sources and with different mix types.

- 4.2 *Core Specimens*—Specimen diameter must be  $150 \pm 2$  mm ( $6 \pm 0.1$  in.), and specimen height must be a minimum of 38 mm (1.5 in.). There is not a specific density requirement for core specimens.

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## 5. PROCEDURE

### 5.1 *Sample Preparation:*

- 5.1.1 Use cylindrically molded specimens according to Section 4.

**Note:** Test roadway cores for informational purposes only.

### 5.2 *Trimming of Cylindrical Specimen:*

- 5.2.1 Refer to the sawing device manufacturer's instructions for trimming specimens.

- 5.2.1.1 Place the cutting template (Figure 1) on the top surface of the laboratory molded specimen or roadway core. Trace the location of the first two cuts by drawing lines using paint or a permanent marker along both sides of the cutting template. For the 5.0-inch tall lab-molded samples, cut two specimens from the middle zone of the sample. It is important to ensure that the cut sides from the middle zone are the surfaces glued to the plates. For each mix and/or variable, a minimum of four replicate specimens should be fabricated and tested. However, experience has shown that fabricating and testing five replicates will generally yield more satisfactory results when the best three replicate results are selected.

**Note:** If one side of the sample has a slightly rougher surface, prepare the sample so that the rougher surface is at the top of the sample.

- 5.2.1.2 Trim the specimen edges by cutting the specimen perpendicular to the top surface following traced lines drawn with the template shown in Figure 1. If the sample size is out of tolerance, discard it.

Trim the top and bottom sections of the specimen to produce samples with a height of  $38 \pm 0.5$  mm ( $1.5 \pm 0.02$  in.). For the 5-inch tall samples, cut two specimens from the middle zone as exemplified in Figure 3. Discard the top and bottom parts of the sample.

**Note:** Refer to Figure 3. Always cut the test specimens from the middle zone of the molded samples where the air void is better uniformly distributed.

- 5.2.2 Measure the relative density of the trimmed specimen in accordance with Tex-207-F. Density for trimmed laboratory molded specimen must be  $93 \pm 1\%$ . Discard and prepare a new specimen if it does not meet the density requirement. Density for trimmed core specimens is for informational purpose only.

- 5.2.3 Dry the trimmed specimen at a maximum temperature of  $40 \pm 3^\circ\text{C}$  ( $104 \pm 5^\circ\text{F}$ ) to constant weight – Oven drying at  $40 \pm 3^\circ\text{C}$  ( $104 \pm 5^\circ\text{F}$ ) is recommended. Maximum drying time should be 24 hours. Discard all samples that are in the oven more than 24 hours.

**Note:** Constant weight is the weight at which further oven drying does not alter the weight by more than 0.05% in a 2-hr. interval.

### 5.3 *Mounting Trimmed Specimen to Base Plates:*

- 5.3.1 Old mounting jig and plates: Use matching sets of plates and a straightedge bar to align the plates. Mount and secure the base plates to the mounting jig. Cut a piece of adhesive tape approximately 102 mm (4.0 in.) in length. Center and place the tape over the gap between the base plates.

New mounting jig and plates: Use matching sets of plates and a space bar in the gap between the plates; see Figure 4. The new mounting jigs are designed to automatically center and align the plates. Using bolts to further secure the plates to the mounting jig is optional.

- 5.3.2 Prepare epoxy following manufacturer's instructions.

- 5.3.3 Cover the majority of both base plates with the epoxy including the tape. Glue the trimmed specimen to the base plates.

**Note:** Wipe any dirt or dust of the bottom of the specimen and plate surface prior to gluing. Glue the sample to the base plates.

**Note:** Experience has shown that  $14.0 \pm 2.0$  grams of the Devcon 2-ton Epoxy package are adequate for one sample. Too little or too much glue will contribute to inconsistent results. An excessive amount of epoxy on the base plates will result in the surplus epoxy squeezing out when pressure is applied. Spread glue on the bottom surface of the specimen as well.

Place a 4.5 kg (10 lb.) weight on top of the glued specimen to ensure full contact of the trimmed specimen to the base plates; see Figure 5. Allow the epoxy to cure for the time recommended by the manufacturer. Remove the weight from the specimen after the epoxy has cured.

**Note:** Experience has shown that a minimum of 8 hours curing time for Devcon 2-ton epoxy provides enough bonding strength.

**Note:** Complete the entire gluing process within the glue working time recommended by the manufacturer.

**Note:** Figure 5 shows the metal space bar with the new mounting jig and base plates. Ensure that the space bar is well lubricated on the sides (with Vaseline or other agents) before sliding it in between the plates. Be careful to steadily pull the space bar outward as straight as possible. While removing the space bar, press down on the middle weight to prevent the specimens from moving. In general, the metal space bar should be pulled out within 5 to 10 minutes after placing the 10 lb weight on top of the glued specimen.

- 5.4 Place the test sample assembly in a 25°C (77°F) temperature chamber for a minimum of 1 hour before testing.

### 5.5 *Starting Testing Device:*

- 5.5.1 Turn on the OT. Turn on the computer and wait at least 1 minute to establish communication with the overlay tester. Start the overlay test software.
- 5.5.2 Turn on the hydraulic pump using the overlay test software. If required, turn the machine to displacement mode.
- 5.6 *Mounting Specimen Assembly to Testing Device:*
- 5.6.1 Enter the required test information (operator name, specimen dimension, specimen density, test conditions, etc.) into the OT software. Mount the specimen assembly onto the machine according to the manufacturer's instructions and the following procedural steps.
- Clean the bottom of the base plates and the top of the testing machine blocks before placing the specimen assembly into the blocks. The machine, specimen, or base plates may be damaged when tightening the base plates if all surfaces are not clean.
  - Ensure that the machine is in displacement mode. Create a larger space between the machine's fixed plate and moving plate than the gap between the base plates in the specimen assembly to ensure a smooth loading.
  - Put the specimen assembly in the machine with one of the dowel pins aligned in the sleeve of the fixed plate.
  - Switch the machine from displacement mode to load mode. In the load mode, the moving plate will automatically drift towards the fixed plate, and the specimen assembly plate will drop into place. After the specimen is fully loaded (experiencing zero load), install the screws.
  - Leave the machine in load mode. Fasten the base plates to the machine by applying 15 lbs-ft (or 15 ft-lbs) of torque for each screw. Use a similar torquing pattern for all the replicate specimens. A crisscross pattern like the example shown in Figure 6 is recommended.
- 5.7 *Testing the Specimen:*
- 5.7.1 Wait for a minimum of ten minutes for specimen relaxation and then perform testing at a constant temperature of  $25 \pm 0.5^{\circ}\text{C}$  ( $77 \pm 1^{\circ}\text{F}$ ). The OT software Version 1.9.0 has an inbuilt time delay function that appears when the start button is enabled. The ten minute delay time can be input into the dialog box. The OT machine will start automatically once the countdown is completed.
- Note:** Ensure that the temperature of trimmed test specimen is  $25 \pm 0.5^{\circ}\text{C}$  ( $77 \pm 1^{\circ}\text{F}$ ).
- 5.7.2 In the case of lab-molded samples, all of the replicate specimens should be tested within five days after the day of molding – if not, the total sitting time should be recorded and reported as an integral part of the results. In general, all of the replicate specimens should be tested within the same timeframe to minimize variability in the test results due to the possibilities of differential oxidative aging effects among others.

- 5.7.3 Start the test by enabling the start button in the program. The OT software Version 1.9.0, will initiate a countdown of the delay time . The machine will start automatically once the countdown is completed. Perform testing until a 93% reduction or more of the maximum load measured from the first opening cycle occurs. If 93% is not reached, run the test to 1,000 cycles or any preset number of cycles.

Visually count the number of cracks (zero, single, or multiple) at the top of the specimen when the test is completed; see examples in Figure 7.

**Note:** Zero cracks on the surface can indicate either one of the following scenarios: (a) the test reached the maximum preset number of cycles before the sample was completely cracked, and (b) the glue failed (in which case, the tests should be discarded). More than one crack is unusual but normally results in a higher number of cycles to failure than the typical single crack case.

- 5.7.4 Remove the specimen assembly (and turn off the OT machine if needed).  
**Note:** Ensure the machine is in load mode before removing specimen assembly.

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## 6. REPORT

- 6.1 Report the following for each specimen:

- trimmed specimen density
- starting peak load
- final load
- percent decline in load
- number of cycles to failure
- number of observed cracks: zero, single, or multiple
- temperature
- for lab-molded specimens, also report the sitting time from the day of molding to the day of actual testing

- 6.2 In addition to the data reported in Item 6.1, also report the following for each mix, material, and/or variable evaluated:

- average cycles for the best three replicate results with the lowest COV out of a minimum of four or five replicates (then relate and compare with the OT pass-fail criteria specified for that specific material or mix; see Table 1) – a macro is available to automatically pick the best three based on the lowest COV.

- COV of the best three replicate results (COV of less than or equal to 30% indicates statistically good results).

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## 7. ARCHIVED VERSIONS

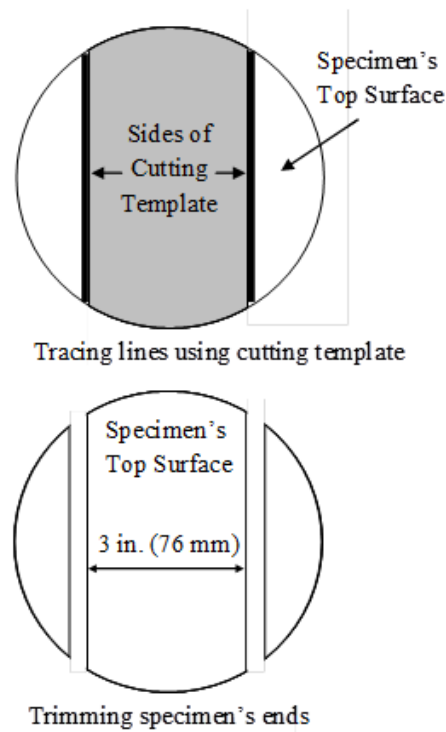
7.1.1 Archived versions are available.

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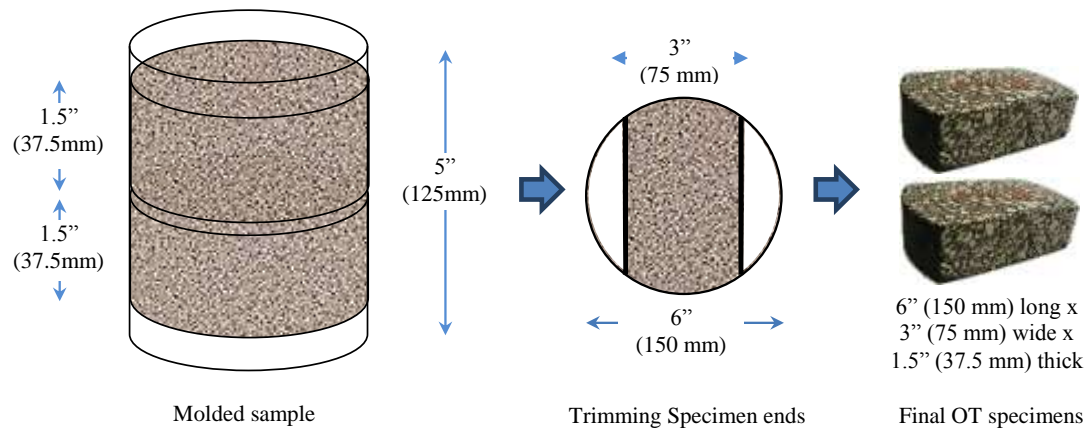
## 8. TABLES AND FIGURES



Figure 1. Marking/Cutting Template.



**Figure 2. Trimming of Cylindrical Specimen.**



**Figure 3. OT Specimen Fabrication from 5-Inch Tall Samples.**





Figure 4. New Mounting Jig and OT Plates with Outer Grooves for Easy Sample Alignment.

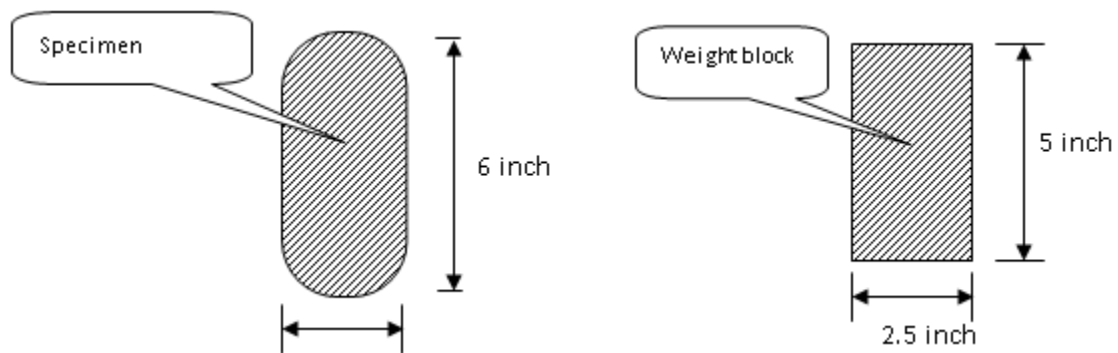


Figure 5a. Sample Curing Weight Configuration.



Figure 5b. 10-lb Gluing Cure Weight.



**Figure 6. Suggested Pattern for Tying the Screws.**





Figure 7a. Example of a Single Crack.



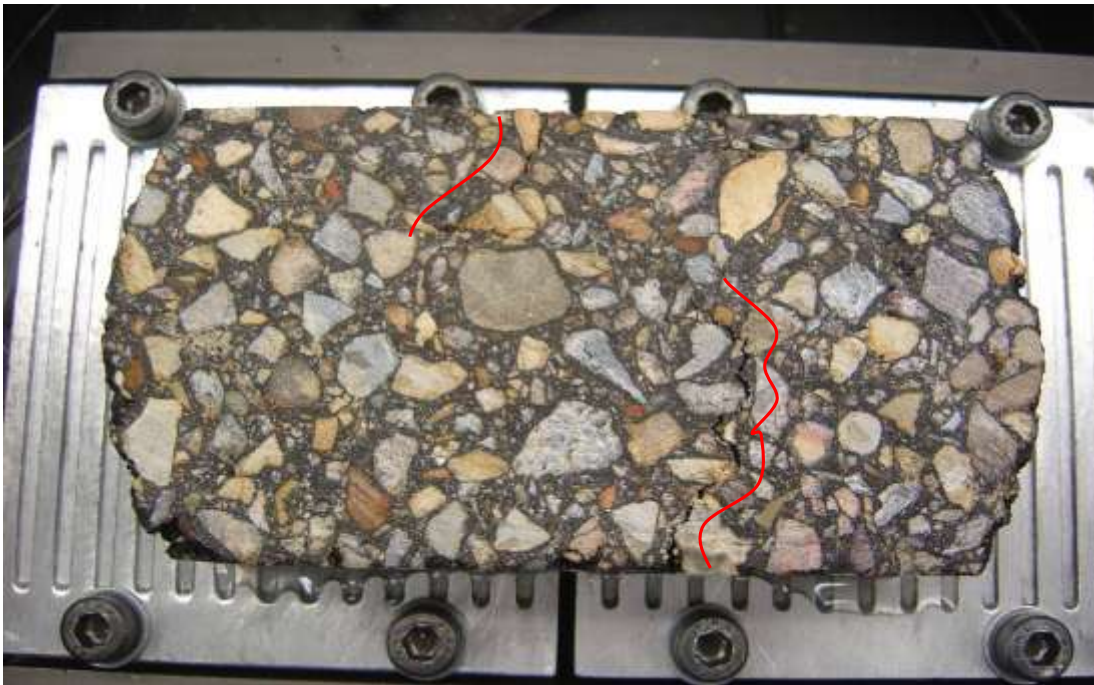


Figure 7b. Example of Double Cracks.

Table 1. Proposed OT Pass-Fail Screening Criteria for Some Texas Mixes.

#	Mix Type	OT Cycles	Comment
1	CAM	$\geq 750$	
2	SMA	$\geq 300$	
3	Types D and F	$\geq 150$	
4	Type C	$\geq 100$	
5	Types A and B	$\geq 30$	