CRD-C 522-88

STANDARD METHODS OF TESTING JOINT SEALANTS, COLD-APPLIED, NON-JET-FUEL-RESISTANT, FOR RIGID AND FLEXIBLE PAVEMENTS

1. Scope

1.1 These methods cover acceptance testing of one and two component, elastomeric, cold-applied, non-jet-fuel-resistant (non-JFR) sealing compounds for use in sealing joints and cracks in rigid and flexible pavements.

1.2 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1.3 Values given in inch-pound units are standard.

2. Referenced Documents

2.1 ASTM Standards:

C 33 Specification for Concrete Aggregates (CRD-C 133)

C 150 Specification for Portland Cement (CRD-C 201)

C 192 Method of Making and Curing Concrete Test Specimens in the Laboratory (CRD-C 10)

D 5 Test Method for Penetration of Bituminous Materials

D 8 Definitions of Terms Relating to Materials for Roads and Pavements

D 140 Method for Sampling Bituminous Materials

D 217 Test Method for Cone Penetration of Lubricating Grease

D 1475 Test Method for Density of Paint, Varnish, Lacquer, and Related Products (CRD-C 305)

D 1851 Methods of Testing Concrete Joint Sealers, Cold-Application Type

3. Terminology

3.1 Terms used in this standard are defined in Definition D 8.

4. Significance and Use

4.1 These methods are to be used to test samples of joint sealants to determine if they comply with the provisions of relevant acceptance specifications.

5. Sampling

5.1 Unless otherwise specified, samples for testing shall be taken at the point of manufacture in accordance with ASTM D 140. The samples taken shall be representative of the batches proposed for shipment. Representative samples of the sealant shall consist of not less than 3 gal. (11.4 L) from each batch and a proportional sample of primer as applicable. Sample identification shall include the name of the testing agency, contract or purchase order number, batch number, and any special marking instructions. The purchaser may obtain samples for testing at the point of manufacture or at the delivery destination or both.

6. Laboratory Conditions

6.1 Laboratory standard conditions shall be 73.4 ± 3.6°F (23 ± 2°C) temperature and 50 ± 5 percent relative humidity. Specimens shall be stored and tested at standard conditions unless otherwise specified.

7. Specimen Preparation

7.1 Mixing: The sealant shall be mixed in the proportioned ratio, at standard conditions, in accordance with the manufacturer's instructions.

7.2 Pouring: The test material shall be poured or extruded as applicable into specimen containers or molds which have been cleaned with residue-free solvent (isopropyl or denatured alcohol) and dried with a clean cloth.

7.3 Curing: Two-component sealants shall be permitted to cure at standard conditions for not less than 48 h nor more than 96 h prior to initiating test procedures, except as otherwise specified herein. One component sealant shall be permitted to cure at standard conditions for not less than 168 h nor more than 240 h. except as otherwise specified herein.

TEST METHODS

8. General

8.1 Samples taken as specified above and prepared as specified above shall be tested as specified below. Either the manufacturer or the purchaser may request that a retest for that property be made at the requestor's expense. Such a test will be made only when adequate quantity of the original sample is available.

9. Application Leveling Test

9.1 A specimen mold meeting the following requirements shall be used. A mold, a channel having both ends closed and inside dimensions of 1/2 in. (12 mm) wide, 1 in. (25 mm) deep, and 12in. (304 mm) long, shall be supplied. In addition, the mold shall be so constructed as to enable positioning the longitudinal base on a 1.5 percent slope with a level plane. The channel may be made of not less than 1/8 in.-(3.2-mm) thick aluminum stock, steel, or plastic. The mold shall be filled with sealant and immediately struck off level full with a knife edge. Within 60 sec after filling, with a minimum of vibration, the mold shall be positioned to provide the 1.5 percent slope on the 12-in. dimension. After curing for 24 h at standard conditions, the specimen shall be examined for flow. The difference in depth of the specimen at the ends of the channel shall be recorded as the depth variation.

10. Volume Change

10.1 Three sealant specimens shall be prepared in 1-1/2-oz (44-mL) containers. Prior to filling the 1-1/2-oz containers, determine the volume displaced by the walls of the container and record for high accuracy calculations. After preparing the specimen, any excess material on the exterior of the container shall be removed before curing. Each containerized specimen shall be conditioned for 1 h at 77 ± 0.5°F (25 ± 0.3°C) just prior to testing. Volume measurements shall be made with a mass-per-gallon cup as specified in ASTM D 1475 at standard conditions. Mass measurements shall be read to the nearest 0.01 g and recorded as follows:

A - Volume of mass-per-gallon cup shall be determined.

B - Mass of cup with specimen shall be determined.

C - Mass of cup with specimen, filled with distilled water shall be determined.

D - Volume of the walls of the specimen container shall be determined.

Volume determination of specimen = A-(C-B)-D. (One mL of distilled water at standard conditions shall be assumed to have a mass of 1.0 g.) Remove specimen from the mass-per-gallon cup and condition at 158 ± 2°F (70 ± 1.1°C) in a forced draft oven for 168 ± 2 h, followed by cooling in air for 1 h. and in a water bath at 77 ± 0.5°F (25 ± 0.3°C) for 1 h. Determine the volume of the tested specimen as described above. The change in volume shall be computed as follows:

$$\text{Change in volume} = \frac{\text{Original volume less oven-aged volume} \times 100}{\text{Original volume}}$$

An average of three determinations shall be made.

11. Swelling

11.1 The specimen mold shall be a channel having both ends closed and inside dimensions of 1/2 in. (12 mm) wide, 1 in. (25 mm) deep, and 12 in. (304 mm) long. The channel may be made of not less than 1/8-in.-(3.2-mm) thick aluminum stock, steel, or plastic. The mold shall be filled with sealant and immediately struck off level full with a knife edge. The mold shall be placed on a level surface to cure. After curing, determine the height of the sealant above the mold surface at the quarter points along the longitudinal axis. Report the average height above the mold surface.

12. Tack-Free Time

12.1 The specimen shall be 4 by 1-1/2 by 1/4 in. (101 by 38 by 6 mm), prepared using a metal or polyethylene mold and a base plate approximately 3 by 6 in. (76 by 152 mm), 16 to 24 gage. The mold shall be filled with sealant, concurrently with other test specimens being prepared, and immediately struck off with a spatula. After curing under standard conditions for 12 h, a 6- by 1- by 0.004-in. (152- by 25- by 0.102-mm) polyethylene film shall be loaded for 30 sec on the top surface of the sealant using a metal plate approximately 1-5/8 by 1-1/8 in. (41 by 28 mm), not less than 30 g nor more than 31 g. On removal of the mass, the film shall be uniformly and progressively withdrawn at right angles to the surface of the sealant. Sealant adhering to the polyethylene film shall constitute failure of this test.

13. Resilience

13.1 Two specimens shall be prepared in 6-oz (177-mL) containers and cured at standard conditions. One specimen to be oven-aged shall be further conditioned in a forced draft oven at 158 ± 2°F (70 ± 1.1°C) for 168 ± 2 h, followed by conditioning in air at standard conditions for 1 h, then for 1 h in a water bath maintained at 77 ± 0.5° F (25 ± 0.3°C). The unaged specimen shall be conditioned for 1 h in a water bath maintained at 77 ± 0.5°F (25 ± 0.3°C). Both specimens, conditioned as specified, shall be tested with a standard penetrometer in which the ball penetration tool shown in Fig. 1 has been substituted for the needle. The surface of the specimens may be lightly dusted with talc with the excess immediately removed by blowing, or the ball of the penetrometer may be lightly coated with glycerine. The ball penetration tool of the penetrometer shall be adjusted for a total mass of 75 g and shall be placed in contact with the surface of the specimen and the indicating dial set at zero. A light may be so positioned that initial contact of the ball with the surface of the specimen can be observed readily. Release the ball penetration tool, allow to penetrate the specimen for 5 sec. and record the reading as initial ball penetration (P), in millimetres to the nearest 0.1 mm. Without returning the dial pointer to zero, press the ball penetration tool down an additional 10 mm (i.e., to a reading of P + 10.0) at a uniform rate in 10 sec. Re-engage the clutch to hold the tool down for an additional 5 sec and during this time return the dial pointer to zero. Release the clutch, allow the specimen to recover for 20 sec, and record the final dial reading (F). Determinations shall be made at three points equally spaced from each other and not less than 1/2 in. (12.7 mm) from the container rim. Compute the resilience as follows:

$$\text{Resilience, percent} = (P + 10.0 - F)\ 100$$

The average of the three determinations shall be recorded as the resilience.

14. Compatibility with Bitumen

14.1 Prepare duplicate specimens of hot-mix asphaltic concrete and tar concrete, not less than 4 in. (101 mm) in diameter and 2.5 in. (64 mm) high. Allow the specimen to cool to room temperature, then cut a groove 4 in. (100 mm) long by 1/2 in. (l3 mm) wide by 3/4 in. (19 mm) deep in the top surface of each bituminous concrete specimen by wet sawing. Remove all residue from the grooves by scrubbing with a stiff-bristle brush under running water. Allow the specimens to dry and return to room temperature, then securely wrap with cloth-backed adhesive tape, or otherwise reinforce to prevent slumping during the test period. Caulk the ends of the grooves to prevent leaking. Fill the groove flush with sealant and allow to cure at standard conditions. After curing, place the specimen in a forced-draft oven at 140 ± 5°F (60 ± 2.8°C) for 168 ± 2 h. Inspect at least once a each day to prevent slumping. Immediately after removing the specimens from the oven and cooling to standard conditions, examine the specimens for incompatibility of the sealant with the bituminous concrete.

15. Flow

15.1 Flow shall be in accordance with ASTM D 1851 except as specified herein. A nonreactive mold release agent shall be used. Duplicate specimens shall be prepared and trimmed after filling the mold and before the sealant cures. The specimens shall be cured as specified at standard conditions prior to removal of the mold. The flow test shall be conducted in a forced-draft oven maintained at 200 ± 2°F (93.3 ± 2.2°C). At the completion of a 5-h exposure period, measure the change in length of the specimens and report the average as the flow value.

16. Penetration

16.1 The penetration testing shall be in accordance with ASTM D 5, except as specified herein. Use a penetrometer as specified in ASTM D 217; a cone conforming to the requirements of the Original Method therein used in place of the needle. One specimen shall be prepared in a 6-oz (177-mL) container and trimmed flush with the container top edge before curing at standard conditions.

17. Bond to Portland-Cement Concrete

17.1 Extension Machine: The extension machine used in the bond test shall be so designed that the specimen can be maintained at the test temperature while being extended at a uniform rate as specified. The machine shall consist essentially of one or more screws rotated by an electric motor through suitable gear reductions. Self-aligning plates or grips, one of each pair fixed and the other carried by the rotating screw or screws. shall be provided for holding the test specimen in position during the test.

17.2 Concrete Block Preparation: The concrete blocks shall be as specified herein.

17.2.1 Prepared Blocks: Prepared blocks are available from the U.S. Army Corps of Engineers, Missouri River Division Laboratory, 420 South 18th Street, Omaha, NE 68102.

17.2.2 Materials: Use aggregate conforming to ASTM C 33 except as specified herein. Use aggregate grading specified in Table 1, with coarse aggregate consisting of crushed limestone (at least 95 percent $CaC0_3$) having a water absorption of not more than 1.5 percent, with fine aggregate of crushed limestone manufactured from the same parent rock as the coarse aggregate, and with fine aggregate approximately 40 percent of the total aggregate solid volume. Use portland cement conforming to ASTM C 150, Type II. Make a concrete mixture with a water-cement ratio of 0.5 by mass, a cement factor of 564 lb ± 45 lb/yd^3 (335 kg ± 27 kg/m^3) of concrete, a lump of 2.5 ± 0.5 in. (65 ± 15 mm), and an air content of 5 ± 0.5 percent by addition of an air-entraining admixture such as a neutralized vinsol resin. Fine aggregate shall approximate 40 percent of the total aggregate by solid volume. Use a 10- by 17.5- by 3-in. (250- by 450- by 75-mm) metal mold, secured to a metal base plate to form a watertight assembly, and oiled with mineral oil before use.

Table I. Aggregate Grading

	Sieve Designation	Percent Passing
Coarse aggregate	19.0 mm (3/4 in.)	97 - 100
	12.5 mm (1/2 in.)	63 - 69
	9.5 mm (3/8 in.)	30 - 36
	4.75 mm (No. 4)	0 - 3
Fine aggregate	4.75 mm (No. 4)	100
	2.36 mm (No. 8)	82 - 88
	1.18 mm (No. 16)	60 - 70
	600 µm (No. 30)	40 - 50
	300 µm (No. 50)	16 - 26
	150 µm (No. 100)	5 - 9

17.2.3 Block Preparation: Prepare and cure the blocks in accordance with ASTM C 192 except as specified herein. Fill the mold to overflowing, vibrate externally 30 sec. screed (level) to a smooth surface with a wooden float, and level off with a metal straightedge drawn across the top with a sawing motion. Cure for not less than 14 days. then cut the block into 1- by 2- by 3-in. (25- by 50- by 75-mm) test blocks, using a 40- to 60- grit diamond saw blade at a peripheral speed of 50.8 ± 1.3 in. per sec (1300 mm/sec), cutting the face to be bonded in a vertical plane, and allowing vertical selvages of 1 in. (25 mm) or more for discard. While the blocks are still wet from the sawing operation, scrub the surfaces lightly with a stiff-bristle brush, under running water. Store the blocks under lime-saturated water maintained at standard-condition temperature. Stocks of prepared blocks may be stored under standard conditions indefinitely, but blocks shall be immersed in lime-saturated water for not less than 7 days prior to use.

17.3 Six bond test specimens (12 blocks) shall be prepared. The blocks shall be removed from the storage water individually, and the 2- by 3-in. (51 - by 76-mm) faces shall be scrubbed lightly with a stiff-bristle brush, under running water, and resubmerged until all blocks have been scrubbed. Then, all blocks shall be removed from the water and lightly blotted with an oil-free, soft, absorbent cloth or paper to remove all free surface water. The blocks shall then be placed with the 2- by 3-in. (51- by 76-mm) face down on blotting paper. At the end of the applicable drying period, pairs of blocks shall be assembled to provide test specimens: setup and pour shall be completed within 1 h. Spacers and base plate shall have nonadherent, nonreactive surfaces. Pairs of the concrete blocks shall be placed on the base plate so that the 1- by 3-in. (25- by 76-mm) faces are on the plate, and the 2- by 3-in. (51- by 76-mm) faces which were against the blotting paper form the space to be filled with sealant. The blocks shall be spaced 0.500 ± 0.005 in. (12.7 ± 0.1 mm) apart by 0.5- by 0.5- by 2-in. (12.7- by 12.7- by 50-mm) spacers. These spacers shall be placed at a distance from the ends of the blocks so that an opening 0.5 by 2 by 2 in. (12.7 by 50.8 by 50.8 mm) is formed. The opening shall be filled from bottom up with sealant in a manner to exclude air pockets. Specimens shall be allowed to cure as applicable after which spacers and base plates shall be removed.

17.4 Nonimmersed bond: Three bond test specimens, with spacers maintaining the 0.5-in. (12.7-mm) dimension, shall be conditioned at the test temperature, -20 ± 2° F (-28.9 ± 1.1°C), for not less than 4 h. The specimens shall then be extended 0.25 in. (6.35 mm) at a uniform rate

during a 2-h extension period while being maintained at the test temperature. The specimens shall be removed from the extension machine, the 0.5-in. (12.7-mm) spacers reinserted, and the specimens permitted to return to their original dimensions at standard conditions. Each specimen shall be rested on one concrete block so that the weight of the top block recompresses the joint sealant. Three cycles of extension and recovery shall be completed within 5 days after the start of the first cycle, and shall constitute one complete test for nonimmersed bond. When initiation of the second or third cycle is delayed, the specimens shall be stored at the test temperature.

17.5 Water-Immersed Bond: Thinner spacers shall be inserted between the concrete blocks of the last three bond specimens, so that the opening of not less than 0.25 by 0.5 by 1 in. (6.35 by 12.7 by 25.4 mm) will be produced and maintained between the spacers and sealant. Using covered containers deep enough to provide a minimum of 0.5 in. (12.7 mm) of water cover, the specimens shall be immersed for 96 ± 1 h in 500 mL of distilled or deionized water per specimen and maintained at standard conditions. The specimen shall be placed with the concrete blocks in a horizontal position. Three specimens may be placed in one container provided the water-to-specimen ratio is maintained. At the end of the 96-h water immersion period, the specimens shall be removed from the water, the spacers removed, and the excess surface water removed from the specimens with a soft, dry, absorbent material. After the surface water is removed, the specimens shall be subjected to conditioning and extension test as described under "Nonimmersed Bond." Three cycles shall constitute one complete test for water-immersed bond.

17.6 Bond Test Results: After the initiation of the bond tests specified, the bond test specimens shall be removed from the extension machine within 30 min after the completion of each extension of the test specimen. The specimens shall be examined for obvious separations within the sealant, and between the sealant and the blocks without distorting or manually causing extension of the specimens. After the final extension and recovery are completed, the specimens shall be thoroughly examined for separations between the sealant and the blocks, and within the sealant, including surface checking and crazing, and for loss of resilient, rubberlike characteristics. This shall be accomplished without distorting the specimens, but the specimens may be extended uniformly up to 0.25 in. (6.35 mm) to permit detailed examination.

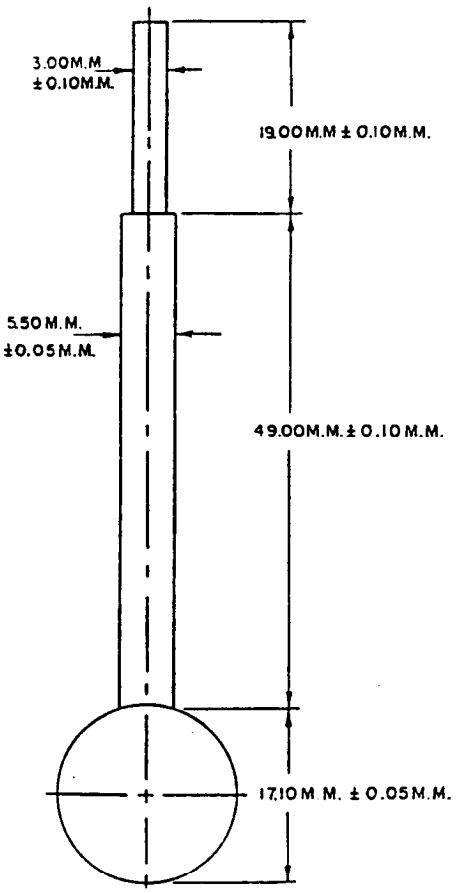
18. Report

18.1 The results of all tests shall be reported. The report shall identify the sample or samples tested and give relevant information on preparation of the test specimens. When certain tests are not made, reasons for such omission shall be given.

19. Precision and Bias

19.1 Precison - The precision of the procedures in Test Methods C 624 is being determined.

19.2 Bias - Since there is no accepted reference material suitable for determining the bias for the procedures in Test Methods C 624, no statement on bias is being made.



NOTES:
MATERIAL: STEEL
TOOL WEIGHT: 27.50 GRAMS PLUS OR MINUS 0.10 GRAMS
TOTAL WEIGHT ON SPECIMEN: 75.00 GRAMS PLUS OR MINUS 0.01 GRAM.

Figure 1. Ball Penetration Tool