

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION
MATERIALS PROCEDURE

QUALITY ASSURANCE OF LAMINATED ELASTOMERIC
BRIDGE BEARING PADS WITH INTERNAL SHIMS

1. PURPOSE

- 1.1. To set forth the procedures which govern the Quality Assurance testing of laminated elastomeric bridge bearing pads with internal shims.
- 1.2. To set forth manufacturer's Quality Control requirements.
- 1.3. To set forth acceptance procedures.
- 1.4. To set forth documentation and shipping procedures.

2. SCOPE

- 2.1. This procedure will apply to all manufacturers of laminated elastomeric bridge bearing pads with internal shims.
- 2.2. This procedure will establish the basis for acceptance of laminated elastomeric bridge bearing pads with internal shims.
- 2.3. This procedure will establish MCS&T Division's acceptance test procedures of laminated elastomeric bridge bearing pads with internal shims.
- 2.4. This procedure will establish accepted dimensions of sample size submitted to MCS&T.

3. REFERENCED DOCUMENTS

- 3.1. All standard types of elastomeric bridge bearing pads with internal shims are to be manufactured and tested in accordance with Sections 715.14, of the Specifications.
- 3.2. Each production lot of laminated elastomeric bearing pads shall be tested and conform to Section 4 of AASHTO M251, and the Sections 106.3 and 715.14.1 of the Specification

A production "LOT" is defined as follows:

A laminated bearing pad of the same size and class that is manufactured using the same process and materials during continuous days of production.

For laminated bearing pads, the sampling rate shall be one bearing pad per lot, per nominal dimensional size. (A change in nominal dimensional size is any change in the designed length, width or height of the bearing pad.)

- 3.2.1. The bearing pad dimension of each bearing pad LOT shall be checked in accordance with ASTM D3767, modified as follows; measure dimensions 100mm [4 in.] or less according to ASTM D3767 Procedure B; measure dimensions greater than 100 mm [4 in.] according to ASTM D3767 Procedure C. If any dimension is outside the limits in Section 6 (ASTM M251M), the bearing pad LOT shall be rejected.
- 3.2.2. The Durometer Hardness Test - ASTM D2240 Type A shall be used to determine material hardness in accordance with ASTM M251M, Section 4.2, Table 1 which shall be conducted on the individual sample selected from the LOT.
- 3.2.3. Oven Aging shall be conducted for samples selected as per ASTM D573 for 70 hours at 212°F (100°C).
- 3.2.4. The minimum tensile strength and minimal ultimate elongation shall be conducted on samples selected as per ASTM D412, Method A for both original and oven aged samples.
- 3.2.5. The compression set test - ASTM D395, Method B, Type 1 shall be conducted on both original and oven aged samples selected. Permissible difference shall be no greater than 35% change in compression between original and oven aged samples.
- 3.2.6. The low temperature test shall be performed in accordance with ASTM D3746 Procedure B.
- 3.2.7. Each sample shall be tested for adhesion to rigid substrates in accordance with ASTM D429-14.
- 3.2.8. Shear Modulus shall be tested in accordance with ASTM D4014, Annex A1.
- 3.2.9. Low temperature crystallization shall be tested in accordance with ASTM D4014, Annex A1.
- 3.2.10. Instantaneous thermal stiffening shall be tested in accordance with ASTM D1043.
- 3.2.11. Oil swell testing shall be tested in accordance with ASTM D471.

4. QUALITY CONTROL REQUIREMENTS

- 4.1. Quality Control is the responsibility of the manufacturer and shall include the following:
 - 4.1.1. Ensure all component materials used in fabrication of the bearing pads have been sampled, tested, and approved in accordance with Section 715.14 of Specifications and ASTM M251.
- 4.2. Ensure quality workmanship as well as a quality product throughout production.
- 4.3. Each bearing pad shall be marked in indelible ink or flexible paint. The marking shall consist of order number, LOT number, bearing identification number, up station, or face of abutment (tapered plates only) and elastomer type and grade. Unless otherwise specified in the contract documents, the marking shall be on a face that is visible after the bridge is erected.

- 4.4. Notify the Division's representative upon the completion of casting of a LOT (Refer to Table 1) of bearing pads so MCS&T may select a representative sample and witness the testing.
- 4.5. Manufacturers must conduct quality control tests in accordance with ASTM M251.

5. ACCEPTANCE CRITERIA

- 5.1. MCS&T will sample and test the component materials to be used in the manufacture of laminated elastomeric bearing pads in accordance with Sections 715.14, and 715.15 of the Specifications and ASTM M251.
- 5.2. A representative sample of the LOT shall be cut to dimensional size by the manufacturer as specified. Representative samples shall be cut to dimensions of no less than 5 inch-length and 2-inch width, but no greater than 7-inch length and 2.5-inch width. A total of (6) individual representative samples must be taken from the selected representative lot prior to the shipping process.
- 5.2.1. A representative of MCS&T Division shall witness all sampling, and those selected shall be shipped to MCS&T Division. Each piece comprising the LOT shall be scribed as stated in Section 4.3.

6. SHIPPING REQUIREMENTS

- 6.1. The approved LOT of bearing pads portion can be shipped by the manufacturer providing the following provisions have been met:
 - 6.1.1. The manufacturer will supply one copy of the shipping invoice to MCS&T Division and one copy to the Division's representative at the project site. The invoice shall contain the following information.
 - a) Cast date of the approved LOT.
 - b) Lab number.
 - c) Size, class, and type of bearing pad.
 - d) Project number.
 - e) Contract ID
 - f) Number of pieces.

7. ACCEPTANCE PRACTICE

- 7.1. MCS&T will ensure the information on the shipping invoice, as required in Section 6, agrees with the shipment it accompanies. (Number of pieces, size, type, etc.).
- 7.2. MCS&T will check each sample of pad for the proper identification markings (Section 6) and make a visual inspection of each sample to ensure there is no evidence of damage during shipment.

8. DIVISIONAL TESTING PROCEDURE

- 8.1. When the bearing pad sample and T-100 Form (sample identification sheet) arrive in the MCS&T laboratory, Division personnel shall make sure that the sample matches the T-100 form. The bearing pad should have an identifiable marking on it, such as project number, Contract ID number and sample number.
- 8.1.1. Once received, the sample must be measured to verify that it meets the dimensions noted on the T-100 form.
- 8.1.1.1. The sample measurement must be documented on the T-100 form. The thickness has a tolerance of 1/8 inch (3.175mm) over the specified thickness. The width and length of the bearing pad sample have a tolerance of 1/4 inch (6.35mm) over the specified values, but they may not be any smaller. Sample size should be in accordance with Section 5 of this document.
- 8.1.1.2. When the paperwork and sample are found to be in order, the bearing pad sample is ready to be processed for acceptance testing.
- 8.2. Sample Cutting- Tensile and Elongation Sets
- 8.2.1. The specimen shall be cut to proper length as per ASTM D412 Method A. The specimen must be taken from the outside edge of the bearing pad sample on both the top and bottom. The minimum width of the specimen must be 1 inch, with a minimum of 5 inch length, and the specimen thickness after cutting must be between 0.05 inch and 0.10 inch. Several test specimen strips must be cut from the sample blocks.
- 8.2.2. Once the specimens have been cut, clean the specimens with water. After cleaning, the specimens must be set in the specified lab condition for at least 1 hour at $23 \pm 2^{\circ}$ C ($73.4 \pm 3.6^{\circ}$ F) and at $50 \pm 5\%$ humidity.
- 8.2.3. After the proper conditioning time has been achieved, the specimens can now be cut on the arbor press with the barbell die as per ASTM D412 Method A. Do not cut more than one strip at a time. Do not pile the strips on top of each other to prevent cupping and deformation of the specimens.
- 8.2.4. A minimum of 10 total specimens must be cut for tensile and elongation testing. It is recommended to cut additional specimens to ensure conformity of thickness of all specimens selected.
- 8.2.5. Once cut, the specimens must be conditioned again in lab conditions for 3 hrs. at $23 \pm 2^{\circ}$ C ($73.4 \pm 3.6^{\circ}$ F) and at $50 \pm 5\%$ humidity.
- 8.3. Thickness Measurements
- 8.3.1. After the 3-hour conditioning in the lab, as specified in Section 8.2.5, the specimens shall be measured with the thickness gauge. A total of 3 measurements shall be performed at the narrow section of the barbell specimen. All three readings must be within 0.003 inch of each measurement, or the specimen must be discarded.

- 8.3.1.1. A minimum of 5 specimens closest to thickness shall be selected for original specimens (O), and a minimum of 5 specimens closest to thickness shall be selected for oven-aged testing (OA).
- 8.3.2. Document the measurements and select the middle reading of the 3 measurements. Record the thickness to be assigned to the specimen. This shall be marked on each individual specimen at one end of the specimen with a silver ink pen.
- 8.3.3. At the opposite end of the specimen, the specimen should then be labeled O-1 through O-5, for original specimens. Additional specimens must be labeled OA-1 through OA-5 for over-aged specimens. Also label the specimen at this end with the last 2 digits of the sample lab number for identification. Record the thickness of the specimens under the original thickness, and oven aged thickness of the sample worksheet.
- 8.4. Oven Aging
 - 8.4.1. Oven Aged Specimens (OA) shall be conditioned in the oven at the recommended specifications per ASTM D412. Natural rubber specimens shall be aged at 70 ± 2 °C, and Neoprene samples shall be aged at 100 ± 2 °C, for 70 hrs. in accordance with ASTM D573.
 - 8.4.2. Oven Aged Specimens (OA) should be suspended above the oven floor from clips, also ensuring that the specimens are not in contact with each other during the oven aging process.
 - 8.4.3. Once the 70-hour oven aging has completed, the samples must then be conditioned in the lab outside of the oven as specified in Section 8.2.5 for 3-hours.
- 8.5. Tensile and Elongation Test
 - 8.5.1. Tensile and Elongation testing shall conform to ASTM D412 Method A. All information shall be recorded on the worksheet. A minimum of three consecutive passing tests must be completed. In case of a failing sample, all 5 oven-aged samples must be tested to meet the following test acceptance criteria:
 - a) Tensile Strength, minimum psi (ASTM D412): 2250 psi combined median of all samples
 - b) Elongation at break, minimum % (ASTM D412) 350% combined median of all samples.
 - 8.5.1.1. Once testing has been completed, all information must be recorded.
- 8.6. Compression Set
 - 8.6.1. Compression set testing must conform to ASTM D395, Method B-Type 1.
 - 8.6.1.1. Specimens for compression testing must be taken from the prepared test specimen strips, with the exception that compression set thickness strip minimal thickness should be 0.100 inches.

- 8.6.2. Specimens should be cut at the arbor press with the circular die as per ASTM D412. A minimum of 10 specimens should be cut. Do not cut more than one strip at a time. Do not pile the strips on top of each other to prevent cupping and deformation of the sample specimens.
- 8.6.3. Specimens should then be conditioned as per Section 8.2.5 of this MP
- 8.6.4. Once the minimum 3-hour conditioning as per Section 8.2.5 of this MP is achieved, the samples can now be measured for thickness.
 - 8.6.4.1. Using the thickness gauge, stack each specimen to achieve a total thickness of 0.5 ± 0.02 inches. A total of seven specimens can be used to achieve the minimum 0.5 inch requirement. Different sample specimens may need to be rearranged in order to achieve the thickness requirement.
 - 8.6.4.2. A total of two stacks should be created and labeled as Sample A, and Sample B, along with the last 2 digits of the lab number assigned to the sample. This should be marked with a silver pen to differentiate the samples. The original thickness shall be recorded on the worksheet.
- 8.6.5. Continue to prepare the compression set device.
 - 8.6.5.1. Once original specimen thickness is recorded, the specimens can then be placed in the compression device. Both spaces must be present with the hole indicator facing, and the spacer thickness (0.375 in) stamp facing upward. Place talc on the bottom and top stack plates. Next, secure the specimens between the plates. Note: make sure the spacers are properly in place before tightening the plates.
 - 8.6.5.2. Once the specimens are secured in the compression device, the sample can now be oven aged.
 - 8.6.5.3. Place the device in the preheated oven. Natural rubber specimens shall be aged at 70 ± 2 °C, and Neoprene samples shall be aged at 100 ± 2 °C, for 22 hours.
- 8.6.6. After the 22 hours oven aging, the samples should be promptly removed from the compression device and then placed on a piece of wood for 30 minutes. The room must be within temperature and humidity tolerances 23 ± 2 °C (73.4 ± 3.6 °F) and at $50 \pm 5\%$ humidity.
- 8.6.7. Once the specimens have cooled, measure the thickness of both Sample A and Sample B as per Section 8.6.4.2 of this MP on the thickness gauge. Record the measurements on the worksheet. Calculate the percentage of compression as follows: The compression set passes if the result is 35% or less than the original compression thickness, if the result is higher 35%, the sample fails the compression set.

$$\text{Compression } (Ci) = 100 \times \frac{T_o - T_f}{T_o - S}$$

$$\text{Average Compression} = 100 \times \frac{Ca + Cb}{2}$$

C = Compression (%)

S = Spacer (0.375 in)

T_o = Original Thickness

T_f = Final Thickness

8.7. Durometer Hardness

- 8.7.1. Measure the thickness of the rubber that is on the outside edge of the metal shim plates. If the rubber is at least 6.0 mm (0.24 inches) thick, then that sample can be used. This sample will be needed for both original and oven aged durometer tests.
- 8.7.2. The sample must be in the specified lab condition of 23 ± 2° C (73.4 ± 3.6° F) and at 50 ± 5% humidity for 3 hours before testing is performed. The durometer device must also have been in lab condition tolerance for at least 12 hours prior to testing.
 - 8.7.2.1. Place test sample on a firm level surface with the outside layer of the pad facing up. Write the lab number on the surface with the silver pen. Place the durometer firmly on the surface and press firmly on the top of the durometer. Do not use excessive pressure as it may affect the durometer reading. Take a total of 5 readings across the surface of the sample. Make sure the readings are at least 6.0 mm (0.24 inches) apart from each reading. Record each reading, and then determine the middle value of the five readings. This middle value shall then be recorded as the original durometer reading on the worksheet. The recorded durometer should be within ± 5 of the specification requirements of the material being tested. If outside the ± 5 range, then the durometer test shall be recorded as failing.
- 8.7.3. Prepare the oven for oven aged test
 - 8.7.3.1. Preheat oven to the following requirements: Natural rubber specimens shall be aged at 70 ± 2 °C, and Neoprene samples shall be aged at 100 ± 2 °C, for 70 hours.
 - 8.7.3.2. After the proper time has elapsed, allow specimen to cool at room temperature at the specified laboratory tolerances of 23 ± 2° C (73.4 ± 3.6° F) and at 50 ± 5% humidity for 3 hours. After cooling, repeat the procedure as per Section 8.7.2.1 of this MP
 - 8.7.3.3. To calculate the durometer change, determine the difference between the oven aged durometer value and the original durometer value. Record the change on the work sheet, recording it as a plus or minus number. Natural rubber is allowed a maximum change of ±10% (5 for 50, 6 for 60, 7 for 70 durometer material). Neoprene is allowed to change to a maximum of ±15% (7.5 for 50, 9 for 60, 10.5 for 70 durometer material). If the durometer is within the allowable limit, then the sample meets Specification requirements.

9. BEARING PAD SAMPLE TEST ACCEPTED BY CERTIFICATION

- 9.1. On a case-by-case basis, results of tests not performed by the Division as described in Section 9 of this MP may be accepted by the certification of the manufacturer for the following:
- a) Rubber Deterioration in Ozone (ASTM D1149)
 - b) Low Temperature Brittleness Test (ASTM C746)
 - c) Adhesion (ASTM D429)
 - d) Shear Modulus (ASTM 4014)
 - e) Low Temperature Crystallization (ASTM 4014)
 - f) Instantaneous Thermal Stiffening (ASTM 1043)
 - g) Oil Swell (ASTM D471)
 - h) Full size bearings more than 50 lbs., and not exceeding 8 inch width by 12 inch length. In accordance with this MP, the manufacturer is to prepare sample sizes as described in Subsection 5.2 of this MP prior to shipment to the Division. In rare occasions, full size bearings weighing more than 50 lbs. may be accepted per manufacturer certification of testing.
- 9.2. For the manufacturer test results described in Section 9 of this MPo be accepted, a full test report must be submitted to the Division. The report must be notarized and submitted to the Division for review and approval. The complete test report must be submitted to the Division prior to, or with the submitted test sample. The report must include the following:
- a) Laboratory Test Report Material Type (i.e. Natural Rubber, Neoprene)
 - b) Customer (i.e. Contractor, etc.)
 - c) Purchase Order #
 - d) Certification Date
 - e) Test Method Required and Results
 - f) Project Number
 - g) Project Authorization
 - h) Quantity
 - i) Description of material
 - j) Lot number
 - k) Notarization
 - l) Signature

**Michael
Mance**

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Michael A. Mance PE,
Director
Materials Control, Soils & Testing Division