



Evaluating Brittleness of Painted Plastics by Means of a Mandrel

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. This standard describes the method to evaluate the amount of cracking that takes place when a painted plastic material is flexed around a designated mandrel at a designated temperature.

1.2 Applicability. This test is a requirement from GMW14797 for painted plastic exterior components made from plastics with a flexural modulus of 800 MPa or less.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW3005

GMW14797

3 Resources

3.1 Facilities.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Mandrel fixture capable of accommodating the specified mandrel.

3.2.2 Environmental chamber capable of maintaining the specified test temperatures.

3.3 Test Vehicle/Test Piece. The test pieces wherever possible shall be the finished part. If size, shape, etc., of the finished part is not practical, tests shall be conducted on specially prepared coated test panels.

3.4 Test Time.

Calendar time: 1 day

Test hours: <1 h **Note 1**

Note 1: Not including pre-conditioning.

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Personnel performing this test shall have received training for this test procedure.

4 Procedure

4.1 Preparation. Not applicable.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

4.3.1 Test Procedures for Painted Flexible Plastics. Flexible plastics, for the purpose of this test, are defined as those plastic materials with a tangent flexural modulus of 800 MPa or less.

4.3.1.1 This procedure shall be used when testing painted materials for conformance to the requirements of GMW14797 or GMW3005. Class M1 is required for all painted plastics with a flexural modulus of 800 or less; class M2 is required only if the suffix M2 is specified on the drawing or in math file (example: GMW14797-M2). See Table 1 for the description of the specific test conditions for testing for class M1 and M2.

4.3.1.2 When specifically stated, this procedure can also be used to evaluate the cracking that occurs using combinations of temperature and mandrel diameter that are different from those defined for class M1 or M2.

4.3.1.3 Unless otherwise specified, painted samples shall be subjected to a minimum aging period of 72 hours following the baking or drying cycle prior to sample preparation or start of testing. A shorter aging period may be used provided it is recognized that this represents a more severe condition of test and that results obtained at different aging times under 72 hours are not a good basis for comparing the relative performance characteristics of paint finishes.

4.3.1.4 Cut or stamp a 150 mm long by minimum 25 mm wide test sample from the part or plaque to be evaluated (150 mm × 75 mm sample size is preferred if part size permits). The sample shall be carefully cut or stamped down through the show surface to avoid any nicks in the edges of the sample which would cause an unnatural stress concentration and consequently premature failure.

4.3.1.5 Expose the test samples and mandrel fixture to the specified test temperatures for a minimum of 4 hours. The mandrel fixture shall be rigidly attached within the environment to allow both hands of the operator to be free to perform the test.

4.3.1.6 Quickly wrap the conditioned sample 180 degrees or as far as possible around the mandrel so that the width of the sample is parallel to the axis of the mandrel. The wrapping action shall take no more than 2 seconds. Painted samples shall be wrapped so that the painted surface is in tension. The operator shall wear gloves when testing the samples at subambient temperatures to avoid warming the surface of the sample.

Table 1: Test Condition for Class M1 and M2

Class	Specification	Test Temperature	Mandrel Diameter ^{Note 1}
M1	GMW14797 - Flexible Substrates only (< 800 MPa Flexural Modulus)	23 °C ± 2 °C	13.2 mm ± 0.7 mm
M2	GMW14797 with suffix M2 ^{Note 2}	23 °C ± 2 °C	13.2 mm ± 0.7 mm
		-15 °C +0 °C/-3 °C	26.0 mm ± 0.7 mm
		-30 °C +0 °C/-5 °C	62.0 mm ± 0.7 mm

Note 1: Mandrel diameters and tolerances are based on American National Standards Institute (ANSI) Schedule 40 welded and seamless wrought steel pipes with nominal IDs of ¼ inch, ¾ inch and 2 inches and/or standard tubing of ½ inch, 1 inch and 2½ inches.

Note 2: Suffix M2 requires tests to be made at all three (3) of the conditions shown.

5 Data

5.1 Calculations. The following equation can be used to relate outer paint film strain to mandrel diameter:

$$E = \frac{T}{T + D}(100),$$

Where: