



Tape for Wiring Harness

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 specifies dimensions, test methods and requirements for harness tapes.

1.2 Applicability. This standard shall be used for all passenger cars and light duty truck wire harnesses to evaluate and classify wire harness tapes for a given application. Class designations are defined in Table 1 for the various temperature ranges encountered in/on vehicles.

Table 1: Temperature Classes

International Organization for Standardization (ISO) Class	Temperature Class	Operating Temperature (°C)	Long-term Aging Temperature 3000 h (°C)	Short-term Aging Temperature 240 h (°C)	Overload Aging Temperature 6 h (°C)
A	T1	-40 ^{Note 1} to +85	+85	+110	+135
B	T2	-40 ^{Note 1} to +100	+100	+125	+150
C	T3	-40 ^{Note 1} to +125	+125	+150	+175
D	T4	-40 to +150	+150	+175	+200
E	T5	-40 to +175	+175	+200	+225
F	T6	-40 to +200	+200	+225	+250
G	T7	-40 to +225	+225	+250	+275
H	T8	-40 to +250	+250	+275	+300

Note 1: A temperature of -25 is acceptable for Polyvinyl Chloride (PVC). See 4.8.4.

1.3 Remarks. There is no international or national equivalent to this standard.

2 References

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

2.1 External Standards/Specifications.

ASTM D5374	EN 1944	ISO 3795	ISO 22241
ASTM D5423	FMVSS 302	ISO 4925	ISO 29862
BS EN 1942	IATF 16949	ISO 6722-1	ISO 29864
DS/EN 61672-1	ISO 2286	ISO 6931-1	ISO/IEC 17025

2.2 GM Standards/Specifications.

GMW3059

GMW3205

GMW15634

GMW3176

GMW3235

GMW15635

2.3 Additional References.

- International Automotive Task Force (IATF) IATF 16949 is available at Uniform Resource Locator (URL) <http://www.aiag.org/>

3 Test Preparation and Evaluation

3.1 Resources.

3.1.1 Facilities. Temperature controlled room with power outlets and internet connections.

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

3.1.1.2 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.

3.1.1.3 Ovens. Unless otherwise specified, when an oven is required, it shall be a hot air oven. The oven type shall either be a forced air or mechanical convection. See Figure 1. The air shall enter the oven in such a way that it flows over the surface of the test pieces and exits near the top of the oven. The oven shall have not less than eight (8) and not more than 20 complete air changes per hour at the specified ageing temperature. See ASTM D5423 and ASTM D5374 for temperature uniformity and air exchange measurements.

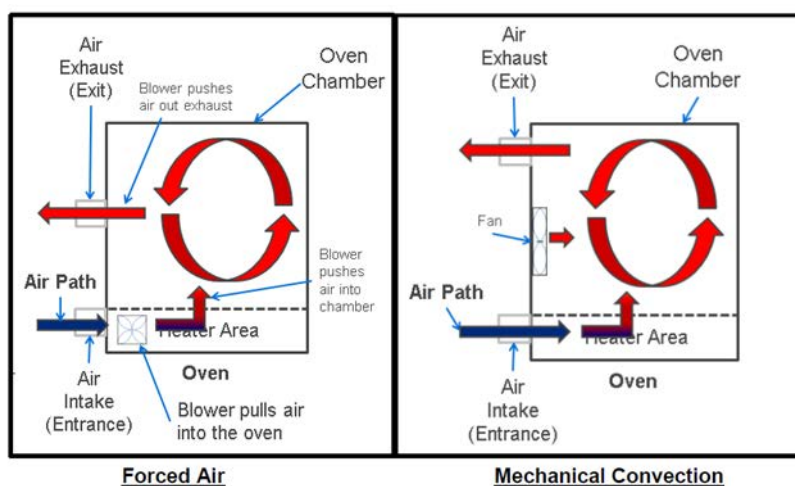


Figure 1: Ovens

3.1.2 Equipment. See each individual test in Section 4.

3.1.3 Test Vehicle/Test Piece. The number of test samples is specified in each single test. No parts out of prototype tools shall be used. Discard the first three layers of tape from the roll to be tested before removing the test samples. For each test, only samples shall be used which, at the start of the test, are not older than six (6) months, and have not been used in previous tests.

3.1.4 Test Time.

Calendar time: 125 days
 Test time: 4400 hours
 Coordination time: 80 hours

3.1.5 Test Required Information.

3.1.5.1 Product Quality Assurance. Tape manufacturers must run quality management according to International Automotive Task Force (IATF) IATF 16949 available at Uniform Resource Locator (URL) <http://www.aiag.org/>. Appropriate statistical tools must be used to analyze process and product data so that variation in the final product is continuously reduced. The tape suppliers must establish cross-functional teams to develop control plans and Process Failure Mode and Effects Analysis (FMEA) for approval by the appropriate Wire Harness Supplier engineering and quality personnel.

The tape manufacturer must develop control plans at the system, subsystem, component and/or material level, as appropriate for the product supplied. At minimum, the control plan shall include a comprehensive documentation of product/process characteristics, process controls, tests and measurement systems that occur during mass production. The control plan shall be reviewed and updated as appropriate when the product or process changes, the processes become unstable, or the process becomes non-capable. The Process FMEA is a supplementary tool to ensure that the harness tape will maintain all performance characteristics identified in this specification on a continuous basis. Efforts shall be taken to continuously improve the process to achieve defect prevention rather than defect detection.

Note: IATF 16949 demands the use of capable measurement devices. Since most of the tape tests described in this specification are material destructive measurements with high complexity in terms of sample preparation, environmental conditions and instrument impact, and since tests on polymeric materials have high variations in general, the normal IATF 16949 requirements of less than 30% gauge Remove and Replace (R&R) cannot be reached. Since these are industry standard tape tests, they can be used despite their lower confidence level.

3.1.6 Personnel/Skills. Proper training is required to operate the instrumentation in this procedure. Each test shall be completed by individuals that specialize in these tests.

3.2 Preparation. See each individual test in Section 4.

3.3 Conditions.

3.3.1 Environmental Conditions. Unless specified otherwise, all test samples shall be preconditioned for at least 16 h at a room temperature of $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ and a Relative Humidity (RH) of 45% to 75%. Unless specified otherwise, all tests, other than "in process" tests, shall also conducted at a room temperature of $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ and a RH of 45% to 75%.

3.3.2 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.

3.4 Instructions. See each individual test in Section 4.

3.5 Data. See 3.7.1.

3.6 Safety.

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

3.7 Documentation. Samples of components or material released to this standard shall be tested for conformity with the requirements of this standard and approved by the responsible GM Department prior to the start of delivery of production level components or materials.

Any change to the component or material, e.g., design, function, properties, manufacturing process and/or location of manufacture requires a new release of the product. It is the sole responsibility of the supplier to provide the customer, unsolicited, with documentation of any change or modification to the product/process, and to apply for a new release.

If not otherwise agreed to, the entire verification test shall be repeated and documented by the supplier prior to start of delivery of the modified or changed product. In some cases, a shorter test can be agreed to between the responsible GM department and the supplier.

3.7.1 Test Results. Test results shall be reported in a test report. See Data Sheet A1 in Appendix A. Along with a comparison of requirements to results/data (pass/fail determination), the test report shall include as minimum:

- Supplier Name
- Date
- Product Designation
- GM Part Number
- International Material Data Standards (IMDS) Identification (ID)
- Temperature Class
- Type of Adhesive
- Test Result and Interpretation of Test Result

Tests shall be run at the frequency described in Table A1 in Appendix A.

4 Requirements and Procedure

4.1 Material. The tape shall comply with the requirements of this standard for a period of six (6) month storing, and be protected from direct solar light. The tapes color shall be defined according to GMW3176. As far as all other properties are unchanged the release of one color implies the release of other colors as well.

4.2 Marking. Every individual roll of tape shall be marked with the name of the supplier.

4.2.1 GM Covering Name Code System. For the purposes of identification on engineering drawings, each individual roll of tape shall be coded as shown in Figure B1, using attributes from Table B1 thru Table B8.

4.3 Dimensions.

4.3.1 Total Thickness. The test shall be performed according to BS EN 1942. For compressible noise damping tapes, the test shall be performed also according to ISO 2286. No single value shall exceed the range given in Table C1 in Appendix C.

4.3.2 Tape Width.

4.3.2.1 Test Sample. Prepare two (2) test samples of 450 mm each.

4.3.2.2 Apparatus. A steel scale having divisions at 0.5 mm intervals.

4.3.2.3 Procedure. Place the test specimen, without tension or pressure, adhesive side down on a hard smooth surface. Measure the width perpendicular to the edge with the steel scale at three approximately equally-spaced points along the length.

4.3.2.4 Interpretation of Results. The width shall be in accordance with Table C1 in Appendix C. The width deviation shall be $\leq \pm 1$ mm.

4.4 Tensile Strength and Elongation. The test shall be performed according to ISO 29864 except prepare five (5) samples, 200 mm long and same width as the tape. For widths > 25 mm, a test sample 25 mm wide shall be cut longitudinally from the tape. Use a sharp knife to obtain clean-cut edges. For interpretation of results, see Table C1 in Appendix C.

4.5 Unwind Force. The test shall be performed according to EN 1944. For interpretation of results, Table C1 in Appendix C. Record the average force. **Note:** Unwind force shall be agreed upon between tape supplier and harness suppliers.

4.6 Adhesion to Steel. The test shall be performed according to ISO 29862, Process 1, 180 Degree (°) Test.

4.6.1 Test Sample. Prepare three (3) samples, 300 mm long and same width as the tape. For widths > 25 mm, a test sample 25 mm wide shall be cut longitudinally from the tape. Use a sharp knife to obtain clean-cut edges.

4.6.2 Procedure. The peel adhesion is expressed in N/25 mm width of tape.

4.6.3 Interpretation of Results. See Table C1 in Appendix C.

4.7 Adhesion to Backing. This test shall be performed according to ISO 29862, Process 2, 180° test, adhesion to backing. The peel adhesion is expressed in N/25 mm width of tape.

4.7.1 Test Sample. Prepare three (3) samples, 300 mm long and same width as the tape. For widths > 25 mm, a test sample 2 mm wide shall be cut longitudinally from the adhesive tape. Use a sharp knife to obtain clean-cut edges.

4.7.2 Interpretation of Results. See Table C1 in Appendix C.

4.8 Bending Test.

4.8.1 Bending Test Sample after Short-term Aging.

4.8.1.1 Test Sample. Three (3) test samples shall be made up of 16 insulated wires (ISO thin wall) of 0.35 mm² size or 12 insulated wires of 0.5 mm² size. All the insulated wires (cables) for this test shall be Ethylene Tetrafluoroethylene (ETFE). When testing tapes in temperature classes E, F, G, and H of Table 1, contact the responsible GM department for information about which cables are to be used in the test. The length of the cables shall be 600 mm. The electric cables shall be bundled by tight winding. The tape shall be applied on the test samples starting from the bottom, each turn overlapping the preceding one by one half the width of the tape. See Figure 2.

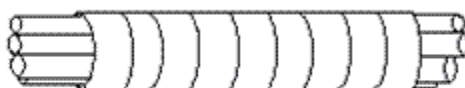


Figure 2: Test Sample

4.8.1.2 Procedure. The test sample shall be conditioned for ≥ 24 h at room temperature and relative humidity. See 3.3.1. Place the test samples, in a vertically orientation, in a convection oven at a temperature specified in Table 1 for 240 h. The samples shall be separated by ≥ 50 mm from each other and from the inner surface of the oven. After aging, the test sample shall be stored at a temperature of $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ for 6 h and then bent over a 30 mm mandrel possessing the same temperature. The test samples shall be wound 720° . The time for winding 360° shall be < 5 s. The time for holding the sample in this position shall be > 60 s then the test sample shall be examined visually.

4.8.1.3 Interpretation of Results. The test sample shall not show any spread of adhesive, cracks, flagging, or other failure.

4.8.2 Bending Test Sample after Long-term Aging.

4.8.2.1 Test Sample. See 4.8.1.1, however, test sample construction shall be as shown in Table 2.

Table 2: Type of Cables used in Bending Test after Long Term Ageing and Moisture Influence

	Number of Single Core Cables by Insulation Type ^{Note 1} , Class and Size (mm ²)									
	FEP/XLFE Class F		ETFE Class E		XLPE/XLPO Class D		XLPE Class C		PVC Class B	
	0.35	0.5	0.35	0.5	0.35	0.5	0.35	0.5	0.35	0.5
Class A Tape							8	6	8	6
Class B Tape							8	6	8	6
Class C Tape					8	6	8	6		
Class D Tape			8	6	8	6				
Class E Tape	8	6	8	6						
Class F Tape	16	12								

Note 1: Cable insulation types are: ETFE = Ethylene Tetrafluoroethylene, FEP = Fluorinated Ethylene Propylene, PVC = Polyvinyl Chloride, XLFE = Cross-linked Fluorinated Ethylene, XLPE = Cross-linked Polyethylene, XLPO = Cross-Linked Polyolefin

4.8.2.2 Procedure. The test sample shall be conditioned for ≥ 24 h at room temperature and relative humidity. See 3.3.1. Place the test samples, in a forced air or convection oven at a temperature specified in Table 1 for

3000 h. The samples shall be separated by ≥ 50 mm from each other and from the inner surface of the oven. Test samples made of different tape materials shall not be tested at the same time. After aging, the test sample shall be stored at $+23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ for 6 h and then bent, still at $+23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$, over a mandrel with a diameter of 30 mm. The test samples shall be wound 720° . The time for winding 360° shall be < 5 s. The time for holding the sample in this position shall be > 60 s then the test sample shall be examined visually.

4.8.2.3 Interpretation of Results. The test sample shall not show any spread of adhesive, cracks, flagging, or other failure.

4.8.3 Bending Test Sample after Overload Temperature Aging.

4.8.3.1 Test Sample. See 4.8.1.1, however all cables for this test shall be ETFE.

4.8.3.2 Procedure. The test sample shall be conditioned for ≥ 24 h at room temperature and relative humidity. See 3.3.1. Place the test samples, in a vertical orientation, in a hot oven at a temperature specified in Table 1 for 6 h. The samples shall be separated by ≥ 50 mm from each other and from the inner surface of the oven. After aging, the test sample shall be stored at $+23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ for 6 h and then bent over a mandrel with a diameter of 30 mm. The test samples shall be wound 720° . The time for winding 360° shall be < 5 s. The time for holding the sample in this position shall be > 60 s then the test sample shall be examined visually.

4.8.3.3 Interpretation of Results. The test sample shall not show any spread of adhesive, cracks, flagging, or other failure.

4.8.4 Cold Bending Test.

4.8.4.1 Test Sample. Three (3) test samples shall be made up of two (2) twisted electric cables with a conductor area of 0.35 mm^2 . All the cables for this test shall be ETFE or FEP.

4.8.4.2 Apparatus. Freezing chamber.

4.8.4.3 Procedure. The test sample shall be stored at a temperature of $-40\text{ }^{\circ}\text{C}$ for a minimum of 4 h and then bent, still at $-40\text{ }^{\circ}\text{C}$, over a mandrel possessing the same temperature. The diameter of the mandrel shall be 30 mm. The test samples shall be wound 720° . The time for winding 360° shall be < 5 s. The time for holding the sample in this position shall be > 60 s then the test sample shall be examined visually. If a PVC tape fails at $-40\text{ }^{\circ}\text{C}$, perform the test at $-25\text{ }^{\circ}\text{C}$.

4.8.4.4 Interpretation of Results. The test sample shall not show any spread of adhesive, cracks, flagging, or other failure.

4.8.5 Bending Test after Moisture Influence.

4.8.5.1 Test Sample. See 4.8.1.1, however, test sample construction shall be as shown in Table 2.

4.8.5.2 Procedure. The test sample shall be stored in a climate simulation cabinet at a relative humidity of $95\% \pm 5\%$ at $+70\text{ }^{\circ}\text{C}$ for 900 h. After aging, the test sample shall be stored at a temperature $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ for 6 h then bent over a mandrel with a diameter of 30 mm and examined visually.

4.8.5.3 Interpretation of Results. The test sample shall not show any spread of adhesive, cracks, flagging or other failure.

4.9 Abrasion Resistance.

4.9.1 Needle Abrasion. The test is done according to ISO 6722-1, with the amendments of 4.9.2 thru 4.9.4.

4.9.2 Test Sample. The 100 mm of tape shall be applied in a single layer to a steel mandrel with a diameter of $5.0\text{ mm} \pm 0.1\text{ mm}$, which is placed into the equipment. The tape shall be applied on the mandrel starting from the bottom, each turn overlapping the preceding one by one half the width of the tape. Ten (10) test samples shall be prepared.

4.9.3 Apparatus/Procedure. The apparatus shall:

- Record the number of cycles to failure and shall stop when the needle abrades through the insulation and makes contact with the mandrel
- Use a needle of diameter $0.45\text{ mm} \pm 0.01\text{ mm}$ made from spring wire according to ISO 6931-1
- Apply a vertical force: $7\text{ N} \pm 0.05\text{ N}$
- Operate at a frequency of $55\text{ cycles/minute} \pm 5\text{ cycles/minute}$. **Note:** One (1) cycle consist of one reciprocating movement
- Create an abrasion length of $15\text{ mm} \pm 1\text{ mm}$