



Flexible Flat Cable Test Specification

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 defines the test methods and performance requirements for Flexible Flat Cable (FFC).

1.2 Applicability. GM passenger car and light duty truck wire harnesses.

1.3 Remarks. FFC is used for power and signal distribution in vehicles.

2 References

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

2.1 External Standards/Specifications.

ASTM D5374	DIN 72551-5	IEC 60068-2-14	ISO 6722-1
ASTM D5423	IEC 60068-2-2	IEC 60068-2-64	ISO 8510-2

2.2 GM Standards/Specifications.

GMW3059	GMW3232	GMW14729	GMW16331
GMW3191	GMW3286	GMW15626	

2.3 Additional References.

- Crimp Terminal Manufacturer Specification
- FFC Harness Maximum Ambient Temperature
- FFC Harness Operating Current and Failure Current Levels
- FFC Part Drawing
- International Material Data System Identification (IMDS ID) and Datasheet

3 Test Preparation and Evaluation

3.1 Resources.

3.1.1 Facilities. As specified in the individual test procedures.

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, forced convection or mechanical convection. See Figure 1 and Figure 2. 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. Reference ASTM D5374 and ASTM D5423 for temperature uniformity and air exchange measurements.

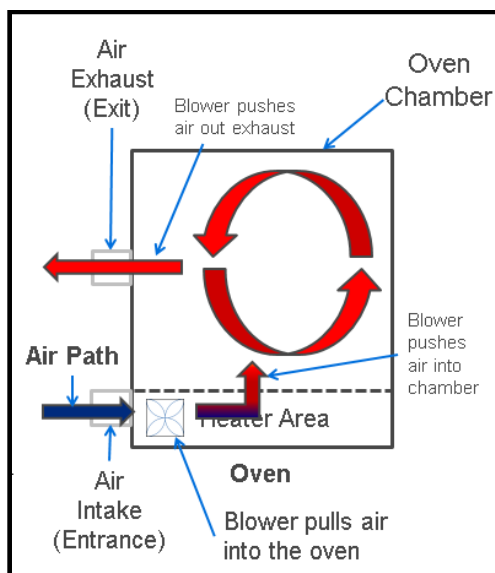


Figure 1: Forced Air Oven

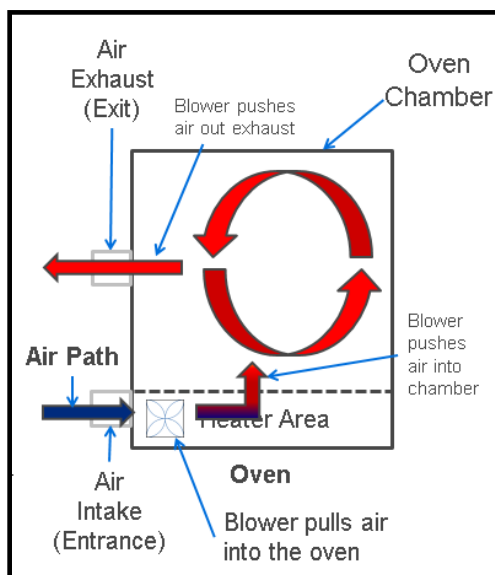


Figure 2: Forced Convection/Mechanical Convection Oven

3.1.2 Equipment. As specified in the individual test procedures.

3.1.3 Test Vehicle/Test Piece. Independent of the production method, the FFC technology is divided into the following:

- Flexible Laminated Cables (FLC). Copper strips which are laminated between two foils.
- Extruded Flat Cables (EFC). Similar to the round conductors where the flat copper strips are isolated in an extrusion process.

For release testing, the total number of test samples specified in the test plan (5.4) shall be tested (used). If all tests are performed, a minimum of 100 samples are required.

3.1.4 Test Time.

Calendar time:	125 days
Test hours:	3000 hours
Coordination hours:	30 hours

3.1.5 Test Required Information. The FFC shall pass all component tests of this standard as well as the test requirements for the assemblies.

3.1.6 Personnel/Skills. Not applicable.

3.2 Preparation. Not applicable.

3.3 Conditions. Tests shall be performed without pre-conditioning unless otherwise stated in the individual tests.

3.3.1 Environmental Conditions. Tests shall be performed at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and 45% to 75% relative humidity, if not stated otherwise in the individual tests.

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. As specified in the individual test procedures.

3.5 Data. As specified in the individual test procedures.

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 are to be recorded in a test report referencing the test procedure used. See Appendix A Sample Test Report. The test report shall include, as a minimum, the following:

- Date
- Name of the supplier
- Supplier product designation
- GM wire code designation
- Production location
- International Material Data System Identification (IMDS ID) and information, if the International Material Data System (IMDS) datasheet has been approved by the customer
- Test result and interpretation of test result.

4 Requirements and Procedure

4.1 General. FFC is constructed with parallel copper conductors. See Figure 3.



Figure 3: FFC with Parallel Copper Conductors

4.1.1 Appearance/Visual Representation.

4.1.1.1 All parts shall be in proper visual condition. There should be no distortions, tears or breaks.

4.1.1.2 Stamped or cut edges of a FFC shall not have metallic points or splinters.

4.1.1.2.1 The cable shall have no sharp edges to cause assembly issues.

4.1.1.2.2 Conductive traces and isolation layers shall not have folds, bubbles or inclusions, which are not part of the design.

4.1.1.2.3 De-lamination of Flexible Printed Circuits (FPC) and FLCs are not permitted.

4.1.1.3 Edges with non-insulated conductive areas and conductive traces are only valid at specifically designed contact areas.

4.1.2 Setup.

4.1.2.1 Flat wires consist of flat foil conductors fully wrapped in plastic insulation. The insulation should be generated in a laminating process with synthetic material, or an extrusion process.

4.1.2.2 It is permitted for the FFC harness to be protected by an insulation cover of varnish ≥ 0.015 mm.

4.1.3 Materials. See 7.1.

4.1.3.1 Conductive material is made of copper with a purity of $\geq 99.8\%$.

4.1.3.2 The conductance shall be ≥ 53 mS/mm² at $+20$ °C ± 2 °C.

4.1.3.3 Thickness and material of the conductive trace and the isolation layer shall be specified on the FFC Part Drawing with a layer thickness tolerance of $\pm 0\%$.

4.1.3.4 Possible coatings of the surface, e.g., tin etc., shall be specified on the FFC Part Drawing.

4.1.4 Marking.

4.1.4.1 All parts should be marked with a part number.

4.1.4.2 The part number can be printed, labeled or etched into the conductive material.

4.1.4.3 The label shall meet the requirements of GMW16331

4.1.5 Visual Inspection.

4.1.5.1 All values and tolerances shown on the FFC Part Drawing shall be met.

4.1.5.2 All requirements described in 4.1.1 thru 4.1.4 shall be met.

4.2 Performance Requirements.

4.2.1 **Inline Interface.** Inline interfaces shall meet the requirements per GMW3191 and/or the requirements defined in the FFC Part Drawing.

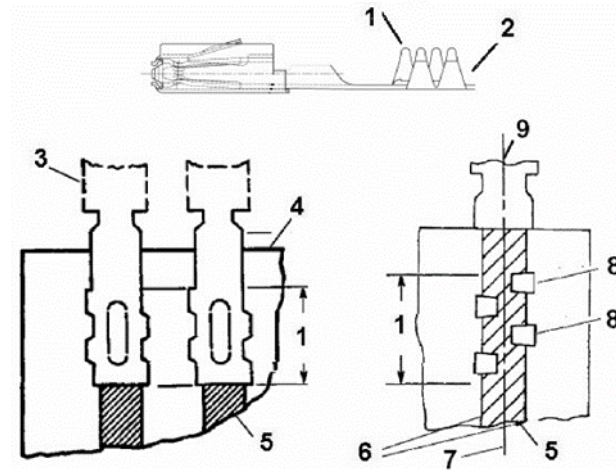
4.2.2 **Non-Inline Interfaces.** Non-Inline interfaces are created by crimping, soldering or welding. Crimp height and cross section measurements shall be per the Crimp Terminal Manufacturer Specification.

4.2.2.1 Requirements for Crimp Interfaces.

4.2.2.1.1 The distance of the crimp tines to centerline of conductive trace and the rolling radius of the crimp tines shall be symmetrical.

4.2.2.1.2 No cracks or burrs shall be evident at the contact.

4.2.2.1.3 The crimp geometry shall be as shown in Figure 4.



1. Crimp area
2. Crimp end
3. Contact mating end
4. Flexible flat cable
5. Conductive trace
6. Conductor edge
7. Centerline of conductive trace
8. Crimp tines
9. Centerline of crimp

Figure 4: Definitions for Crimp Interface

4.2.2.1.4 The contact shall be centered on the conductive trace.

4.2.2.1.5 The center lines of the conductive trace and the crimp shall be within the limits specified on the FFC Part Drawing. If not stated otherwise, the deviation of the orientation of the contact to the conductive trace shall not exceed ± 5 degrees.

4.2.2.1.6 The grid size (pitch) shall be specified on the FFC Part Drawing.

4.2.2.1.7 The tips of all crimp tines shall overlap the conductor edge.

4.2.2.1.7.1 The crimp tines shall visually form a good overlap.

4.2.2.1.7.2 The contact area should be as large as possible.

4.2.2.1.7.3 If required, the crimp tines should penetrate the insulation layers to contact the copper.

4.2.2.1.8 The crimp interface shall be evaluated based on the Crimp Terminal Manufacturer Specification.

4.2.2.2 Requirements for Soldered, Welded and other Interfaces.

4.2.2.2.1 The requirements shall be defined and agreed upon with GM.

4.2.2.2.2 The interfaces shall meet the same electrical and mechanical requirements as crimped interfaces.

4.2.2.3 Retention Force.

4.2.2.3.1 The retention force of a crimped interface shall meet or exceed the minimum requirements shown in Table 1.