

WSD 1800 Issue 4
**150°C Rated Ford Automotive Sensor
Cable Specification**
October 2012

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1 SCOPE

This specification covers the requirements for a range of 150°C rated cables using a radiation crosslinked, extruded, modified polymer insulation system, designed using Ford Engineering Specifications as a basis with additional requirements for process verification defined herein. The detail requirements of the individual products within the range are defined on the Specification Control Drawing (SCD). Where a difference occurs between this document and the SCD, the SCD shall take precedence.

2 RELATED DOCUMENTS

Reference is made in this document to the following specifications:

ES 2S7T-14401-AA *ES 2S7T-14401-BA ES 2S7T-14401-CA Issue in effect	Cable, low tension, insulated, 150°C, thin wall, aluminized PET wrap plus drain wire constructions, bare copper.
Ford WSK-1A348-A4: 03/06/03	Primary Low Tension Cable 150°C
FLTM BB 101-13: 2000/08/07	Electrical resistivity of automotive cable.
BSG 3G230:2000	Specification for general requirements for aircraft electrical cables (second series)
WSK-M1L128-A1: 11/11/97	Cable, low tension, insulated, 150°C, thin wall, shielded & twisted, bare, two core.

Note: * The maximum Outside Diameters of ACW6229-0.75 and ACW6229-1.00 may be up to 0.1mm larger than that stated in the Ford specification.

3 QUALITY ASSURANCE PROVISIONS

The tests detailed in section 5 & 6 are to be carried out at the frequencies described below. Where appropriate, individual test frequencies may be modified through the use of statistically derived data.

3.1 Quality Assurance

The supplier shall provide reasonable access to facilities for quality audit and control purposes on customer request.

3.2 Test Frequency

Tests are divided into three frequency categories. These are routine, lot/batch and qualification tests.

3.2.1 Routine Tests (100%)

Performed on 100% of the production length.

3.2.2 Lot/Batch Tests (Lot)

Performed on each production batch. A batch is any quantity of material manufactured on a substantially continuous basis, under conditions that are presumed uniform.

3.2.3 Qualification Tests (Q)

These are performed:

- i) Prior to first shipment of a new product.
- ii) Whenever any significant change is made to the materials or manufacturing process.

3.2.4 Test Frequency

Table 1

Clause Number	Test	Test Category
5.1	Cable Dimensions	Lot
5.2	Insulation Fault Testing	100%
5.3	Duration test voltage and breakdown voltage	Q
5.4	Heat ageing (3000 hours)	Q
5.5	Heat ageing (240 hours)	Q
5.6	Resistance to flame propagation	Q
5.7	Retention of core	Lot
5.8	Fluid Resistance	Q
5.9	Hydrolysis	Q
5.10	Notching Resistance	Q
6.1	Beam Verification	Lot

4 CABLE CONSTRUCTIONS AND MATERIALS

4.1 General

The material defined by this specification is a low tension stranded cable, insulated conductor for dedicated service temperature. The cable shall meet the requirements of section 5 & 6 of this specification

4.2 Component Wires

The cables use component wires that meet the requirements of the SCD.

4.3 Drain Wires

For cable constructions using a drain wire, the wire shall meet the conductor requirements of the SCD.

4.4 Wrap

For cable constructions using a wrapped component bundle, the tape shall be as specified on the SCD.

4.5 Braid

For braided cable constructions, the braid shall be as specified on the SCD.

4.6 Jacket Insulation

The cable is jacketed using a material that meets the requirements defined in this specification and the SCD.

5 TESTS AND TEST METHODS

5.1 Cable Dimensions

Specimen Length: 1.2 m

The maximum outside diameter of the cable shall be determined by taking measurements at three points along the length separated by at least 100 mm and recording the greatest overall diameter at each point. The single measured values shall be within the minimum and maximum specified values on the SCD.

5.2 Insulation Fault Testing

All cables and component wires shall be tested along 100% of their length, to ensure the electrical integrity of the insulation. Several methods are permissible for this test, such as BSG 3G230:2000 or WSK-1A348 03/06/03.

Test Voltage

For conductor against drain wire: 1.5kVeff for 1 minute

For component against component: 1.5kVeff for 1 minute

5.3 Duration Test Voltage And Breakdown Voltage

The centre section of a 1.2 m length of cable shall be immersed for 4 hours in a salt solution (30 grams of NaCl in 1.0 litre of distilled water) with 75 mm of both ends protruding. Immediately afterwards the cable is tested with 1.0 kV applied between each of the insulated primary wires individually and the salt solution for a period of 30 minutes.

After 30 minutes the test voltage shall be raised at a rate of 0.5kV/s until 3.0kV is reached.

Requirement: There shall be no voltage breakdown.

5.4 Heat Ageing (3000 Hours @ 150 °C)

A sample length of cable shall be suspended horizontally in an air circulating oven at 150°C for 3000 hours. After removal from the oven the sample is to be maintained at room temperature for 16 hours. Following this one end of the sample is fixed to a mandrel 4 times the cable diameter and the other end loaded with 5 kg. The sample is then wrapped around the mandrel for three close turns. The wound sample without mandrel shall be subjected to the duration voltage test as per paragraph 5.3 (at 1kV for 1 min).

Requirement: There shall be no cracks and no voltage breakdown

5.5 Heat Ageing (240 Hours @ 175°C)

A sample length of cable shall be suspended horizontally in an air circulating oven at 175°C for 240 hours. After removal from the oven the sample is to be maintained at room temperature for 16 hours. Following this one end of the sample is fixed to a mandrel 4 times the cable diameter and the other end loaded with 5 kg. The assembly is then placed in a cold cabinet at -25°C for 4 hours. After the conditioning period the sample is wrapped around the mandrel for three close turns whilst still in the cold cabinet. The wound sample without mandrel shall be subjected to the duration voltage test as per paragraph 5.3 (at 1kV for 1 min).

Requirement: There shall be no cracks and no voltage breakdown

5.6 Resistance To Flame Propagation

A 500 mm long sample shall be placed in a flammability test cabinet at an angle of 45° to the vertical. A Bunsen burner must be adjusted to give an overall flame height of 100 mm with an inner blue cone of 50 mm and a measured temperature at the peak of the inner blue cone of 950±50°C. The Bunsen shall then be placed perpendicular to the sample at a distance of 100 mm from the lower end. The flame is applied with the tip of the inner blue cone in contact with the outer surface of the sample for 30 seconds.

Requirement: The afterburn time shall not exceed 30 seconds

5.7 Retention Of Core

100 mm of the cable jacket insulation shall be removed from a 150 mm sample of cable. The bared cable core is to be passed through a sheet metal plate having a suitable hole diameter. The diameter of the hole is equal to the diameter of the cable core plus a maximum of 0.1 mm. The assembly shall then be placed in a tensometer and pulled at a speed of 50 mm/min. Record the force in Newtons required to remove the remaining 50 mm of cable insulation.

Requirement: See SCD

5.8 Fluid Resistance

The samples will be immersed in the fluids as indicated in Table 2 for the times and temperatures as specified, with the ends protruding. Following immersion the samples are removed from the fluid, wiped clean and left to return to room temperature for a minimum of 30 minutes.

Requirement: Conduct a notching resistance test as per section 5.10 (except the 4 notching resistance tests must be taken approximately equidistant to each other on the immersed section of the sample). Record the notching resistance forces for comparison with results of virgin samples. The notching resistance force values of all immersed samples, must be at least 20% of those values recorded against the comparable virgin samples.

Table 2

Test Fluid		Test Temperature (°C±3°C)	Test Duration
Name	Referee Fluid		
Oil Resistance	ASTM D471, ASTM No1	135	20 hours
Engine Oil	ASTM D471, IRM 902	90	20 hours
Gasoline	ISO 1817, Liquid C	23	30 mins
Gasoline + Methanol	ISO 1817, Liquid C + 15% Methanol	23	30 mins
Methanol	ASTM D471, Ref. Fuel K	23	30 mins
Diesel Fluid	ASTM D471, Ref. Fuel F	23	30 mins
Power Steering	ASTM D471, IRM 903	50	20 hours
Auto. Trans.	Dexron III	50	20 hours
Engine Coolant	ASTM D471, Service Fluid 104	50	20 hours
Battery Acid	H ₂ SO ₄ Specific Gravity = 1.260±0.005	23	20 hours
Windscreen Washer Sol.	50% Water + 50% Isopropanol	23	20 hours

5.9 Hydrolysis Test

Prepare a test sample with approximate length of 2000 mm. Wind the sample of cable on a mandrel 4 times the diameter of the cable. Lay the windings next to each other. Immerse the assembly in a water bath with the sample ends protruding from the surface at a temperature of 90±2°C. Connect the positive terminal of a 48 V DC power source to the cable components and screen+drain wire connected together and the negative terminal to the water. Allow the cable to age in water for 21 days (504 hours). The specific volume resistance of the insulation shall be measured immediately after immersion and every three days thereafter. Specific volume resistance to be measured as per FLTM BB 101-13, between each of the insulated primary wires individually and the water. The specimen shall be subjected to a visual inspection and the duration voltage test as per paragraph 5.3 after 21 days.

Requirement: Specific volume resistivity of the insulation shall be >10⁸ Ω.cm. A visual inspection shall show neither cracks, fractures or other defects. During the duration voltage test, breakdown shall not occur.

5.10 Notching Resistance

Procedure: The test set-up (see Figure 1) comprises a tensile testing machine, a notching tool (blade), a power circuit with a small voltage and a load-sensing device (plotter or other display unit). The notching tool must use a 0.45mm round spring wire in accordance with DIN 2076 measuring accuracy C, and consist of material X12CrNi177 in accordance with DIN 17224.

The sample shall be secured in the tensile testing machine in accordance with Figure 1 below.

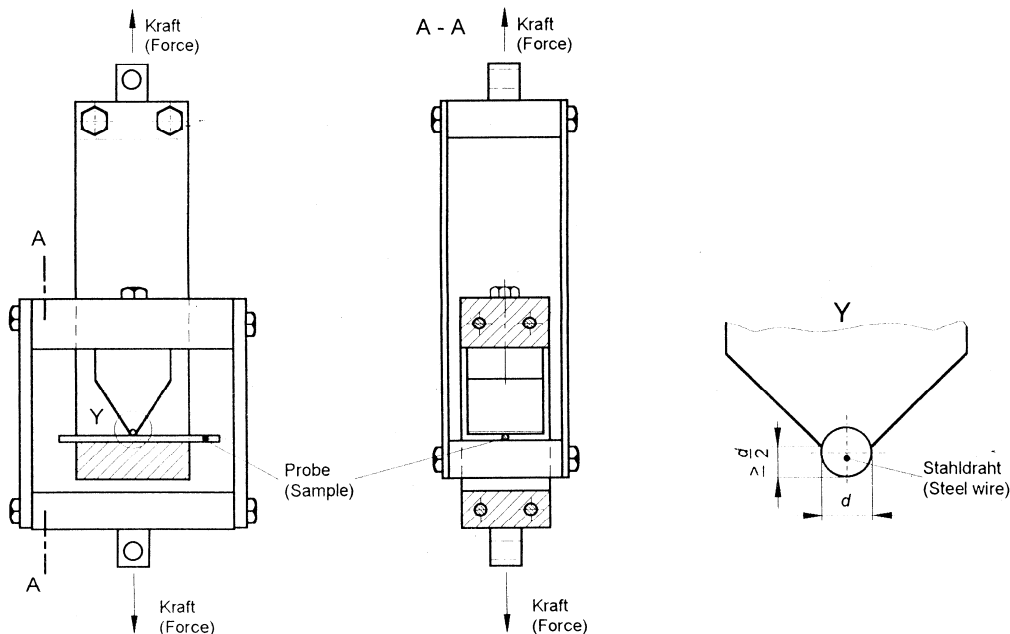


Figure 1

The steel wire shall be pushed through the insulation at a constant speed of max. 10 mm/min, until an electrical contact between the steel wire and the screen shuts off the machine. The axes of the specimen and the blade are at right angles to each other here.

The force recorded at the time of contact is noted. After each reading the specimen is moved along by 25 mm and rotated a total of 4 times by 90° through its longitudinal axis. The average value of the 4 measurements is the notching force.

Requirement: Record the notching force.

6 ADDITIONAL TESTS

6.1 Beam Verification

Verification will be achieved by a Quality Control check of the beam stamp on the Manufacturing Specification (MS) and then endorsing this by stamping the appropriate acceptance box on the Quality Control test report.

7 REVISION HISTORY

Issue No.	Amendment No.	CR No.	Date	Incorporated By
1	-	-	August 2005	Guy Mundy
2	-	CR06-DP207	May 2006	Guy Mundy
3	-	CR06-DP476	December 2006	Guy Mundy
4	-	CR12-DP-040	October 2012	Keith Carter

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