

WSD1223 Issue 9
**Automotive 150°C Rated ACW Wire
Specification**
November 2018



AUTOMOTIVE

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1 SCOPE

This specification covers the requirements for 150°C rated Automotive Composite Wire (ACW).

The detailed 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. This specification has been based on the documents as listed in section 2, using the most stringent method or requirement from the individual specifications. Where the same test exists in the documents, ISO6722 has been chosen as the standard test method.

2 RELATED DOCUMENTS

Reference is made in this document to the following specifications:

Ford WSK-1A348-A4 03/06/03	Primary Low Tension Cable 150°C
ISO6722:2006(E) Second edition 2006-08-01	Road vehicles – 60V and 600V single core cables – Dimensions test methods and requirements
ES-AU5T-1A348-AA Revision A, 10-24-07	Ford Global Wire Specification

3 QUALITY ASSURANCE PROVISIONS

The tests detailed in section 5 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 four frequency categories. These are routine, lot/batch, production quality 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 Production Quality Tests (PQ)

Performed on an audit basis at a frequency of one test per month of manufacture unless otherwise stated.

3.2.4 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.

4 CABLE CONSTRUCTIONS AND MATERIALS

4.1 Conductors

4.1.1 Copper Conductors

Strands shall be clean, bright and free from surface irregularities. Constructions shall show no kinks, joints or other irregularities in the completed conductor. They shall comply with section 5 and the SCD.

4.2 Wire Insulation

The insulation system shall meet the requirements of section 5 of this specification. It shall be extruded to cover the conductor uniformly and be homogeneous, smooth and free from flaws. The insulation shall not be loose but be capable of stripping cleanly without damage to the conductor.

4.2.1 Wire Marking

The insulation shall be capable of identification by application of marks onto the standard base colours. The marks shall be as specified on the SCD. The colours shall be defined as in Table 1.

Table 1

Reference Number	Colour
1	Brown
2	Red
2L	Pink
3	Orange
4	Yellow
5	Green
6	Blue

Reference Number	Colour
7	Violet
8	Grey
9	White
0	Black

5 TESTS AND TEST METHODS

5.1 Tests Taken from ISO6722 or WSK-1A348-A4

<u>Clause</u>	<u>Frequency</u>	<u>Method</u>	<u>Definition</u>	<u>Test Requirements</u>
5.1.1	Lot	-	Wall thickness	See SCD
5.1.2	Lot	-	Wire diameter	See SCD
5.1.3	Lot	-	Conductor diameter	See SCD
5.1.4	Lot	ISO6722 clause 6.1	Conductor resistance	See SCD
5.1.5	100%	ISO6722 clause 6.3	Spark testing	No breakdown
5.1.6	Q	ISO6722 clause 6.2	30 Minute withstand voltage	No breakdown
5.1.7	Q	ISO6722 clause 6.4	Insulation volume resistivity	$>10^9 \Omega\text{mm}$
5.1.8	Q	ISO6722 clause 7.1	Pressure at high temperature	No breakdown
5.1.9	Q	ISO6722 clause 7.2	Strip Force $\leq 6\text{mm}^2$	As per Table 2
5.1.10	Q	ISO6722 clause 8.1	Low temperature winding (-40°C)	No cracks, No breakdown
5.1.11	Q	ISO6722 clause 8.2	Low temperature impact	No cracks, No breakdown
5.1.12	Q	ISO6722 clause 9.3	Abrasion resistance $\leq 6\text{mm}^2$	As per Table 3
5.1.13	Q	ISO6722 clause 10.2	Short term heat ageing	No cracks, No breakdown
5.1.14	Q	ISO6722 clause 10.1	Long term heat ageing	No cracks, No breakdown
5.1.15	Q	ISO6722 clause 10.3	Thermal overload	No cracks, No breakdown

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5.1.16	Q	ISO6722 clause 10.4	Shrinkage by heat	<2 mm either end
5.1.17	Q	ISO6722 clause 11.2	Fluid Compatibility	Max. swell as per ISO, No cracks, No breakdown
5.1.18	Q	ISO6722 clause 11.4	Resistance to ozone	No cracks
5.1.19	Q	ISO6722 clause 11.5	Resistance to hot water	>10 ⁹ Ωmm, No cracks, No breakdown
5.1.20	Q	ISO 6722 clause 11.6	Environmental cycling	No cracks, No breakdown
5.1.21	Q	ISO 6722 clause 12	Resistance to flame propagation	Self-extinguish within 70s, >50mm unburnt at top
5.1.22	Q	WSK-1A348-A4 clause 3.11.10a	Flexibility ≤3.0mm ²	As per Table 4
5.1.23	Q	WSK-1A348-A4 clause 3.11.10b	Flexibility ≥3.0mm ²	As per Table 5
5.1.24	Q	WSK-1A348-A4 clause 3.11.11	Dynamic cold bend 2.50mm ² & 6.0mm ² only	Max. Resistance as per SCD, No cracks, No breakdown
5.1.25	Q	WSK-1A348-A4 clause 3.11.12	Notching resistance ≤6.0mm ²	As per Table 6
5.1.26	Q	WSK-1A348-A4 clause 3.11.14	Column strength 0.35mm ² & 0.5mm ²	15N minimum
5.1.27	Q	WSK-1A348-A4 clause 3.12	Compatibility tests	No cracks, No breakdown
5.1.28	Q	WSK-1A348-A4 clause 3.13	PVC Compatibility test	No cracks, No breakdown
5.1.29	Q	WSK-1A348-A4 clause 3.16	Mycological	No mould growth, No cracks

5.2 Additional Tests

<u>Clause</u>	<u>Frequency</u>	<u>Method</u>	<u>Definition</u>	<u>Test Requirements</u>
5.2.1	Lot	-	Bond test	Cut a 25 mm (minimum) strip in the insulation and check for any delamination of the core and PJ layers by trying to peel the layers apart. There shall be no delamination of the layers.
5.2.2	Lot	-	1x mandrel wrap	A length of finished wire shall be wound around a mandrel having a diameter equal to the diameter of the wire for a minimum of 5 turns. The winding shall be performed at a rate of approximately 1 wrap per second and tension applied by hand sufficient to ensure contact with the mandrel. Each successive wrap shall be touching the previous wrap. The sample shall then be removed from the mandrel and placed in a dye indicator (Acetone + 0.1% Methyl Violet), then examined for cracks and pinholes in the PJ without the aid of magnification. The core shall not be exposed through the PJ.
5.2.3	Q		Wicking test	Prepare a 2:1 mix of windscreen washer fluid with 2 parts of Propan-2-ol (IPA) and 1 part of distilled water and add 0.5g of methyl blue per 30ml of solution. Remove the conductor from a 50mm length of 1.5mm ² wire. Add enough windscreen washer fluid to a test tube to give a depth of 5mm at the bottom of the tube. Dip the sample vertically into the 5mm of fluid in the test tube. Stopper the test tube to prevent evaporation and position the tube vertically and leave for 24 hours. After this period remove the sample from the test tube and inspect for wicking of the fluid between the insulation layers. There shall be no signs of fluid wicking beyond 15mm from the dipped end of the insulation.

Table 2

Wire Size (mm ²)	Min. (N)	Max. (N)
0.25	3	30
0.35	3	30
0.50	5	40
0.75	5	40
1.00	5	40
*1.25	7	60
1.50	10	80
2.00	10	80
2.50	10	80
3.00	10	80
4.00	15	120
6.00	15	120

*No requirements given in ISO6772 for the above test, 7-60N chosen.

Table 3

Wire Size (mm ²)	Number of Cycles (minimum)	Applied Vertical Loads (N)
0.25	100	7
0.35	200	7
0.50	300	7
0.75	350	7
1.00	500	7
*1.25	1500	7
1.50	1500	7
2.00	1500	7
2.50	1500	7
3.00	1500	7
4.00	1500	7
6.00	1500	7
8.00	1500	7
10.00	1500	7
16.00	1500	7

*No requirements given in ISO6772 for the above test, 1500 cycles chosen.

Table 4*

Wire Size (mm ²)	Flexibility (Max.) (N)
0.35	1.70
0.50	2.30
0.75	3.60
1.00	5.00
1.25	7.00
1.50	9.00
2.00	-
2.50	17.00

*No requirements given in Ford WSK-1A348-A4 03/06/03 for the above test.

Requirements stated taken from Ford Global Wire Specification ES-AU5T-1A348-AA Clause 3.11.10. Revision A, 10-24-07.

Table 5

Wire Size (mm ²)	Flexibility (max.)	
	Against reel set (N)	With reel set (N)
4.00	6.00	4.00
6.00	8.00	6.00
8.00	15.00	13.00
10.00	20.00	18.00

Table 6

Wire size (mm ²)	0.35	0.50	0.75	1.00	*1.25	1.50	2.00	2.50	3.00	4.00	6.00
Notching force (min.) (N)	30	40	50	50	55	60	60	70	70	100	120

*No requirements given in Ford WSK-1A348-A4 03/06/03 for the above test, 55N chosen.

6 REVISION HISTORY

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1	-		June 1999	Guy Mundy
2	-	CR01-DP-0036	January 2001	Guy Mundy
3	-	CR02-DP-0210	April 2002	Guy Mundy
4	-	CR04-DP-0715	November 2004	Guy Mundy
5	-	CR09-DP-060	April 2009	Vince Hill
6	-	CR09-DP-118	June 2009	Vince Hill
7	-	CR11-DP-071	February 2011	Keith Carter
8	-	CR12-DP-040	February 2012	Keith Carter
9	2	CR18-DP-076	November 2018	Colin May

Prepared by	Approved by	Approved by
Colin May	Kevin Acott	Paul Scott
W&C Engineering Manager	Product Manager	Engineering Manager

Electronic Sign Off – No Signatures will appear

Tyco Electronics UK Ltd.
 Faraday Road, Dorcan
 SWINDON, SN3 5HH
 Tel: (01793) 528171
 Fax: (01792) 572516
 www.te.com

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