WQ 2403 Issue 2

Qualification Report for ACW 4 Series To Specification WSD 2366 Issue 1

August 2012

TE connectivity AUTOMOTIVE

Report Number:	**WQ 2403**
Issue Number:	**Issue 2**

Qualification report for ACW4 Series to specification WSD2366 issue 1

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Summary

This report details the qualification approval testing of ACW4229-0.50, ACW4229-1.00, ACW4239-0.50, ACW4239-1.00, ACW4249-0.50 and ACW4249-1.00.

The samples tested met the requirements of WSD 2366 Issue 1.

ACW4229-0.50, ACW4229-1.00, ACW4239-0.50, ACW4239-1.00, ACW4249-0.50 and ACW4249-1.00 are deemed representative to also qualify the 0.35 and 0.75mm² component wire sizes in the ACW42X9 product range.

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1 INTRODUCTION

This report details the qualification approval testing of ACW4229-0.50, ACW4229-1.00, ACW4239-0.50, ACW4239-1.00, ACW4249-0.50 and ACW4249-1.00 to the test methods and requirements of WSD 2366 issue 1.

ACW4229-0.50, ACW4229-1.00, ACW4239-0.50, ACW4239-1.00, ACW4249-0.50 and ACW4249-1.00 are deemed representative to also qualify the 0.35 and 0.75mm² component wire sizes in the ACW42X*9 product range.

X* = No. of component wires in cable

2 CONCLUSION

The samples tested met the requirements of WSD 2366 issue 1.

3 SAMPLES

Wire Size (mm^2)	Part Number	Batch Number
2 x 0.50mm²	ACW4229-0.50-2/9-0 TRLI13987(PS)	F680481091
2 x 1.00mm²	ACW4229-1.00-0/2-0 TRLI13986(PS)	F680495091
3 x 0.50mm²	ACW4239-0.50-2/3/9-0 TRLI13985(PS)	F680498091
3 x 1.00mm²	ACW4239-1.00-0/2/9-0 TRLI13984(PS)	F680503091
4 x 0.50mm²	ACW4249-0.50-9/0/6/1-0 TRLI14071(PS)	F841748032
4 x 1.00mm²	ACW4249-1.00-0/5/2/4-0 TRLI14072(PS)	F841755032

4 EXPERIMENTAL

WQ 2403 Clause	Test	Spec Clause	Method
5	Cable Dimensions	5.1	WSD 2366 Issue 1
6	Circularity	5.2	WSD 2366 Issue 1
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5 CABLE DIMENSIONS

Test method:
The maximum insulation outside diameter was measured at three points, separated by at least 100mm, along a 1.2m sample length of cable.

Requirement:
The single measured values shall be within the minimum and maximum specified values on the SCD.

Result:

Part Number	Batch Number	Requirement		Result		
		min (mm)	max mm)	1 (mm)	2 (mm)	3 (mm)
ACW4229-0.50	F680481091	4.20	4.60	4.35	4.55	4.42
ACW4229-1.00	F680495091	5.20	5.60	5.30	5.37	5.41
ACW4239-0.50	F680498091	4.40	4.80	4.66	4.66	4.60
ACW4239-1.00	F680503091	5.50	5.90	5.82	5.74	5.76
ACW4249-0.50	F841748032	4.80	5.20	4.97	5.03	5.06
ACW4249-1.00	F841755032	6.00	6.40	6.10	6.19	6.22

Ref: Test Report.

6 CIRCULARITY

Test method: As per SCD.

Requirement: 90% Minimum.

Result:

Part Number	Batch Number	Circularity (%)
ACW4229-0.50	F680481091	99.0
ACW4229-1.00	F680495091	99.0
ACW4239-0.50	F680498091	99.1
ACW4239-1.00	F680503091	99.3
ACW4249-0.50	F841748032	99.0
ACW4249-1.00	F841755032	99.0

Ref: Test Report.

7 BEAM VERIFICATION

Test method: Verification will be achieved by a check of the beam stamp on the MS.

Requirement: Sample beamed as manual.

Result:

Part Number	Batch Number	Result
ACW4229-0.50	F680481091	Sample beamed as manual Exit reel No. R0427SEP1104
ACW4229-1.00	F680495091	Sample beamed as manual Exit reel No. R0427SEP1106
ACW4239-0.50	F680498091	Sample beamed as manual Exit reel No. R0427SEP1105
ACW4239-1.00	F680503091	Sample beamed as manual Exit reel No. R0427SEP1107
ACW4249-0.50	F841748032	Sample beamed as manual Exit reel No. R0421MAR1206
ACW4249-1.00	F841755032	Sample beamed as manual Exit reel No. R0422MAR1201

Ref: MS & Test Report.

8 JACKET STRIP FORCE

Test method: ISO 6722-1:2011(E) Clause 5.8

100mm of the jacket was removed from a 150mm sample of the cable. The component wires were passed through a metal plate having a suitable hole diameter. The assembly was placed in a tensometer and pulled at a speed of 50mm/min. The force required to remove the insulation was measured.

Requirement: The removal force shall be as specified on the SCD.

Result:

Part Number	Batch Number	Removal force (N)	
		Requirement	Results
ACW4229-0.50	F680481091	15 - 120	21.3, 30.7, 27.9
ACW4229-1.00	F680495091	15 – 120	29.7, 39.2, 31.9
ACW4239-0.50	F680498091	15 – 120	34.9, 34.9, 38.1
ACW4239-1.00	F680503091	15 – 120	38.7, 36.0, 35.5
ACW4249-0.50	F841748032	15 – 120	31.5, 36.0, 36.1
ACW4249-1.00	F841755032	15 – 120	54.3, 49.2, 49.9

Ref: 5394/39.

9 INSULATION FAULT TESTING

Test method: The cable component wires were tested along 100% of their length, to ensure the electrical integrity of the insulation at a voltage of 1.5kV for 5 seconds between components.

Requirement: There shall be no breakdown of the insulation.

Result:

Part Number	Batch Number	Result
ACW4229-0.50	F680481091	No Breakdown
ACW4229-1.00	F680495091	No Breakdown
ACW4239-0.50	F680498091	No Breakdown
ACW4239-1.00	F680503091	No Breakdown
ACW4249-0.50	F841748032	No Breakdown
ACW4249-1.00	F841755032	No Breakdown

Ref: Test Report.

10 LONG TERM HEAT AGEING (3000 HOURS @ 150°C)

Test method: ISO 14572:2011(E) Clause 5.13

A sample length of cable was suspended in an air circulating oven at 150°C for 3000 hours. After removal from the oven the sample was maintained at room temperature for 16 hours. One end of the sample was fixed to a mandrel 5 times the cable outside diameter and the other end loaded with a weight as specified below. The sample was then wrapped around the mandrel for three close turns. The wound sample without mandrel was subjected to the duration voltage test at 1kV for 1 minute.

Requirement: The cable shall show no signs of cracks, fracture or defects and shall withstand the voltage test without breakdown.

Result:

Part Number	Batch Number	Mandrel size used (mm)	Weight (kg)	Visual examination		Voltage test
				after ageing	after wrap	
ACW4229-0.50	F680481091	22	2.5	No cracks	No cracks	No breakdown
ACW4229-1.00	F680495091	26	5	No cracks	No cracks	No breakdown
ACW4239-0.50	F680498091	22	2.5	No cracks	No cracks	No breakdown
ACW4239-1.00	F680503091	26	5	No cracks	No cracks	No breakdown
ACW4249-0.50	F841748032	22	5	No cracks	No cracks	No breakdown
ACW4249-1.00	F841755032	26	5	No cracks	No cracks	No breakdown

Ref: 5394/43.

11 ACCELERATED HEAT AGEING (500 HOURS @ 175°C)

Test method: ISO 14572:2011(E) Clause 5.13 (Except time and temperature)

A sample length of cable was suspended in an air circulating oven at 175°C for 500 hours. After removing from the oven the sample was maintained at room temperature for 16 hours. One end of the sample was fixed to a mandrel 5 times the cable outside diameter and the other end loaded with a weight as specified below. The sample was then wrapped around the mandrel for three close turns. The wound sample without mandrel was subjected to the duration voltage test at 1kV for 1 minute.

Requirement: The cable shall show no signs of cracks, fracture or defects and shall withstand the voltage test without breakdown.

Result:

Part Number	Batch Number	Mandrel size used (mm)	Weight (kg)	Visual examination		Voltage test
				after ageing	after wrap	
ACW4229-0.50	F680481091	22	2.5	No cracks	No cracks	No breakdown
ACW4229-1.00	F680495091	26	5	No cracks	No cracks	No breakdown
ACW4239-0.50	F680498091	22	2.5	No cracks	No cracks	No breakdown
ACW4239-1.00	F680503091	26	5	No cracks	No cracks	No breakdown
ACW4249-0.50	F841748032	22	5	No cracks	No cracks	No breakdown
ACW4249-1.00	F841755032	26	5	No cracks	No cracks	No breakdown

Ref: 5394/45.

12 SHORT TERM HEAT AGEING (240 HOURS @ 175°C)

Test method: ISO 14572:2011(E) Clause 5.14

Sample lengths of cable were suspended in an air circulating oven at 175°C for 240 hours and 500 hours. After removing from the oven the sample was maintained at room temperature for 16 hours. One end of the sample was fixed to a mandrel with the size specified below and the other end weighted with the weight as specified below. The assembly was placed in a cold cabinet at -25°C for 4 hours then wrapped around the mandrel for three close turns. The wound sample without mandrel was subjected to the duration voltage test at 1kV for 1 minute.

Requirement: The cable shall show no signs of cracks, fracture or defects and shall withstand the voltage test without breakdown.

Result:

Part Number	Batch Number	Mandrel size used (mm)	Weight (kg)	Visual examination		Voltage test
				after ageing	after wrap	
ACW4229-0.50	F680481091	22	2.5	No cracks	No cracks	No breakdown
ACW4229-1.00	F680495091	26	5	No cracks	No cracks	No breakdown
ACW4239-0.50	F680498091	22	2.5	No cracks	No cracks	No breakdown
ACW4239-1.00	F680503091	26	5	No cracks	No cracks	No breakdown
ACW4249-0.50	F841748032	22	5	No cracks	No cracks	No breakdown
ACW4249-1.00	F841755032	26	5	No cracks	No cracks	No breakdown

Ref: 5394/45.

13 COLD BEND

Test method: ISO 14572:2011(E) Clause 5.10

One end of the sample was attached to a mandrel, with diameter as specified in the table below. The other end loaded with the specified mass stated in the table below. The assembly was suspended vertically for 4 hours in a climatic chamber at -40°C. At the end of the conditioning period, the samples were wrapped around the mandrel whilst still in the chamber. The assembly was then removed from the chamber and the samples were unwrapped from the mandrel. . The wound sample without mandrel was subjected to the duration voltage test at 1kV for 1 minute.

Requirement: The cable shall show no signs of cracks, fracture or defects and shall withstand the voltage test without breakdown.

Result:

Part Number	Batch Number	Mandrel size used (mm)	Weight (kg)	Visual examination after wrap	Voltage test
ACW4229-0.50	F680481091	22	2.5	No cracks	No breakdown
ACW4229-1.00	F680495091	26	5	No cracks	No breakdown
ACW4239-0.50	F680498091	22	2.5	No cracks	No breakdown
ACW4239-1.00	F680503091	26	5	No cracks	No breakdown
ACW4249-0.50	F841748032	22	5	No cracks	No breakdown
ACW4249-1.00	F841755032	26	5	No cracks	No breakdown

Ref: 5394/40.

14 RESISTANCE TO FLAME PROPAGATION

Test method: ISO 14572:2011(E) Clause 5.21

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

Requirement: The afterburn time shall not exceed 70 seconds and a minimum of 50mm of insulation at the top of the sample shall remain unburned.

Result:

Part Number	Batch Number	Sample	After burn (seconds)	Unburned length (mm)
ACW4229-0.50	F680481091	1	12	235
		2	9	247
		3	10	250
		4	10	242
		5	8	245
ACW4229-1.00	F680495091	1	10	235
		2	8	250
		3	7	245
		4	4	238
		5	7	240
ACW4239-0.50	F680498091	1	6	240
		2	8	245
		3	6	248
		4	6	240
		5	8	243
ACW4239-1.00	F680503091	1	8	245
		2	3	250
		3	6	250
		4	3	240
		5	4	240

Resistance to flame propagation continued

Part Number	Batch Number	Sample	After burn (seconds)	Unburned length (mm)
ACW4249-0.50	F841748032	1	4	255
		2	5	245
		3	3	250
		4	7	250
		5	2	250
ACW4249-1.00	F841755032	1	2	255
		2	2	248
		3	3	255
		4	3	250
		5	2	256

Ref: 5394/44.

15 SCRAPE ABRASION

Test method: ISO 6722-1:2011(E) Clause 5.12

A wire sample was secured onto the abrasion equipment and the 0.45mm diameter wire abrasion blade loaded with 7N. The test was conducted over a 15.5mm stroke at an abrasion speed of 55 cycles per minute. The abrader was automatically stopped when the blade made contact with the conductor, at which point the number of cycles was recorded. The sample was moved forward 100 mm and turned through 90° and the procedure repeated. Four tests were carried out and the number of cycles recorded.

Requirement: 1000 cycles minimum.

Result:

Part Number	Batch Number	Result (cycles)			
		1	2	3	4
ACW4229-0.50	F680481091	>10000	>10000	>10000	>10000
ACW4229-1.00	F680495091	>5000	>5000	>5000	>5000
ACW4239-0.50	F680498091	>5000	>5000	>5000	>5000
ACW4239-1.00	F680503091	>5000	>5000	>5000	>5000
ACW4249-0.50	F841748032	>5000	>5000	>5000	>5000
ACW4249-1.00	F841755032	>5000	>5000	>5000	>5000

> Sample stopped at this point as exceeded test requirement.

Ref: 5394/41.

16 FLUIDS RESISTANCE

Test method: ISO 6722-1:2011(E) Clause 5.17.3

The test consists of two different fluid groups in accordance with table 15 of ISO6722-1:2011(E), Media Group 1 with a heat ageing period of 1000h at the actual cable class temperature (150°C) and Media Group 2 with a heat ageing period of 240h at actual class temperature (150°C). Individual test samples, 600mm long with 25mm of the insulation removed from each end were immersed in the fluids listed below for a 10 second period. Following immersion the samples were removed and allowed to drain for 3 minutes before being stored in an oven. For Media Group 1 fluids the immersing in the respective fluid shall be repeated at 240, 480 and 720 hours of the 1000 hour test. After fulfilled exposure the samples were subjected to a winding test at room temperature followed by voltage test.

Requirement: After winding, no conductor shall be visible. During the withstand voltage test, breakdown shall not occur.

Result:

Media Group 1

Fluid	Specification	Sample	Hours			
			240	480	720	1000
Engine coolant	50% ethylene glycol + 50% distilled water	ACW4229-0.50	Pass	Pass	Pass	Pass
		ACW4229-1.00	Pass	Pass	Pass	Pass
		ACW4239-0.50	Pass	Pass	Pass	Pass
		ACW4239-1.00	Pass	Pass	Pass	Pass
		ACW4249-0.50	Pass	Pass	Pass	Pass
		ACW4249-1.00	Pass	Pass	Pass	Pass
Engine oil	ISO 1817, Oil No 2	ACW4229-0.50	Pass	Pass	Pass	Pass
		ACW4229-1.00	Pass	Pass	Pass	Pass
		ACW4239-0.50	Pass	Pass	Pass	Pass
		ACW4239-1.00	Pass	Pass	Pass	Pass
		ACW4249-0.50	Pass	Pass	Pass	Pass
		ACW4249-1.00	Pass	Pass	Pass	Pass

Media Group 1 continued

Fluid	Specification	Sample	Hours			
			240	480	720	1000
Salt water (road)	5% NaCl, 95% water (mass %)	ACW4229-0.50	Pass	Pass	Pass	Pass
		ACW4229-1.00	Pass	Pass	Pass	Pass
		ACW4239-0.50	Pass	Pass	Pass	Pass
		ACW4239-1.00	Pass	Pass	Pass	Pass
		ACW4249-0.50	Pass	Pass	Pass	Pass
		ACW4249-1.00	Pass	Pass	Pass	Pass
Windscreen washer fluid	50% Iso-propanol, 50% water	ACW4229-0.50	Pass	Pass	Pass	Pass
		ACW4229-1.00	Pass	Pass	Pass	Pass
		ACW4239-0.50	Pass	Pass	Pass	Pass
		ACW4239-1.00	Pass	Pass	Pass	Pass
		ACW4249-0.50	Pass	Pass	Pass	Pass
		ACW4249-1.00	Pass	Pass	Pass	Pass

Media Group 2

Fluid	Specification	Sample	240 Hours
Gasoline	ISO 1817, Liquid C	ACW4229-0.50	Pass
		ACW4229-1.00	Pass
		ACW4239-0.50	Pass
		ACW4239-1.00	Pass
		ACW4249-0.50	Pass
		ACW4249-1.00	Pass
Diesel	90% ISO 1817, Oil No 3 + 10% p-xylene	ACW4229-0.50	Pass
		ACW4229-1.00	Pass
		ACW4239-0.50	Pass
		ACW4239-1.00	Pass
		ACW4249-0.50	Pass
		ACW4249-1.00	Pass
Ethanol	85% Ethanol + 15% ISO 1817 liquid C	ACW4229-0.50	Pass
		ACW4229-1.00	Pass
		ACW4239-0.50	Pass
		ACW4239-1.00	Pass
		ACW4249-0.50	Pass
		ACW4249-1.00	Pass
Power steering fluid	ISO 1817, Oil No 3	ACW4229-0.50	Pass
		ACW4229-1.00	Pass
		ACW4239-0.50	Pass
		ACW4239-1.00	Pass
		ACW4249-0.50	Pass
		ACW4249-1.00	Pass
Auto. transmission fluid	Dexron VI	ACW4229-0.50	Pass
		ACW4229-1.00	Pass
		ACW4239-0.50	Pass
		ACW4239-1.00	Pass
		ACW4249-0.50	Pass
		ACW4249-1.00	Pass
Brake fluid	SAE RM-66-06	ACW4229-0.50	Pass
		ACW4229-1.00	Pass
		ACW4239-0.50	Pass
		ACW4239-1.00	Pass
		ACW4249-0.50	Pass
		ACW4249-1.00	Pass

Media Group 2 Continued

Fluid	Specification	Sample	240 Hours
Battery acid	25% H_2SO_4 and 75% H_20 density 1.28	ACW4229-0.50	Pass
		ACW4229-1.00	Pass
		ACW4239-0.50	Pass
		ACW4239-1.00	Pass
		ACW4249-0.50	Pass
		ACW4249-1.00	Pass

Ref: 5394/49.

17 VOLTAGE WITHSTAND

Test method: ISO 14572:2011(E) Clause 5.5

Remove 100mm of sheath from both ends of a sample, and remove 25mm of insulation from all the cores at both ends. Connect the conductors of all the cores together at one end, except for the core being tested. Apply a 2kV a.c. between a core and the remaining core(s) for a minimum of 3 seconds. Repeat the procedure until all the cores have been tested.

Requirement: There shall be no breakdown between cores.

Result:

Part Number	Batch Number	Result
ACW4229-0.50	F680481091	No Breakdown
ACW4229-1.00	F680495091	No Breakdown
ACW4239-0.50	F680498091	No Breakdown
ACW4239-1.00	F680503091	No Breakdown
ACW4249-0.50	F841748032	No Breakdown
ACW4249-1.00	F841755032	No Breakdown

Ref: 5394/42.

18 THERMAL OVERLOAD

Test method: ISO 14572:2011(E) Clause 5.15

Two sample lengths of wire were suspended in an air circulating oven at 200°C for 6 hours. After removing from the oven the samples were maintained at room temperature for 16 hours, one end of the sample was fixed to a mandrel 5 times the cable outside diameter and the other end loaded with a weight as specified below. The sample was then wrapped around the mandrel for three close turns. The wound sample without mandrel was subjected to the duration voltage test at 1kV for 1 minute.

Requirement: After winding, no conductor shall be visible. During the '1 min withstand voltage' test, breakdown shall not occur.

Result:

Part Number	Batch Number	Mandrel size used (mm)	Weight (kg)	Visual examination after wrap	Voltage test
ACW4229-0.50	F680481091	22	2.5	No cracks	No breakdown
ACW4229-1.00	F680495091	26	5	No cracks	No breakdown
ACW4239-0.50	F680498091	22	2.5	No cracks	No breakdown
ACW4239-1.00	F680503091	26	5	No cracks	No breakdown
ACW4249-0.50	F841748032	22	5	No cracks	No breakdown
ACW4249-1.00	F841755032	26	5	No cracks	No breakdown

Ref: 5394/59.

19 KEYWORDS

1	WSD 2366	4	4 Series
2	Qualification	5	
3	ACW	6	

20 REFERENCES

1	WSD 2366 Issue 1
2	ISO 6722-1:2011(E)
3	ISO 14572:2011(E)
4	TE Connectivity Laboratory notebook: 5394 (P. Scott)

21 DISTRIBUTION

Name	Location	Title
Wire & Cable Technical	Main file	