ELECTRICAL WIRING COMPONENT APPLICATION PARTNERSHIP

09/25/2023

Subject: Change #5 to SAE/USCAR-45 (initial relese)

Changes have been made to the USCAR-45 to add a “collateral damage” inspection test similar to what is in USCAR-38. It is effective starting today. Comments and questions can be sent to EWCAP@uscar.org.

Concern:
Damage can happen to “opposite end” terminals from ultrasonic weld energy in a wire-to-wire splice and an inspection method is needed at DV validation to assess the risk. A test similar to section 4.9 of USCAR-38, that has been used succesfully for many years, is recommended as a basis for the new test.

Resolution:

1) A new test section to USCAR-45 has been added per **ITEM 1**.
2) Table 10 has been updated to add the new test to the required test sequence list per **ITEM 2.**

ITEM #1

4.8 Screening Test for Damage to Terminals or Weld Bonds on the Opposite End of a Short Wire

4.8.1 Purpose
This is a screening test that can predict a risk of low weld bond strength and terminal damage at the opposite end from where the weld is being done. This test assesses whether a terminal that is not related to the wire-to-wire weld under test may be damaged from the energy created by the weld under test. (The failure mode is that the weld under test sends excessive ultrasonic energy through the wire, putting nearby components at risk.) Damage at the far end of a 300 mm cable has been observed and components within 500 mm are considered at risk. Damage to nearby components should be evaluated on parts to be used within 500 mm of a welded bond. This is a generic screening test and is not a substitute for testing the specific application in its exact manufacturing configuration. Any cable length under 500 mm must have the validation performed in the as-manufactured condition.

4.8.2 Samples
Group 1: 50 samples using the cable configuration under test with a cable length of 200 mm. The “far end” of the wires are terminated with the terminal used in the design under test. The “near end” of the wire (where the wire-to-wire weld is done) is left unprocessed. These are the control samples.

Group 2: 50 samples using the cable configuration under test and length of 200 mm. The “far end” of the wire is terminated with the same terminals as the control samples. The “near end” wire-to-wire is welded at the “nominal” process setting being validated to an identical group of wires.

4.8.3 Procedure

1. Perform pull to failure test on all samples of the terminal-to-wire bond. Record peak force. Calculate average force difference between the groups.

2. Inspect far-end terminals per 4.2. Record any instance of damage unique to Group 2.

4.8.4 Acceptance Criteria

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1. If the average pull force for Group 1 is higher by 20% or more compared to the force for Group 2, the WUT is deemed to be “process-sensitive” to configurations with another weld closer than 500 mm.

2. If the inspection identifies any damage caused by the welding process, the WUT is deemed to be “process-sensitive” in configurations shorter than 500 mm.

NOTE: This is only a screening test that indicates the sensitivity of the WUT to cause damage to nearby weld bonds. Meeting the criteria can give confidence that the weld setup parameters used will not create damage to nearby terminals, even in short-wire configurations. Failure to meet the criteria does not reject an otherwise acceptable validation. The validation using production-intent short wires must perform a full validation on the specific configuration to be put in production using 4.8.3.

ITEM 2:

Table 10 - Tests required for validation

	Test Name	Cross-Sectional Analysis	Bond Tensile Strength	Bond Tensile Strength (Incorrectly Made)	Bond Peel Strength	Performance after Environmental Aging	Screening for terminal cracks [7]
	Test Group	A	B	C	D	E	F
	Sample size minimum for group	2	30[(2)]	5[(3)]	10[(2, 6)]	13[(2,4)]	100
4.1	General	1	1	1	1	1	1
4.2	Visual Inspection	2	2	2	2	2, 6	2, 4
4.3	Welded termination Cross-Section and compaction Analysis	3[(1)]					
4.4	Weld Bond Tensile Strength		3 [(5)]			7[(5)]	
4.4 [(3)]	Weld Bond Tensile Strength (same test “4.4” but performed on incorrectly made samples)			3			
4.5	Weld Bond Peel Strength		3 [(5)]		3		
4.6	Thermal Shock Conditioning					4	
4.7	Electrical Resistance Measurement					3, 5	
4.8	Screening for terminal damage on nearby tetrminals						3

NOTES:

[(1)] Perform measurement of weld attribute dimensions on both samples. Separate sample group after measurement using one sample for photographs and cross-section analysis and save the other part as a representative sample.

[(2)] If tensile or peel test is of a configuration at risk to fail requirements due to a low cable tensile strength (this is seen occasionally on small wire sizes with annealed copper strands), doubling the sample size is recommended. If the test fails, the extra samples can

have a reinforcement added to the weld area (such as by adding dual-wall heat shrink) and then retested per section 4.4.

(3) Samples intentionally made with worst-case wire orientation in the welding fixture are required for this test. Use samples with the biggest wire intentionally located on the anvil side of the ultrasonic tooling. All process tooling and settings are to be the same as for typical samples. Clearly identify samples as having “worst-case wire orientation for Group C.”

(4) Prepare 13 samples. Ten samples are for measurement and three are for an electrical resistance “deduct” reference. Construct the three reference samples by soldering the weld nugget to eliminate weld resistance.

(5) Pick the applicable test for step 3 based on the application: “Weld Bond Tensile Strength” is the default test. If “Weld Bond Tensile Strength” test of the smallest wire is not possible due to WUT being a “butt splice” configuration, replace test 4.4 with test 4.5 (Weld Bond Peel Strength).

(6) Skip test path D for “Butt splice” type samples. They are not subjected to tensile stresses.

(7) Include samples only if instructed, typically a request will be made when WUT has at-risk unrelated components placed on a shared wire within 500 mm.

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