EWCAP
ELECTRICAL WIRING COMPONENT APPLICATION PARTNERSHIP

Version 2 -- Changes (marked in RED) are:
1) Lowered sample size from 30 to 10
2) Clarifed current cycling procedure to note that the applied current is calculated from the limit temp and not the default of 5A/mm^2 of cable cross section used in other tests.

Subject: Change to SAE/USCAR-2, Revision 8, (Letter #1 Rev 2)

Changes have been made to the USCAR-2 specification. Comments and questions can be sent to EWCAP@uscar.org.

Situation:

USCAR-2 does not have a method for "derating" a terminal, which is used to determine what reduction in current carrying capacity a circuit has as ambient temperature increases. USCAR-2 only has a method to validate the current carrying capability of a terminal at room temperature, so it's left up to the customer and supplier to agree on way to derate. Several methods are available such as in ISO 8092-2. But, these methods require knowledge of the highest temperature a terminal can tolerate (its limit temperature), that is not available.

To resolve this, USCAR has been asked to develop a test to validate a supplier's claim of a limit temperature for a terminal. USCAR has not been asked to revise the USCAR-2 method or come up with a common derating method… the only task at USCAR is about the limit temperature.

Currently, there is a wide variation of claimed temperature limits even for similar terminals with similar platings. It is suspected that the difference in given limit temperatures is mostly from how the supplier determines the service temperature. The OEM customers would like to create a standardized method to confirm that the temperature given is correlated to actual terminal or connector performance.

Resolution:

A new section, Appendix G, provides a method for "Validation for Claimed Terminal Service Temperature." This is a stand-alone evaluation that can be used at the customer's discretion. This test simulates terminal conditions at the worst-case limit of the terminal's operational temperature limit, and then calls for inspection for damage and measurement of electrical performance.

This test is constructed by combining parts of three USCAR-2 tests:

- USCAR-2 #5.3.4 (Current Cycling)
- USCAR-2 #5.6.3 (High temperature exposure)
- USCAR-2 #5.3.3 (Temperature rise)

The method starts on the next page.

APPENDIX G- DESIGN NOTES - TEMPERATURE AND CURRENT RATING

G.1 VALIDATION TEST FOR CLAIMED TERMINAL SERVICE TEMPERATURE

G.1.1 Purpose:

This test evaluates whether a claimed 'Service temperature limit' on a terminal can be confirmed using electrical and visual test results. The service limit is used in derating calculations. This test is separate from and not required for a USCAR-2 connector validation.

G.1.2 Equipment

- DC power supply per 5.3.3.1.
- Temperature chamber similar to the chamber defined in 5.6.3 with the exception that airflow restrictions (baffles) are allowed.
- Instrumentation to continuously monitor temperature and mV drop on each terminal.
- Insulating platform to mount terminals on that can withstand the chamber temperatures (typically, phenolic resin board or similar).
- Omnidirectional anemometer to measure airflow at each terminal location in the chamber (optional).

G.1.3 Samples

- 10 terminal pairs (prior version of this letter was 30) typically with the largest applicable wire for the terminal under test, but any wire size is allowed.
- Attach required test leads on all terminal samples:
  - Per Figure 5.3.3.3-2 for the voltage drop leads
  - Per Figure 5.3.3.3-3 for thermocouple leads

G.1.4 Procedure:

1. Identify the following from the terminal supplier's product documentation and customer's intended use statement:
   a. T_{va} - The vehicle ambient maximum for the intended use, expressed as a temperature class per Table 5.1.4.1.
   b. T_{limit} - Limit temperature that the terminal maker claims to be the operational limit for the terminal under test.
2. Mate and unmate terminals 10 times per 5.1.7.
3. Arrange the terminals on the insulating platform per Figure 5.3.3.3-2, with the exception that the terminal spacing requirement is changed to 30mm minimum.
4. Stabilize temperature chamber at T_{va} from Step 1.
5. Place platform in temperature chamber.
6. Increment current to the terminals until T_{limit} or higher is measured on at least one terminal pair.
7. Record the current that resulted in a terminal reaching T_{limit}. This will be the test current for the rest of this procedure.

8. Optional step for confirmation that the baffle configuration is effective: Use the omnidirectional anemometer to measure the airspeed at each terminal. If temperature rise difference between samples is >5°C and difference in air flow >0.2m/s, expect the variation in temperature to be too high for consistent results and consider a different baffle configuration. (Note that using this step and even use of baffles is not required, but experience shows that using baffles will reduce variation that is unfavorable for the terminal under test.)
9. With the chamber constantly at T_{va} --- Cycle current as follows:
    a) 45 minutes with current at the "test current" determined in Step 7. Record temperature and voltage drop continuously when the current is flowing. From voltage drop readings, calculate resistance.
    b) 15 minutes with the current at 0. Note: This cycle is similar to the current cycling test 5.3.4.3.

    Note: the test current from Step 7 is the current that resulted in a terminal reaching T_{limit}: Ensure that the current that results in a temperature of T_{limit} is used. Do not use a different current, such as a current based on cable cross section). T_{limit} may be exceeded while the current is applied. Exceeding T_{limit} is not a failure, nor a reason to stop the test.

10. Repeat the cycle for a total of 1008 cycles/hours.
11. Remove samples from chamber and separate terminals. Inspect for visible degradation, plating peeling, terminal welding/bonding, or tearing of plating. Verify possible degradation with additional inspection at exactly 10X magnification.

G.1.5 Acceptance Criteria

1. No degradation or anomalies shall be seen in the visual inspection for items in Step 10.
2. During current application, samples under test shall meet requirements for Total Connection resistance per Table 5.3.2.4 (Note: the 50mV criterion also in Table 5.3.2.4 is not applied for this assessment, only the resistance.)

G.1.6 Application of results

1. If the acceptance criteria are met, the claimed T_{limit} and current that achieves T_{limit} can be used as input in a derating equation.
2. Derating equation or method is selected based on agreement between the customer and supplier.