477 kcmil, 3M Brand Composite Conductor Connector Sustained Load Tests in Accordance with ANSI C119.4

3M Company
Purchase Order 0000528060

NEETRAC Project Number: 02-137

August 2002

A Center of
The Georgia Institute of Technology

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Summary:

3M contracted with NEETRAC for dead-end connector sustained load tests in accordance with ANSI C119.4. The Alcoa Fujikura Limited (AFL) dead end sample showed no signs of problems during the load test, and exceeded RBS in a room-temperature tensile test following the 168-hour, 77% RBS sustained load period.

Samples:

1) Ten (10) meters of 477 kcmil, type 16, 3M Brand Composite conductor
2) AFL compound compression dead end terminal (special design for the ACCR conductor)

References:

1) "Proprietary Information Agreement …." Dated 3/27/01
2) ANSI C119.4 – 1999, (Connector performance requirements)
3) 3M Purchase Order 0000528060.
4) PRJ 02-137, NEETRAC Project Plan

Equipment Used:

1) MTS Servo-hydraulic tensile machine, Control # CQ 0195.
2) NEETRAC creep and sustained load frame.
3) HBM load cell, Model USB-XX108, Control # CN 3018
4) Omega Engineering DMD load cell conditioner, used to condition HBM load cell
5) Limitorque actuator
6) Creep/sustained load system LabView data acquisition system, Control # CN 3040

Procedure:

Testing was conducted in accordance with a NEETRAC procedure entitled "PRJ02137, CONFIDENTIAL – MMC Conductor Evaluation, Sustained Load Test per ANSI C119.4". The procedure controls all technical and quality management details for the project.

Wayne Quesnel of AFL provided a 100-ton compression tool and dies for compressing the core sleeve and the aluminum conductor tube. Splice materials and workmanship were under the direction of AFL, who designed the connector system.

Compressing the aluminum tube forces about one inch (25 mm) of slack into the outer aluminum layer, and ¾ inches (20 mm) of excess slack into the inner aluminum conductor layer. Excess slack was worked by hand to the free end of the sample. Garter clamps (heater hose clamps) were applied to work additional slack to the free end, and hold the strands in position for installation of a special lab fitting. A cast-resin fitting was installed on the conductor sample on the end opposite the dead end terminal. The cast resin system preserves the location of each conductor layer, and ensures that the loading on each of the conductor elements is similar to the loading in an overhead line. Special handling is needed because the lab tests are done on short samples, and birdcaging is concentrated in a short conductor section.

The sample was installed in a load frame. A load of 14,997 lbs +/-20 lbs was held for 168 hours. Actuator position, load, and tension were recorded on 20-minute intervals. Figure 1 shows the load, actuator travel (indirect indicator of creep), and temperature during the test.

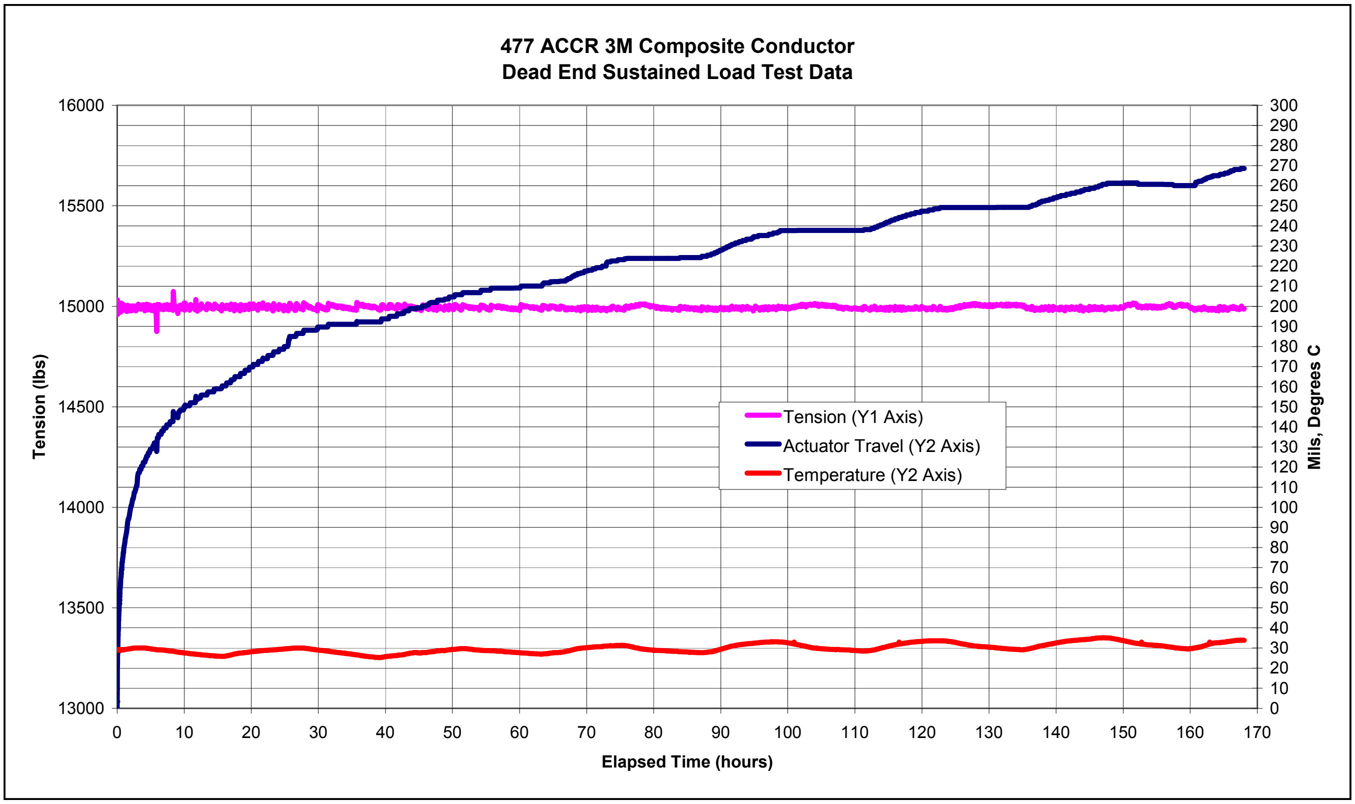


Figure 1, Temperature, Load, and Actuator Position Data for Sustained Load Test

At the end of the required sustained load period, the tension was reduced to zero. The sample was subjected to a room-temperature tensile test to destruction. The tensile test is part of the ANSI C119.4 requirements, and is intended to show that the week-long 77% RBS sustained load did not damage the mechanical strength of the connectors. The sample failed at 20,620 lbs, or 106% of RBS. The failure was in the mid-span. ANSI C119.4 requires a residual strength greater than or equal to 95% of the nominal RBS. The connector therefore meets the requirements for sustained load capability. Figure 2 shows load versus crosshead position for the tensile tests. Photographs 1 through 5 show testing in progress.

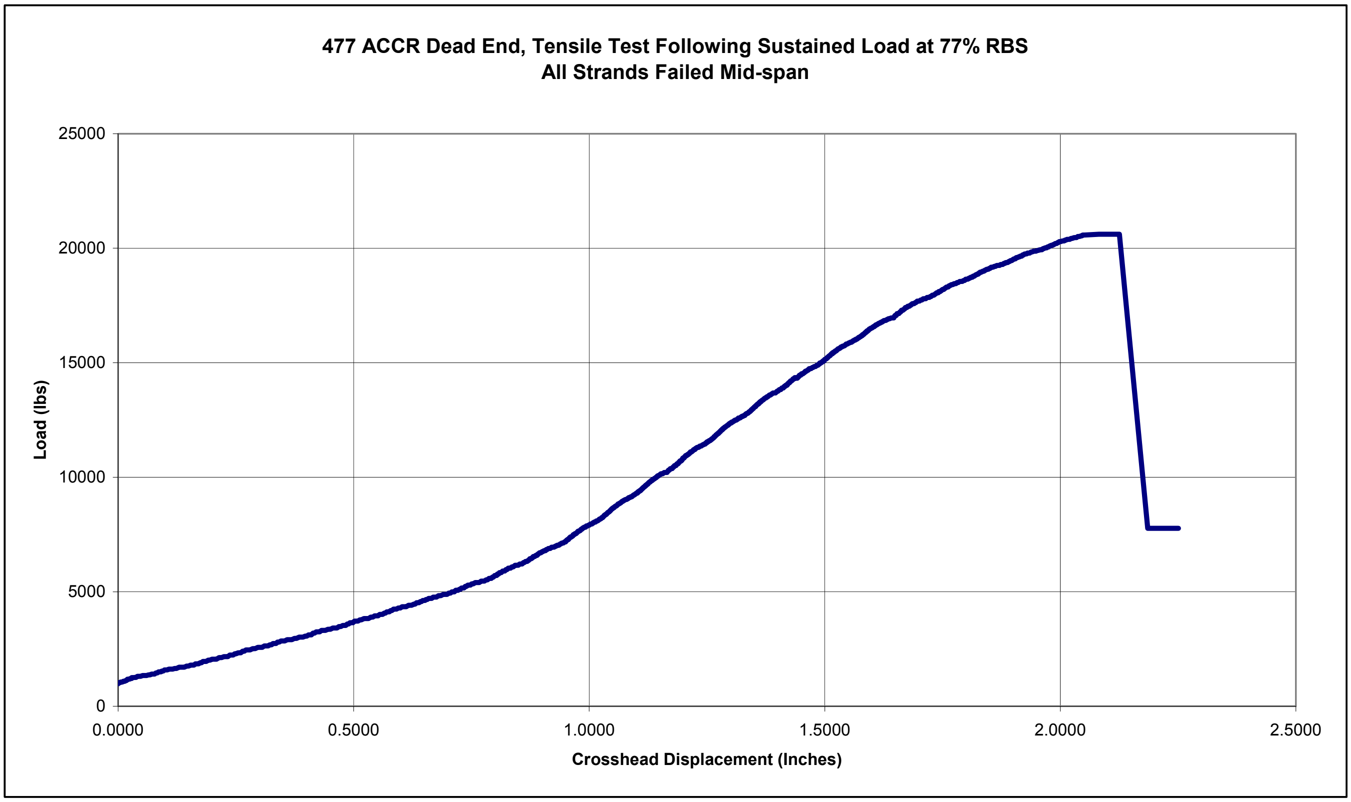
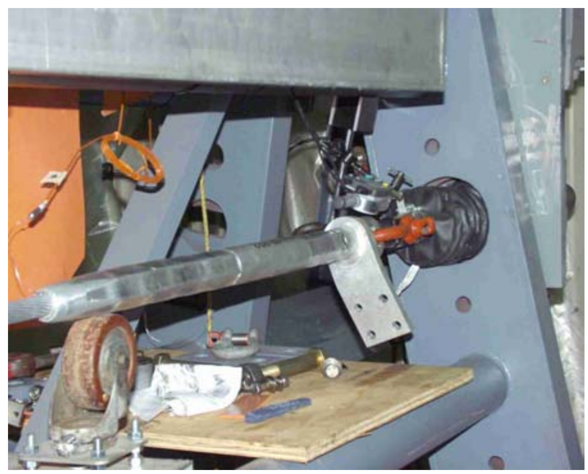
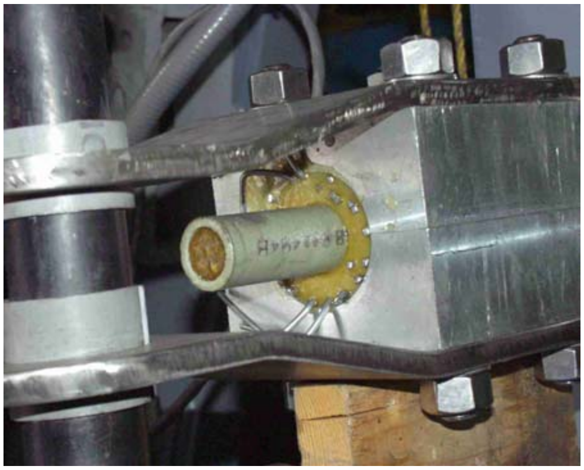


Figure 2, Tensile Test Graph for Sustained Load Dead End Sample

Photograph 1, Dead-end sample, load actuator, and dial indicator for actuator travel

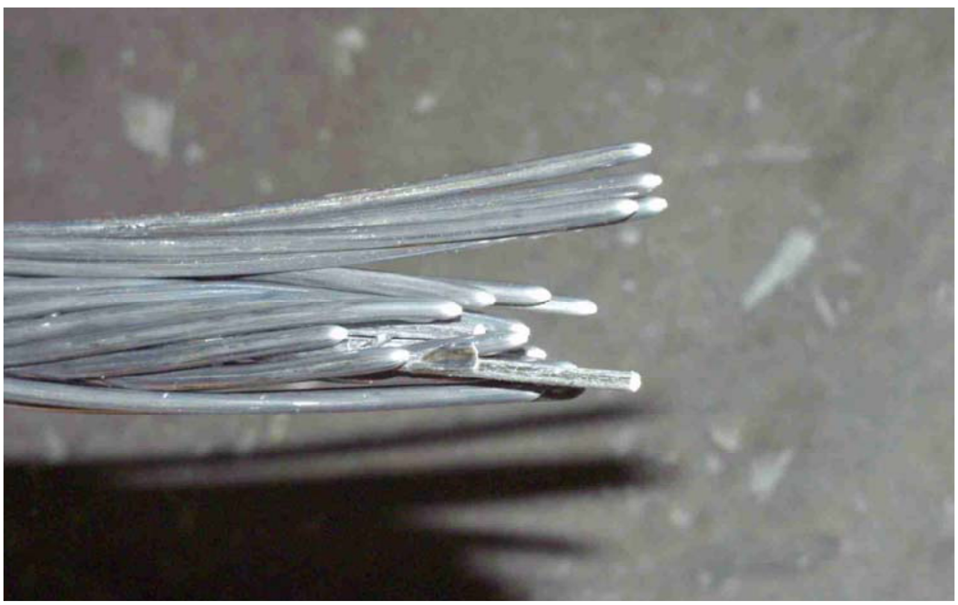


Photograph 2, Dead end sample



Photograph 3, resin (lab) termination opposite compression dead end

Photograph 4, tensile test



Photograph, 5, mid-span tensile break