795 kcmil, 3M Brand Composite Conductor
Sustained Load Test at 77% RBS

3M Company
Purchase Order 0000680338

NEETRAC Project Number: 02-282

October 2002

NEETRAC
National Electric Energy Testing, Research & Applications Center

BVQI ISO 9001 · ANSI-RAB QMS ACCREDITED

A Center of
The Georgia Institute of Technology

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Reviewed by: ______________________
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Summary:

3M contracted with NEETRAC for a sustained load test in accordance with ANSI C119.4, with the exception that no connector was installed. The performance of the lab fittings and the conductor would be evaluated independent of connector effects. NEETRAC Project 01-239 reports on the sustained load test with a dead end fitting.

Samples:

1) Ten (10) meters of 795 kcmil, type 16, 3M Composite conductor, from reel received at NEETRAC on 6/3/02.

References:

1) "Proprietary Information Agreement …." Dated 3/27/01.
2) ANSI C119.4 – 1999 (Connector performance requirements).
3) 3M Purchase Order 0000680338.
4) PRJ 02-282, NEETRAC Project Plan.

Equipment Used:

1) MTS Servo-hydraulic tensile machine, Control # CQ 0195.
2) Dynamics Research Corp./NEETRAC digital cable extensometer, Control # CQ3002.

Procedure and Results:

I. Sustained load/creep:

ANSI C119.4 requires that a connector hold 95% of the conductor RBS after holding 77% of conductor RBS for 7 days. A 20-ft sample was terminated with cast resin terminations, and loaded to 77% of RBS for one week. A high-resolution cable extensometer was attached to the sample to measure creep during the sustained load phase. Figure 1 shows the creep after reaching 77% RBS. Figure 2 shows the sample elongation during the load changes to and from the sustained load. The presentation of the creep and sustained load data is similar to the Aluminum Association's 1999 guide on creep and stress-strain testing, except that load levels and hold times are consistent with the ANSI connector test.

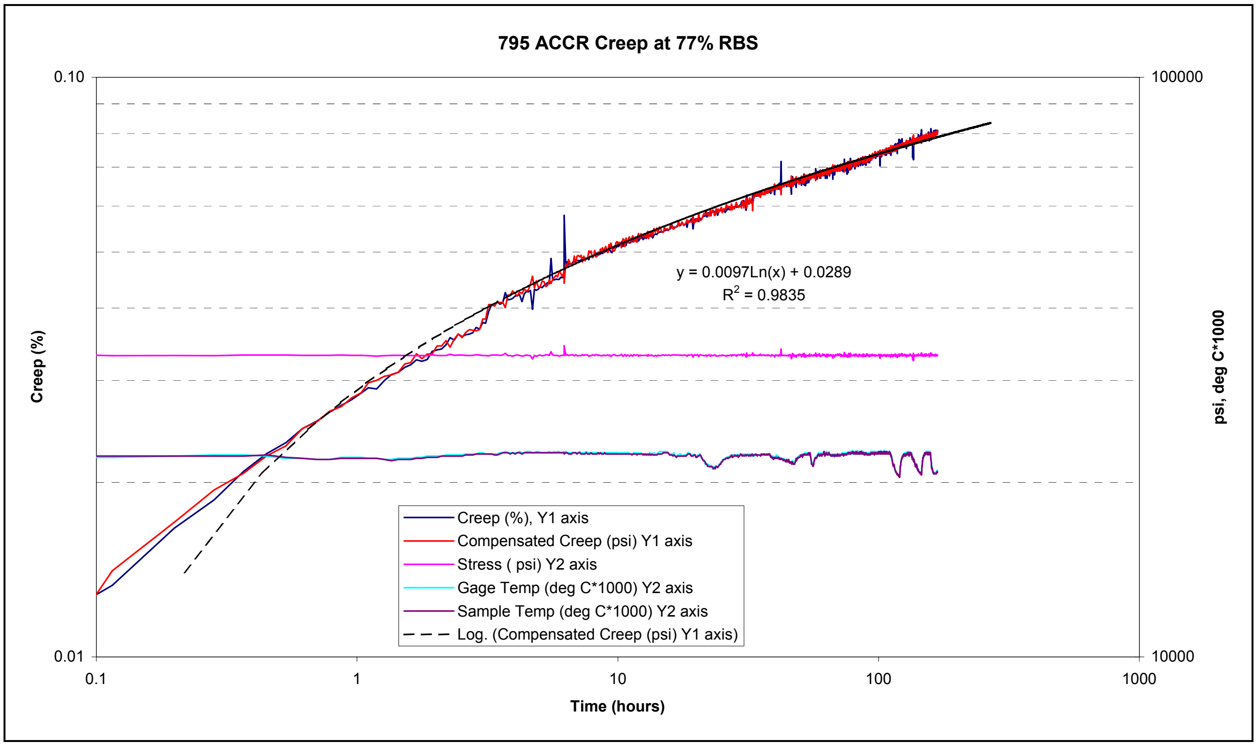

Figure 1, Graph of data collected during load hold period

Spikes in the creep test data are caused by small load excursions. The raw data was post-processed to account for both load and temperature effects on both the sample and the extensometer. The extensometer responds to temperature change, and post processing is needed to remove that effect. Raw data is plotted with compensated data to show the effect of compensation.

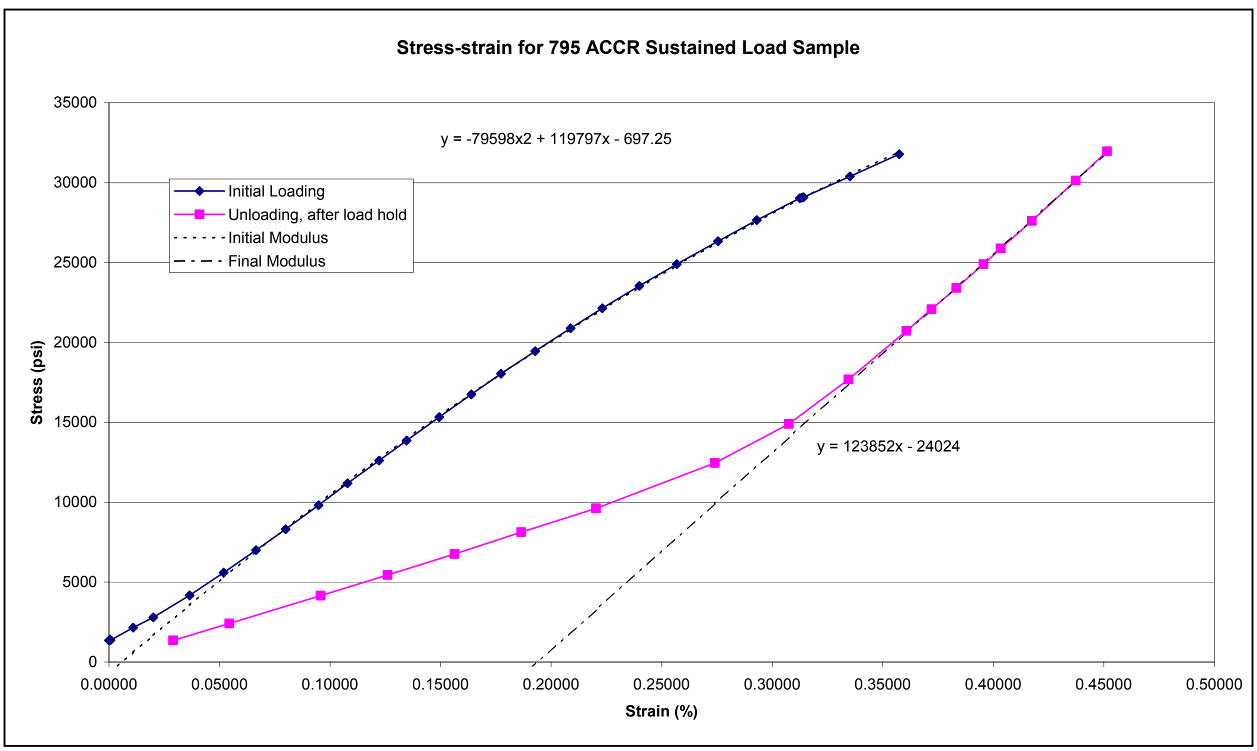

Figure 2, loading and unloading (stress-strain) data

II. Residual Strength Test:

At the end of the sustained load period, a tensile test was used to determine the sample residual strength. ANSI C119.4 requires that a connector hold 95% of the conductor RBS. This sample has no connector effects, but includes the effect of the week-long sustained load. Figure 3 shows a plot of load versus strain for the tensile test. Maximum load is 32,920 lbs, or 106% RBS. This is in the range of breaking loads for new conductor, and demonstrates that the sustained load test does not significantly degrade conductor strength.

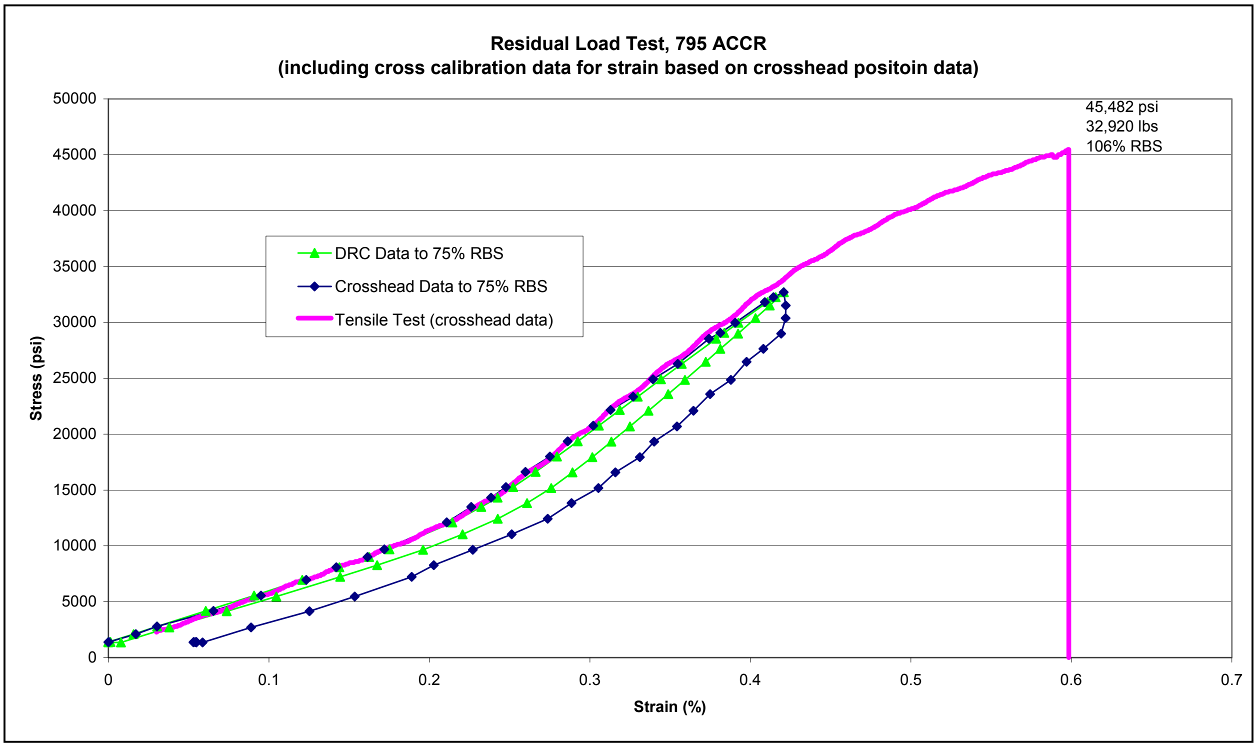

Figure 3, Residual Strength Test Data

Note: Figure 3 shows strain during the tensile test by an indirect measurement. “DRC Data to 75% RBS” is a direct strain measurement. The strain instrument must be removed for its own protection before exceeding 75% RBS. “Crosshead Data to 75% RBS” is based on crosshead position data recorded at the same time as the DRC data. The crosshead instrument is remote from the sample, and protected. Its data is always available, but the measurement includes both sample elongation and other extraneous effects. Extraneous effects include elastic effects on the tensile machine frame and end-termination effects from the sample. However, crosshead position data can be scaled so that its “strain curve” matches the direct measurement. Assuming the extraneous effects are linear with respect to load, crosshead position data can be scaled to provide a strain estimate up to sample rupture. Data used to scale the crosshead position instrument are shown in Figure 3, along with the tensile test data. Tensile test data tracks the calibration data up to approximately 0.3% strain. Rate effects explain the small discrepancy above 0.35% strain. Load rate for the calibration test was 3,000 lb/min. Load rate for the tensile test was 15,000 lb/min. The rate effect is likely due to short-term conductor creep.