Testing of THERMOLIGN® Full Tension Splice

For

795-kcmil 3M Brand Composite Conductor

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Scope

This report will cover the description and results of laboratory testing of PLP's THERMOLIGN® Dead-End and 795-kcmil 3M Brand Composite Conductor (also called ACCR – Aluminum Conductor Composite Reinforced) manufactured by 3M.

The specific tests included in this report are:

- Room Temperature Tensile Test
- Sustained Load Test
- Sustained Heat Test
- Heat Cycle Test
- High Voltage Corona Test

The results for each test are reported separately.

Room Temperature Tensile Test

After completing the design of the Full Tension Splice for the 795 ACCR conductor, a room temperature tensile test was conducted to verify the holding strength. The test sample consisted of a 50 ft. length of 795 ACCR (Type A) conductor terminated on both ends with PLP Dead-End Assemblies (3-Piece), and cut and spliced at the mid-point with a PLP Splice Assembly.

The PLP Splice Assembly consists of two layers of aluminum alloy rods. The inner layer of rods is directly applied over the ACCR conductors to be spliced (without exposing the conductor's composite core). The outer rods are applied over the inner rods (see Figure 1).

The test sample was loaded at a rate of 10,000# per minute in the 55K Tensile Equipment until failure occurred. At a load of 29,569# (95% RBS), the conductor failed mid-way between one of the Dead-End Assemblies and the Splice Assembly (see Figure 2).

Figure 1 – THERMOLIGN® Splice

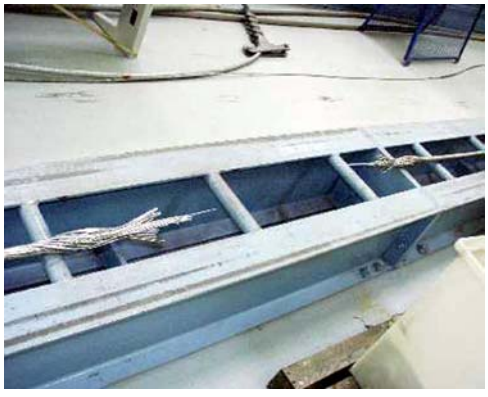

Figure 2 – Failure of Conductor

Sustained Load Test

The purpose of this test is to determine that the 795 Spice assembly will hold at a high tension level (77% RBS) at room temperature for an extended period of time (168 continuous hours).

The test sample consisted of a 53 ft. length of 795 ACCR conductor terminated on both ends with a PLP Dead-End Assembly, then cut in the middle, after which a PLP Splice Assembly was applied. The tension (23,970#) was maintained throughout the test period with the 55K Tensile Equipment.

The test sample successfully completed the 168 continuous hours, and then was tensioned in the same 55K Tensile Equipment until a failure occurred. The conductor failed in mid-span between the Splice and the Dead-End at a load of 29,630# (95% RBS).

Sustained Heat Test

The purpose of this test is to demonstrate that the performance of the 795 Splice Assembly will not be affected by continuous operation at an elevated temperature. Specifically, after being exposed to 240C for a period of 168 hours.

The test span consisted of a 65 ft length of 795 ACCR conductor, terminated at both ends with a PLP Dead-End Assembly, then severed in the middle, for the application of the Splice Assembly. A tension of 15% RBS (4,670#) was maintained throughout the test period using a tension beam/weight basket arrangement. The conductor was heated by applying approximately 1,500 Amps of AC current, supplied by a pair of heavy duty power supplies.

Thermo-couples were attached to the conductor and to locations on and within the Splice Assembly. The maximum temperatures recorded during the 168 hour test period are shown in Table 1.

Location	Max Temperature
Conductor	241C
Inner Rods	116C
Outer Rods	91C

Table 1

The maximum temperatures shown in Table 1 are well below the maximum rated temperatures of the aluminum alloy material used in the rods of the Splice Assembly. Furthermore, there was no observed deformation or damage to the Splice Assembly as a result of the sustained heat exposure.

After exposure to the sustained heat, the test sample was loaded into the 55K Tensile Equipment, then tensioned at a rate of 10,000 lbs/minute until a failure occurred. At a load of 31,786# (102% RBS), the conductor "peeled out" of the Dead-End Assembly at the tail-stock end of the test frame. The peel out occurred because the length of conductor beyond the "cross-over" point of the Dead-End Assembly was very short and unrestrained. However, the maximum load was still above the RBS of the conductor.

Heat Cycle Test

The 795 Splice was subjected to a modified version of ANSI C119.4 at the NEETRAC Laboratories. See NEETRAC Report # 04-091 (November 2004) for results.

High Voltage (Corona) Test

The purpose of this testing is to verify that the 795 ACCR conductor Splice from PLP will have acceptable performance when subjected to typical transmission line voltages.

The testing was conducted at the NEETRAC indoor high voltage laboratory.

For the 795 Splice Assembly the 1.125" tubing was again suspended horizontally, 12 feet above the ground plane. Corona onset occurred at 306 KV (phase-to-phase).

For a single conductor configuration, it may be possible to use a 795 conductor on lines operating at voltages up to 230 KV. The twin 795 configuration would commonly be used on 345 KV lines (400 KV internationally). Even though the Dead-End and Splice Assemblies were tested only in a single configuration, the onset voltages were sufficiently high enough to conclude that the performance would be acceptable at 345 KV in a twin configuration.

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